PROGRESS/ACTIVITY REPORTS PRESENTED AT JOINT WMO-IOC TECHNICAL COMMISSION FOR OCEANOGRAPHY AND MARINE METEOROLOGY (JCOMM) (Marrakech, Morocco)

(unedited)

BACKGROUND MATERIAL

Introduction

1. The Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) has come a long way since the development of the concept of a joint WMO-IOC technical commission in the mid-1990s, and its formal establishment in 1999. This report provides a summary of the activities undertaken by the Commission since JCOMM-II (Halifax, Canada, September 2005) to October 2009, the major challenges and issues that the Commission had faced during this period, and would continue to face in the years to come. More information is given in the reports of the chairpersons of the Programme Area Coordination Groups and in documents submitted under relevant agenda items.

Fifth, sixth and seventh sessions of the JCOMM Management Committee (MAN)

2. The membership of the JCOMM Management Committee (MAN) has remained relatively stable over the past four years, with only two changes from those elected in Halifax. The Committee met formally four times during the period; in addition, a JCOMM Bureau (co-presidents, PA coordinators and the Secretariat) met several times by teleconference, to address specific and pressing issues, which proved to be a very effective way of doing business. The co-presidents were able to engage all other members of the JCOMM Management Committee in specific tasks and projects, which greatly enhanced the effectiveness of the Committee and added to its achievements.

3. MAN-5 (Geneva, October 2006), MAN-6 (Paris, December 2007) and MAN-7 (Melbourne, December 2008) sessions reviewed the activities, which had taken place since its last session, and addressed the evolving needs of each of its programme areas. It agreed upon necessary steps for JCOMM to take within the WMO and UNESCO/IOC strategic planning processes, including preparation of the JCOMM Operating Plan 2010-2013. The MAN-7 also reviewed the Commission's contributions to specific WMO and UNESCO/IOC programmes and projects. It reviewed the JCOMM working structure, the progress in planning the third session of the JCOMM, scheduled to be held from 4 to 11 November 2009, in Marrakech, Morocco, and agreed upon the provisional agenda. The Management Committee meeting reports are available at http://www.jcomm.info/JCOMM-MR.

Programme Areas' activities

4. The operational ocean observing system being implemented by the Observations Programme Area (OPA) has continued to grow, being around 61% complete against the GCOS requirements in August 2009, with three key components now fully implemented (VOSClim, surface drifters and Argo). The system also incorporates several new elements, including "animal oceanographers" – specially equipped marine mammals. The OPA has close relations with external bodies operating some of the system elements (including OceanSITES and the International Ocean Carbon Coordination Project (IOCCP), and the Argo programme). An important support facility for ocean observations for a number of years now has been JCOMMOPS, and some effort has been put into the process of expanding and transforming this facility into an observing programme support centre, with full external funding.

5. The Data Management Programme Area (DMPA), working closely with the IODE of UNESCO/IOC, has completed data management strategic and implementation plans, which include in particular joint work in developing end-to-end data management technology for ocean data, and an ocean data portal, to facilitate data discovery and access. Work is underway to compile a virtual catalogue of existing JCOMM material on standards and best practices, as well as on the management of existing and new standards in key aspects of ocean data management. Substantial progress has been made in the design and implementation of a WIGOS Pilot Project

for JCOMM, which will greatly enhance the accessibility of key ocean data sets through UNESCO/IOC-IODE Ocean Data Portal (ODP) and WIS.

6. A highlight of the intersessional period has been the implementation of operational ocean forecast systems, developed under the Global Ocean Data Assimilation Experiment (GODAE) Project. To assist in this process, and as a direct follow up to GODAE, JCOMM has established an Expert Team on Operational Ocean Forecast Systems (ET OOFS) under the Services Programme Area (SPA), to guide and facilitate the standardization of these new systems. JCOMM/SPA has also developed close relations with the new GODAE Ocean View (GOV) Steering Team as a means to coordinate the efficient transition of a new generation of ocean forecasting models and systems from a research to an operational environment. The SPA has also further developed and enhanced existing maritime safety services, including the addition of five new METAREAs in the Arctic Ocean, in cooperation with IMO. Substantial work has been put into the development of storm surge forecast services, including the preparation and publication of a new Guide to Storm Surge Forecasting, and the convening of a major international symposium on storm surges (Seoul, October 2007). The work on storm surges is undertaken in support of the major cross-cutting programmes in both WMO and UNESCO/IOC relating to disaster risk reduction.

Cross-cutting issues and activities

7. Capacity building under JCOMM is undertaken largely within the three Programme Areas, with guidance and coordination provided by the Management Committee, and in accordance with a set of JCOMM Capacity Building Principles. Major events in the past intersessional period include two training workshops on wave and surge forecasting; courses and workshops on ocean data buoys and tide gauges; a workshop for Port Meteorological Officers; and workshops on ocean data management, in conjunction with IODE.

8. The outline of a comprehensive requirements document for ocean satellite data in support of JCOMM programme activities has been prepared for JCOMM-III by the cross-cutting team on satellite data requirements, while many JCOMM experts have been involved in the campaign to encourage satellite agencies to proceed with the JASON-3 ocean topography mission and the Sentinel-3B ocean-dedicated satellite.

9. JCOMM is directly involved in all the major WMO cross-cutting activities, including WIGOS, WIS and the QMF. It has provided strong support for the implementation of the IPY, through all programme areas and the Management Committee, and has developed strong links, and joint projects, with other WMO Technical Commissions and major UNESCO/IOC subsidiary bodies.

10. While past interactions between JCOMM and the WMO Regional Associations has not been strong, it is important that this be further developed in the future, from the perspective, both of the importance of regional and local marine observations to the overall ocean observing system, as well as for enhancing regional and local forecast capabilities for extreme events affecting coastal areas.

External interactions

11. JCOMM now has widespread recognition as the primary implementation body for the Global Ocean Observing System, while the requirements specified in the GCOS Implementation Plan (GCOS-92) form the backbone of the ocean observing system being implemented by the Commission. The Ocean Observation Panel for Climate (of GOOS, GCOS and the WCRP) is a primary science advisory body for JCOMM. JCOMM has developed joint activities with CCl and CHy, and provides significant support to the tsunami programme of UNESCO/IOC, through the OPA in particular. The Commission has strong links with IMO and IHO in maritime safety-related issues; it is involved in the implementation of a number of tasks in the GEO workplan; and it has

strong links with key peak bodies in the private sector, including the International Chamber of Shipping and the offshore Oil and Gas Producers Forum.

Strategic planning and development

12. The adoption, in both the WMO and the UNESCO/IOC, of strategic plans based around a set of strategic objectives and expected results, accompanied in WMO (and probably also UNESCO/IOC in the future) by a results-based management (RBM) system focused on these expected results, has posed a major challenge. JCOMM, as with the other WMO Technical Commissions and major subsidiary bodies of UNESCO/IOC, has responded successfully to this new approach, with all its major programme activities mapped onto the combined set of expected results.

13. At the same time, the Management Committee believes that JCOMM should maintain a programmatic approach to its work, as it is much easier for all those involved in JCOMM work to associate with and work towards an identifiable JCOMM programme. To this end, the Commission has revised, updated and shortened the JCOMM Strategic Plan, the new version of which is to be presented at JCOMM-III. This new plan will align with the strategic objectives and expected results of both parent Organizations, but at the same time address these within the existing programme structure. In line with this, all programme areas have developed operating plans, combined into a single JCOMM operating plan, again aligned with the expected results and Secretariat operating plans.

14. In response to the proposal put forward at JCOMM-II for an external review of the Commission during the current intersessional period, a limited version of this review has taken place during the first half of 2009.

15. In the light of the ever-diminishing resources, and in response to the concerns of the parent Organizations to improve the efficiency and effectiveness of their major subsidiary bodies, the Management Committee will be proposing to JCOMM-III some streamlining of the subsidiary body structure, to reflect developing and new work priorities, in line with the expected results.

Communications and outreach

16. The JCOMM Website (http://www.jcomm.info), with linked components maintained by both the WMO and the UNESCO/IOC, is a major resource and outreach tool for the Commission, in facilitating communications and information sharing, both internally and externally. Likewise, a regular electronic JCOMM newsletter has proven popular as an information-sharing tool for both the JCOMM members and the external marine community. The Commission has maintained an extensive technical publication programme: a new Guide to Storm Surge Forecasting has been prepared, and major revisions are underway for the Manual on Marine Meteorological Services and the Guide to Wave Analysis and Forecasting, while the dynamic part of the Guide to the Applications of Marine Climatology has been updated with the results from CLIMAR-III (Gdansk, Poland, May 2008).

Major issues and challenges

17. JCOMM has had to address a number of major challenges and issues during the past four years, and most of these will continue to challenge it in the years to come.

18. Resources, both financial and human, will remain a major issue for the Commission. As with all technical commissions, it is in a situation of diminishing regular budget funding, in both WMO and UNESCO/IOC, and it therefore has to be realistic in adjusting its work programme to fit within the available budget. To date JCOMM has had some success in attracting extrabudgetary resources (notably for JCOMMOPS), and this remains a potential to be further exploited in the future. Even more of a concern is the diminishing supply of the human resources so essential to its

work. The national agencies, on which it relies for expertise, are themselves being increasingly squeezed in this area, and are thus reluctant to release staff to undertake international work. To address this, JCOMM needs to demonstrate to these agencies and to Members/Member States generally, that they themselves will derive value from the engagement of their experts internationally, and at the same time make the Commission's work as attractive as possible for these experts. JCOMM also needs to be realistic, in adjusting its work programme to suit the available resources. The Management Committee will therefore go to JCOMM-III with a reduced work programme, which can be realistically implemented in the coming intersessional period.

19. As noted, a highlight of the past four years has been the effort made by JCOMM to support the operational implementation of ocean forecast systems and the delivery of real-time ocean services. This will remain a challenge and focus in the coming intersessional period. Other future technical challenges include:

(a) Long-term maintenance and further implementation of the in situ observing system;

(b) Support for wider efforts in WMO and UNESCO/IOC, and in the international ocean community generally, to ensure the long-term maintenance of key ocean satellite missions;

(c) Ensuring proper coordination across the JCOMM Programme Areas and with external bodies and programmes;

(d) Ongoing engagement with processes in the WMO and the UNESCO/IOC, such as WIS, WIGOS, which will include closer integration with IODE in ocean data management;

(e) Enhanced involvement in coastal issues, including the implementation of coastal GOOS, and further support for DRR and UNESCO/IOC-ICAM; and

(f) Response to the increasing pressure to become involved in non-physical oceanography.

20. The future for JCOMM will indeed be challenging, but also exciting, as the relevance and role of the Commission in addressing the major issues in marine meteorology and oceanography becomes ever more apparent and sought after.

_____

BACKGROUND MATERIAL

WMO Governing Body sessions

1. Possibly the most significant outcome from WMO Fifteenth Congress (WMO Cg-XV, May 2007) was its reaffirmation that many of the marine-related activities could only be implemented through the full and active cooperation between WMO and the UNESCO/IOC. In this regard, Congress urged the Secretary-General of WMO, the Executive Secretary of the UNESCO/IOC and the Co-presidents of JCOMM to further strengthen the integration of WMO and UNESCO/IOC activities, in order to provide a more effective and cost-efficient JCOMM work plan. Major decisions of WMO Cg-XV with impact on the work programme of JCOMM were:

(a) Resolution 30 (Cg-XV) – Towards Enhanced Integration between WMO Observing Systems, and it reaffirmed that the WMO Information System (WIS) was serving all WMO Programmes. Follow-up actions on the WMO Integrated Global Observation System (WIGOS) and WIS are discussed under agenda item 10;

(b) Resolution 32 (Cg-XV) – WMO Quality Management Framework (WMO-QMF). Follow up actions on the subject are reported under agenda item 11.

A full report is available at:
http://www.wmo.int/pages/governance/congress/congress_reports_en.html.

2. The WMO EC-LXI (June 2009) endorsed the theme areas proposed in the JCOMM work programme for the period 2010-2013, as follows:

(a) Met-Ocean Forecasting Systems and Services, including Coastal Marine Hazards and related Climate Change Adaptation in Coastal Areas;

(b) Met-Ocean QMF, including the Catalogue of Best Practices and Standards, and the development of a QMS for the provision of Met-ocean Services for International Navigation, in collaboration with international organizations representing the user community, such as IMO and IHO;

(c) Long-term maintenance and enhanced implementation of the in situ and remote sensing Ocean Observing Systems, and contribution to the WIGOS;

(d) Modernization of Met-Ocean related Data Management Activities, including further development of interoperability between ocean data management systems and the WIS;

(e) Technology transfer and implementation support, with especial attention to LDCs and SIDSs.

It recommended that JCOMM consider at its third session:

(a) Balancing requirements against available resources, and identifying a core set of tasks, as a basis for prioritizing the future work programme;

(b) Further strengthening its coordination with the IODE of UNESCO/IOC;

(c) Adopting a project-oriented structure for the Services Programme Area.

3. The WMO EC-LXI had held extensive discussions on result-based management and actions towards the improvement of efficiency and effectiveness of the technical commissions. A full report is available at: http://www.wmo.int/pages/governance/ec/ec_docs_en.html.

4 Over the intersessional period, the work of the presidents of technical commissions has focused on a range of cross-commission activities, including the WIS, WIGOS, QMF, IPY 2007-2008, the Volunteerism in WMO, and the review of the Terms of Reference (ToRs) of the technical commissions with a view to linking them with the WMO's Results-based Management approach. It was recognized that for JCOMM there was a need to fit in with both WMO and UNESCO/IOC planning processes. Current JCOMM ToRs are available at: http://www.wmo.int/pages/governance/tc/documents/annex_iii.pdf. A full report is available at: http://www.wmo.int/pages/governance/tc/index_en.html.

UNESCO/IOC Governing Body sessions

5. The Twenty-fifth Session of the UNESCO/IOC Assembly (June 2009) recognized the advantage of multi-sponsor arrangements, such as JCOMM and GOOS, and supported enhanced inter-agency cooperation with clear lines of responsibility with respect to their mandates and specialities. It further endorsed the following priorities for the future:

(a) Enhanced implementation of the ocean observing system, including close coordination with pilot projects and programmes, such as Argo and OceanSITES, and support for the IPY legacy projects SOOS and SAON;

(b) Development of standards and best practices for operational ocean and marine meteorological data, products and services;

(c) Joint work with IODE of UNESCO/IOC on data management standards, the Ocean Data Portal and the WIGOS Pilot Project;

(d) Scientific and technical support for marine hazard forecasting systems, particularly for vulnerable coastal areas;

(e) Further work to standardize, facilitate and apply operational ocean forecasting systems.

6. The UNESCO/IOC Assembly expressed its satisfaction for the exemplary collaboration between JCOMM and IODE of UNESCO/IOC, and recommended continuation of this cooperation with a view to acquiring a wider range of observing data to be used for marine services, and to benefit from the technology and infrastructure of the UNESCO/IOC-IODE Ocean Data Portal (ODP) in developing marine services. The Assembly also recommended that JCOMM should enhance its support for coastal hazard and management issues, through the coordinated efforts of its Programme Areas and other associated organizations/programmes of the UNESCO/IOC.

7. The Assembly encouraged JCOMM, at its third session, to further streamline its structure, working methods and priorities, both to align it with the strategic priorities and programme structure of the UNESCO/IOC and the WMO, and to undertake work which is achievable within the available resources. A full report is available at http://www.ioc-unesco.org/ioc-25.

_____

BACKGROUND MATERIAL

1. THE WMO/CBS ROLLING REVIEW OF REQUIREMENTS (RRR)

1.1 The WMO/CBS Rolling Review of Requirements process has documented the user requirements for observations for all application areas within WMO Programmes (global NWP, regional NWP, synoptic meteorology, nowcasting and very short-range forecasting, seasonal and inter-annual forecasting (SIAF), atmospheric chemistry, aeronautical meteorology, climate monitoring, marine meteorology and oceanography, hydrology and agricultural meteorology) and has developed *Statements of Guidance* (SoGs) on the extent to which these requirements are or will be met by present, planned and proposed observing systems.

1.2 The process periodically reviews users' evolving requirements for observations, together with the capabilities of observing systems to meet them. It consists of four stages:

- A review of users' requirements for observations, within an application area;
- A review of the observing capabilities of existing, planned and proposed observing systems;
- A *Critical Review* of the extent to which the capabilities meet the requirements; and
- A *Statement of Guidance* (SoG), based on the output of the *Critical Review*.

1.3 The SoG is essentially a *gap analysis*. It informs WMO Members on the extent to which their requirements are met by present systems, will be met by planned systems, or would be met by proposed systems. Further information on the RRR process and the SoGs for the applications areas listed above, including their covered activities, is available at http://www.wmo.int/pages/prog/sat/RRR-and-SOG.html.

User requirements for observations

1.4 Within the RRR process, observational requirements for each application area are captured within the WMO/CEOS database, which is available at http://www.wmo.int/pages/prog/sat/Databases.html. For each application, user requirements are stated for each geophysical variable of interest in a "technology-free" way, in terms of spatial and temporal resolution, accuracy and timeliness. Each requirement is quantified in terms of three values:

- The "*goal*" is a maximum requirement. The cost of improving the observations beyond the goal is unlikely to be matched by a corresponding benefit;
- The "*threshold*" is the minimum requirement below which data are not useful;
- The "*breakthrough*" is an intermediate level between "*threshold*" and "*goal*", which, if achieved, would result in a significant improvement for the targeted application.

Observing capabilities and user requirements - a gap analysis

1.5 The observing capabilities of present and planned observing systems are quantified using the same criteria as for the user requirements and also stored in the WMO/CEOS database. This facilitates the comparison with user requirements, which constitutes the *Critical Review*, and the subsequent documentation of the key compliances and gaps in the SoG. Impact studies, such as the Observing System Experiments (OSEs) and the Observing System Simulation Experiment (OSSEs), as well as workshops, are key elements in this review. The full SoGs (*gap analyses*) for each application area can be found at http://www.wmo.int/pages/prog/sat/RRR-and-SOG.html.

2. ASSESS SCIENTIFIC AND OPERATIONAL REQUIREMENTS

2.0.1 Although the baseline global ocean observing system developed under GOOS and implemented by JCOMM is designed to meet climate requirements, marine services in general and NWP will be improved by the implementation of the systematic global observations called for by the GCOS-92 plan. The system supports global and regional weather prediction, global and coastal ocean prediction, marine hazard warning, marine environmental monitoring, naval applications, weather forecasts and many other non-climate uses. In items 2.1 and 2.3 of this report are presented only those variables not adequately covered by the GCOS-92, which are required for met-ocean applications, global and regional NWP, and synoptic meteorology. Progress has been made to include those variables in the *OPA implmentation goals* [see agenda items 6.1 and 6.3] and in the *Implementation Plan for the Evolution of the Global Observing System (GOS)* [see item 3 of this report].

2.1 Met-ocean applications

2.1.1 The full set of observational requirements for met-ocean applications for geophysical variables within the ocean or at the ocean/atmosphere interface is given in the WMO/CEOS database, which is available at http://www.wmo.int/pages/prog/sat/Databases.html. During the intersessional period, the SPA developed a *User Requirement Document*, which describes the observational requirements for met-ocean applications (see http://www.jcomm.info/SPA). These include marine forecasting and warning services, and ocean mesoscale forecasting. The WMO/CEOS database and the *Statement of Guidance (SoG) for Ocean Applications* have been updated accordingly. CBS, at its fourteen session (Dubrovnik, March 2009), requested JCOMM to address tsunami monitoring in both the WMO/CEOS database and the *SoG for Ocean Applications*.

2.1.2 Those critical issues relevant to observations of the ocean and the ocean/atmosphere interface for met-ocean applications are presented below [full SoG for Ocean Applications available at http://www.wmo.int/pages/prog/sat/RRR-and-SOG.html]. Variables, such as sea surface temperature, sea ice and snow over sea ice, waves, ocean sub-surface variables, ocean topography, and ocean currents, also required for GNWP, RNWP, SIAF or synoptic meteorology are addressed under this item.

Waves

2.1.3 Requirements for wave observations include: (i) assimilation into wave forecast models; (ii) validation of wave forecast models; (iii) calibration/validation of satellite wave sensors; (iv) ocean wave climate and its variability on seasonal to decadal time scales; and, (v) role of waves in coupling. Marine forecasters use wave model outputs as guidance to issue forecasts and warnings of wave variables (such as significant wave height and period, and dominant wave direction) for their area of responsibility and interest, in support of several marine operations. Satellite altimeters provide information on significant wave height with global coverage and good accuracy but marginal horizontal/temporal coverage. Information on the 2-D frequency-direction spectral wave energy density is provided by SAR instruments with good accuracy but marginal horizontal/temporal resolution. HF radars are also being used for costal models. *In situ* observations are used for the validation of models and satellite products with requirements of 1000km spacing requiring a network of around 400 buoys with minimum 10%/25cm accuracy for wave height and 1 second for wave period.

Sea Level

2.1.4 Sea level observations are needed for tsunamis, storm surges and coastal flooding forecasting and warning systems, as well as for tide and mean sea level applications. While altimeters are primarily being used for sea level and provide for good global coverage and accuracy, the horizontal/temporal coverage is marginal. *In situ* observations are used for

assimilation in ocean circulation models, and for calibration/validation of the satellite altimeter and models. The aim of any tide gauge recording should be to operate a gauge which is accurate to better than 1cm at all times; i.e., in all conditions of tide, waves, currents, weather; and provide for high frequency data (6 to 15 min) with accurate timing (1 min.); measurements must be made relative to a fixed and permanent local tide gauge bench mark (TGBM).

Sea surface temperature

2.1.5 Ships and buoys provide observations of sea surface temperature of good temporal frequency and accuracy. Coverage is marginal or absent over some areas of the Earth, but recent improvements in the *in situ* network have enhanced coverage considerably. Infra-red instruments on polar satellites provide information with global coverage, good horizontal resolution and accuracy, except in areas that are persistently cloud-covered. Here, data from passive microwave instruments on research satellites has been shown to be complementary. Temporal coverage is adequate for met-ocean applications, GNWP and RNWP but, for SIAF, observation of the diurnal cycle is required, for which present/planned geostationary satellites offer a capability. In general, higher accuracy would be useful in support of met-ocean applications and SIAF.

Sea-ice and snow over sea-ice

2.1.6 Sea-ice cover and type are observed by microwave instruments on polar satellite with good horizontal and temporal resolution and acceptable accuracy. Data interpretation can be difficult when ice is partially covered by melt ponds. Operational ice thickness monitoring is required, particularly in support of met-ocean applications and SIAF, but it is not currently planned. Satellite imagery (visible/infra-red and microwave) provide information on snow cover and snow water content over land, but interpretation is very difficult over sea-ice resulting in an observational gap.

Ocean sub-surface variables

2.1.7 For met-ocean applications, and in the latter part of the medium-range for GNWP (~7-15 days) and for SIAF, the role of the sub-surface layers of the ocean becomes increasingly important, and hence observations of these variables, particularly temperature and salinity, become relevant. Argo is the major source of sub-surface temperature and salinity observations, providing global coverage to ~2000 m, mostly with acceptable-to-good spatial resolution, but only marginal temporal resolution in the tropics. The Tropical Atmosphere Ocean (TAO)/TRITON moored buoy network provides data of good frequency and accuracy, and acceptable spatial resolution, of sub-surface temperature for the tropical Pacific. The tropical moored networks in the Atlantic (PIRATA) and the Indian (RAMA) Oceans are better than marginal but do not yet have long-term commitment. The Ships-of-Opportunity Programme (SOOP) provides data of acceptable spatial resolution over some regions of the globe but temporal resolution is marginal. SOOP is evolving to provide enhanced temporal resolution along some specific lines. Surface salinity will be measured by satellite instruments on forthcoming research missions. There will be a need for continuity of those measurements.

Ocean topography and ocean currents

2.1.8 Ocean altimetry provides a measure of the sea surface topography. Research satellites are providing a mix of data with acceptable accuracy and resolution, and with good spatial resolution (along the satellite tracks) but marginal accuracy and frequency. Geodetic data from satellites such as GRACE, CHAMP and GOCE will improve knowledge of the geoid and hence the utility of altimeter data. Satellite altimetry is also being used to infer the distribution of ocean currents, for which moored buoys provide observations which are good in temporal coverage and accuracy but marginal otherwise.

Visibility

2.1.9 Poor visibility is a major hazard to all vessels because of the increased danger of collision. Surface visibility observations are made primarily by ships, and at the coastal stations (mainly at harbours, where the VTS (Vessel Track System) is usually available). This parameter can vary substantially over short distances. Accuracy is acceptable in coastal areas and marginal in open ocean. Horizontal/temporal resolution is poor over the most of the global ocean. Visibility is deduced from the output of regional atmospheric models [see SoG for regional NWP, available at http://www.wmo.int/pages/prog/sat/RRR-and-SOG.html].

2.2 GOOS and GCOS

2.2.1 The Global Climate Observing System (GCOS) cooperates closely with the Global Ocean Observing System (GOOS), which is led by the UNESCO/IOC and co-sponsored by the WMO, the United Nations Environment Programme (UNEP) and the International Council for Science (ICSU). The Ocean Observation Panel for Climate (OOPC), sponsored by GOOS, GCOS and the World Climate Research Programme (WCRP) has the lead responsibility in planning of the open ocean climate module of GOOS. The Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) takes responsibility for the implementation of the ocean component of GCOS. GCOS and GOOS together will work on an integrated framework for coastal and arctic systems.

OceanObs'09 Conference

2.2.2 Almost a decade has passed since the *OceanObs'09 Conference* (Venice, September 2009) played a major role in consolidating the plans for a comprehensive ocean observing system able to deliver systematic global information about the physical environment of the oceans. Now, the world's oceans are being observed routinely and systematically by means of satellite and *in situ* techniques. The availability of these observations has led to rapid progress in ocean analysis and forecasting as well as new scientific understanding of oceanic variability and the role of the oceans in weather and climate. This information and knowledge supports a wide range of societal and business benefits. It is now critically important to ensure sustainability and further development of the present system and to realize the full extent of the benefits across all stakeholders and for all participating nations. It is equally important to define a clear path to plan for extending the present system to include comprehensive observation, analysis and forecasting of the biogeochemical state of the ocean and the status of marine ecosystems. The OceanObs'09 conference will celebrate a decade of progress and make a major contribution to chart the way forward for the coming decade. Detailed information, including the Community White Papers and the Conference Statement that outlines consensus outcomes from the OceanObs'09 conference, is available at http://www.oceanobs09.net/.

Integration of Marine Meteorological and Oceanographic Observing Systems

2.2.3 The Argo profiling float network has reached completion with 3000 floats operational in November 2007. All operational floats report their data in real time onto the Global Telecommunication System (in TESAC and BUFR format) via the two Global Data Assembly Centres (GDAC) of US and France. Argo has revolutionized understanding and monitoring of the world's oceans by providing unique insight into temperature, salinity and currents in the ice-free oceans. It has been recognized that continued operation of the array is crucial for GOOS and the ocean component of GCOS. Maintenance of the Argo array faces challenges, as the floats have a nominal 4 year lifetime. Most Argo national programmes continue to be supported by research funding, which poses difficulties for sustaining the observations over decadal timescales. Support from operational agencies and users are needed to justify the long-term funding. The Prediction and Research Moored Array in the Tropical Atlantic (PIRATA) has completed its pilot phase (reflected in a redefinition of the acronym) and continued in a 17 surface mooring and one subsurface ADCP mooring configuration in 2008.

2.2.4 The status of the all over *in-situ* global ocean observing system reached 62% of its initial goals and, despite of the impression of a dense network and that a significantly amount of observations are made by satellites, there are still significant gaps. The percentage of implementation per year needs to be increased urgently.

2.2.5 The WCRP Climate Variability and Predictability (CLIVAR) project has continued the development of pilot observing systems in all oceans of the world. The novel feature of most of these systems is that they include requirements for future climate prediction and the scope of observations goes beyond the physical variables. These developments require cooperation with similar initiatives by other programmes. A hydrography advisory group, the "Global Ocean Shipbased Hydrographic Investigations Panel (GO-SHIP)" has been formed, co-sponsored by the CLIVAR's Global Synthesis and Observations Panel (GSOP), the IOC International Ocean Carbon Coordination Project (IOCCP) and the IGBP SOLAS-IMBER carbon group. It brings together interests from physical hydrography, carbon, and biogeochemistry to develop guidelines and advice for the development of a globally coordinated network of sustained ship-based hydrographic sections that will become an integral component of the ocean observing system post-CLIVAR.

2004-2008 Progress Report on the Implementation of the Global Observing System for Climate

2.2.6 GCOS published a "*Progress Report on the Implementation of the Global Observing System for Climate in Support of the UNFCCC 2004-2008*" in response to a request by the United Nations Framework Convention on Climate Change (UNFCCC) Subsidiary Body for Scientific and Technological Advice (SBSTA), at its 23rd session in December 2005. The Progress Report was prepared by a broadly-based group of experts with strong support from the GCOS Panel Chairs, GCOS Secretariat and the Secretariats of the three main component observing systems (WMO, GOOS and GTOS). It describes progress against 131 actions set forth in the 2004 GCOS Implementation Plan to ensure the availability of observations for climate information, services, and assessment purposes. The Progress Report was submitted, at the 30th session of the SBSTA, which took place in June 2009, in Bonn, Germany. The assessment was mainly based on: (i) performance reports from GCOS component systems; (ii) national reports on systematic observation of climate submitted to the UNFCCC in 2008; and (iii) additional information by experts of all three domains and in-situ and space measurement systems. The Progress Report showed significant progress against 76% of the 131 Actions. The implementation of GCOS has progressed but still does not meet all UNFCCC needs, particularly in the areas of systematic and sustained observations of the oceans and the terrestrial domain, and of regional-scale observations in developing countries. Developed countries have generally improved their observational capacity, but have made only limited progress in assuring long-term continuity of measurements. Space agencies have actively incorporated GCOS requirements, as defined in the Satellite Supplement to the GCOS Implementation Plan, into mission planning and strategies for data exploitation, including reprocessing and generation of satellite-derived, user-tailored products. In the Report, key priorities for the next five year have been identified as:

2.2.7 General Conclusions of the Progress Report:

(a) Developed Countries have improved their climate observation capabilities, but limited progress in resolving financial issues related to long-term continuity;

(b) Developing Countries have only made limited (*in-situ*) progress, with decline in some regions, and capacity building support remains small in relation to needs;

(c) Operational and Research Networks show increasing regard to climate needs;

(d) Satellite agencies have improved both mission continuity and capability and are increasingly meeting the needs for reprocessing, data access, and product generation.

2.2.8 Main conclusions for the *Atmospheric Domain*:

(a) Good progress with availability, quality and exploitation of data from satellites for climate purposes across the range of Essential Climate Variables (ECVs) – from basic meteorological variables to radiation and atmospheric composition;

(b) Good progress in general with *in-situ* meteorological networks; support through the system improvement programme has helped maintaining a baseline; however, overall progress in developing countries has been limited;

(c) Some specific issues persist (e.g., measurement of precipitation, clouds, snow depth; precipitation data exchange; sunshine duration; metadata);

(d) Good progress in advancing climate reference networks;

(e) Improved planning and progress with implementation of atmospheric composition networks meeting climate needs.

2.2.9 Main conclusions for the *Ocean Domain*:

(a) Useful progress in almost every action called for in the Implementation Plan of 2004, but many actions remain incomplete;

(b) The ice-free upper 1500 m of the ocean are being observed systematically for temperature and salinity for the first time in history;

(c) Most in-situ networks have made progress (e.g., tide gauges, moored reference sites, tropical moored arrays, full ocean depth observations);

(d) Most in-situ observing activities continue to be carried out under research agency support and on research programme time limits;

(e) Important progress in provision of critical ocean satellite data of sea surface ECVs has been made, but not for all variables, and data access remains to be ensured;

(f) Important progress in development of historical ocean reanalysis and in high resolution ocean forecasting capabilities;

(g) Promising developments in improved methods and standards will allow wider measurement of biological and chemical ECVs and consideration of new ECVs in the years ahead;

(h) Data sharing remains incomplete, particularly for tide gauges and biogeochemical ECVs. Data archaeology needs to continue.

Up-Date of the GCOS Implementation Plan

2.2.10 The SBSTA-30 invited the GCOS Secretariat to prepare an update of the GCOS Implementation Plan for its 33rd session in November 2010. The update of the GCOS Implementation Plan will take into account developments over the past five years such as adaptation plans and mitigation measures, and will revise the needed actions and the list of Essential Climate Variables (ECVs). The SBSTA invited the GCOS Secretariat to include, in this updated GCOS Implementation Plan, a breakdown of costs involved. The costs should be broken down by region, observing system and between developed and developing countries. The SBSTA invited the GCOS Secretariat to provide a provisional updated Implementation Plan in conjunction

with a provisional estimation of costs, for the 15th session of the Conference of the Parties (COP-15), 7–18 December 2009, in Copenhagen.

National Committees and Coordinators

2.2.11 GCOS is promoting the establishment of National GCOS Coordinators and encourages national ocean services to participate in national GCOS committees. A letter signed by all heads of the four sponsoring organizations has been sent on 19th June 2009 to the respective representatives asking for support for improved coordination of GCOS at the national level.

Standardization

2.2.12 The list of marine and ocean stations, including VOS (WMO Pub. 47, the International List of Selected, Supplementary and Auxiliary Ships) is updated quarterly.

2.2.13 WIGOS is addressing standardization issues from a multi-disciplinary perspective, dealing with requirements from all WMO Programmes and co-sponsor programmes [see agenda item 10.2].

2.2.14 JCOMM and UNESCO/IOC-IODE prepared a *Catalogue of Best Practices and Standards under JCOMM and IODE of UNESCO/IOC*, which had been published on the web at http://bestpractice.iode.org/ [see agenda item 11.2].

2.2.15 The GCOS/WCRP Atmospheric Observation Panel for Climate at its thirteenth session (Geneva, April 2007) had recognized that monthly CLIMAT TEMP/CLIMAT TEMP SHIP reports had very limited value for ongoing climate research purposes, taking into account improvements in collection and exchange of the daily TEMP messages and improved real-time quality control at operational weather prediction centres. The Panel conclued that CLIMAT TEMP was no longer required for GCOS purposes and that the Hadley GUAN Monitoring Centre had ceased its CLIMAT TEMP monitoring activities in 2007. CCl has been requested to assess the impacts of a possible discontinuation of CLIMAT TEMP on other domains, such as applied climatology, research and aviation.

Observing Systems under GAW addressing climate

2.2.16 The WMO/GAW Global Atmospheric CO_2/CH_4 Monitoring Network was formally recognized by CAS and GCOS as a major component of the GCOS comprehensive network in 2006. In 2007, an agreement was reached between GCOS and GAW, which specified the terms under which the GAW ozone and contributing networks were designated as the GCOS Global Baseline Total Ozone Network and the GCOS Global Baseline Profile Ozone Network. The agreement further specified terms under which selected NDACC stations could contribute to a GCOS Reference Upper-Air Network. The agreement has been approved by the WMO/GAW Scientific Advisory Group for Ozone, the Chair of the OPAG EPAC, and the GCOS Steering Committee, and thus added another component to the set of GCOS baseline networks in addressing the Essential Climate Variables. Implementation of GCOS networks continues, with additional networks being formally added as appropriate; in the upcoming years aerosols will be the focus.

GCOS Global Terrestrial Network for River Discharge (GTN-R)

2.2.17 The Pilot Project *"Initiation of Global Hydrological Network addressing a GCOS Requirement*" is largely based on the "*Hydrological Applications and Run-Off Network (HARON)*" project proposal. The proposal for HARON, jointly developed by WMO and GEO, is intended to improve and support the closure of the global water budget, in line with requirements of GCOS and the Global Water Cycle Experiment (GEWEX). In a phased approach, HARON foresees integration of dedicated river gauging networks of existing hydrological stations on a global scale into a global

runoff observation network, including the 380 global river discharge stations in the GCOS Global Terrestrial Network for River Discharge (GTN-R). Technical upgrade and sustained maintenance of these stations will be addressed by HARON.

2.3 Global and regional NWP, and synoptic meteorology

2.3.1 The full set of observational requirements for global NWP (GNWP), regional NWP (RNWP), seasonal and inter-annual forecasting (SIAF) and synoptic meteorology, for geophysical variables within the ocean or at the ocean/atmosphere interface is given in the WMO/CEOS database, which is available at http://www.wmo.int/pages/prog/sat/Databases.html.

2.3.2 RNWP has observational requirements very similar to those of GNWP. Where they differ they are more demanding in terms of horizontal and temporal resolution, and timeliness. Observational requirements for SIAF take, as their starting point, those for GNWP, and then add requirements for additional variables (e.g. ocean currents and ocean colour) or more demanding requirements of the same variables (e.g. for SST, and for sub-surface temperature and salinity). Those issues relevant to observations of the ocean and the ocean/atmosphere interface, principally for GNWP but with comments on differences for RNWP and SIAF where necessary, are presented below [see the full SoGs, available at http://www.wmo.int/pages/prog/sat/RRR-and-SOG.html, for more details]. Variables, such as sea surface temperature, sea ice and snow over sea ice, waves, ocean sub-surface variables, ocean topography, and ocean currents required for GNWP, RNWP, SIAF or synoptic meteorology are addressed in item 2.1 of this report.

Surface pressure and surface wind

2.3.3 Over ocean, ships and buoys provide observations of acceptable frequency. Accuracy is good for pressure and acceptable/marginal for wind. Coverage is marginal or absent over large areas of the Earth. Polar satellites provide information on surface wind – with global coverage, good horizontal resolution, and acceptable accuracy – in two ways. Scatterometers give information on wind speed and direction, whereas passive microwave imagers provide information on wind speed (only). Passive polarimetric radiometers have recently been demonstrated; in addition to wind speed, they offer directional information but of inferior quality to scatterometers at low wind speed. Temporal coverage is acceptable for GNWP and SIAF but marginal for RNWP. Surface pressure is not observed by present or planned satellite systems except for: some contribution from radio occultation data, and measurements of atmospheric optical depth for a gas of known composition such as oxygen (e.g. as planned with NASA's OCO mission). Surface pressure observations at relatively low spatial density are important as a complement to high-density satellite surface winds, in order to anchor the NWP surface pressure field. Such observations would be useful at high temporal resolution (e.g. hourly).

Surface air temperature and humidity

2.3.4 Over oceans, ships and buoys provide observations of acceptable frequency and acceptable accuracy (except ship temperatures during the daytime, which currently have poor accuracy). Coverage is marginal or absent over large areas of the Earth. Satellite instruments do not observe these variables, or do so only to the extent that they are correlated with geophysical variables that significantly affect the measured radiation (i.e. skin temperature and atmospheric layer-mean temperature and humidity). Observations of surface humidity over ocean are of lower priority for NWP than many other variables.

Precipitation

2.3.5 Surface stations measure accumulated precipitation with a temporal resolution and accuracy that is acceptable but a horizontal resolution that is missing over most of the Earth. Ground-based radars measure instantaneous precipitation with good horizontal and temporal resolution and acceptable accuracy, but over a few coastal areas only. Microwave imagers and

sounders offer information on precipitation of marginal horizontal and temporal resolution, and acceptable/marginal accuracy (though validation is difficult). Geostationary infra-red imagers offer some information at much higher temporal resolution through the correlation of surface precipitation with properties of the cloud top, but accuracy is marginal due to the indirect nature of this relationship. Satellite-borne rain radars, together with plans for constellations of microwave imagers, offer the potential for improved observations. For RNWP, satellite estimates of precipitation are marginal at best but, away from coastal areas, they are virtually the only source of precipitation information over oceans.

2.4 Other

2.4.1 The requirements for the operational collection and exchange of data for coastal GOOS, including physical and non-physical variables (biogeochemical and socio-economic) have been just emerging. Such requirements had been compiled Design and Implementation Strategies for the Coastal Module of GOOS, which are available at http://www.ioc-goos.org/content/view/14/ 28/. All three requirements, physical, biological and chemical, together with a range of complementary meteorological observations, are needed to obtain a comprehensive view of the behaviour of coastal seas and their responses to natural and anthropogenic forcing, in support of sustainable development. IODE of UNESCO has been dealing with the data management issues of all kinds of data, including management and exchange of non-physical observations.

3. The Vision for the Global Observing System (GOS) in 2025

The vision for the GOS in 2025 – the ocean component

3.1 In 2009, WMO/CBS adopted a new Vision for the GOS, in response to the evolving needs of WMO Programmes for observations and to the opportunities offered by recent developments in technology and in planned/proposed observing systems. This new *Vision for the GOS in 2025* in available at http://www.wmo.int/pages/prog/www/OSY/WorkingStructure/documents/CBS-2009_Vision-GOS-2025.pdf .

3.2 The new Vision provides high-level goals to guide the evolution of the GOS in the coming decades. These goals are intended to be challenging but achievable. The new Vision addresses general trends and issues facing the evolution of the GOS: response to user needs, integration, expansion, automation, consistency and homogeneity. It contains high-level guidance to observing system providers for the task of developing an interoperable and co-ordinated “system of systems”: a system of space-based and surface-based observing systems to meet a comprehensive range of user requirements for observations in a coordinated manner.

3.3 Those elements of the Vision relevant to the implementation of ocean observing systems are extracted below [see the full Plan for more details]:

3.3.1 The *space-based component of the GOS* will provide information on:

Sea surface temperature	High-resolution multi-spectral visible/IR imagers and IR spectral sounders on operational geostationary and polar-orbiting satellites; microwave imagers on polar-orbiting satellites; dual-view IR imagers
Sea ice cover	microwave and visible/infra-red imagers, and scatterometers
Sea surface wind speed and direction	scatterometers and polarimetric microwave imagers
Ocean surface topography, sea level, wave heights and sea ice topography	Altimeter constellation including a reference mission in a precise orbit and polar-orbiting altimeters for global coverage
Precipitation	microwave imagers and sounders and from precipitation radars
Ocean colour	narrow-band and hyperspectral visible / near-IR imagers

Wave heights, directions and spectra; sea ice leads; ice shelfs; ice bergs	synthetic aperture radars

3.3.2 The *surface-based component of the GOS* will include:

Ocean – upper air	
Automated Shipboard Aerological Platform (ASAP) ships	Wind, temperature, humidity, pressure
Ocean – surface	
HF Coastal Radars	Surface currents, waves
Synoptic sea stations (ocean, island, coastal and fixed platform)	Surface pressure, temperature, humidity, wind; visibility; cloud amount, type and base-height; precipitation; weather; sea-surface temperature; wave direction, period and height; sea ice
Ships	Surface pressure, temperature, humidity, wind; visibility; cloud amount, type and base-height; precipitation; weather; sea-surface temperature; wave direction, period and height; sea ice
Buoys – moored and drifting	Surface pressure, temperature, humidity, wind; visibility; sea-surface temperature; 3D & 2D wave spectrum, wave direction, period and height
Ice buoys	Surface pressure, temperature, wind, ice thickness
Tide stations	Sea water height, surface air pressure, wind, salinity, water temperature
Ocean – sub-surface	
Profiling floats	Temperature, salinity, current, dissolved oxygen, CO_2 concentration
Ice tethered platforms	Temperature, salinity, current
Ships of opportunity	Temperature
R&D and Operational pathfinders – examples	
Instrumented marine animals	Temperature
Ocean gliders	Temperature, salinity, current, dissolved oxygen, CO_2 concentration

Implementation strategy and key issues for ocean observing systems

3.4 The WMO/CBS has developed an *Implementation Plan for the Evolution of the GOS* (EGOS-IP), in response to the *Vision for the GOS* and the gaps identified by the SoGs. The current version of EGOS-IP, which includes comments on implementation status and issues, is available at http://www.wmo.int/pages/prog/www/OSY/WorkingStructure/index.html. EGOS-IP includes the following sections relevant to ocean observing systems [with EGOS-IP section numbers shown in parentheses – see the full Plan for more details]:

- Data dissemination: higher temporal frequency and more widespread exchange (G1);
- Documentation: improved metadata (G2);
- Timeliness: more timely availability of observations from ocean systems (G3);
- Improved dissemination of atmospheric vertical profile information from radiosondes, including ASAPs (G8);
- More atmospheric profiles over the oceans, including ASAPs (G14);
- Improvements in marine observation telecommunications (G15);

- Tropical moorings: develop RAMA in Indian Ocean and sustain both RAMA and the Atlantic Ocean arrays (G16);
- Drifting buoys: improved coverage of surface pressure observations, particularly in the Southern Oceans (G17);
- XBT and Argo: improved timely delivery of observations (G18);
- Ice buoys: increased coverage (G19);
- New observing systems, including ocean gliders and deep ocean reference stations (G22);
- In-situ wave observations capability (GN1);
- Increased temporal resolution of SST data (GN2);
- Develop and consolidate VOSClim fleet (GN3);
- Sea-surface wind from low Earth orbiting (LEO) satellites (S7);
- LEO altimeters: develop ocean topography missions to operational status (S8);
- LEO ocean salinity: develop operational capability (S14);
- LEO synthetic aperture radar (SAR): make data available for operational use (S15).

3.5 The EGOS-IP will be reviewed in November/December 2009, to take into account elements from *Vision for the GOS in 2025*.

_____

PROGRESS/ACTIVITY REPORT

1. INTRODUCTION

1.1 The Observations Programme Area (OPA) "*Observing System Implementation Goals for building a sustained Global Ocean Observing System in support of the Global Earth Observation System of Systems (GEOSS)*" is aligned with the ocean chapter of the GCOS *Implementation Plan for the Global Observing System for Climate in support of the UNFCCC* (GCOS-92). The implementation goals provide specific implementation targets for building and sustaining an initial global ocean observing system representing the climate component of the Global Ocean Observing System (GOOS) and the ocean component of the Global Climate Observing System (GCOS). Although the baseline system proposed under the implementation goals was designed to meet climate requirements, non-climate applications, such as NWP, global and coastal ocean prediction, and marine services in general [see agenda item 5], will be improved by implementation of the systematic global observations of Essential Climate Variables (ECVs) called for by the GCOS-92 plan. Progress has been made towards system-wide performance metrics based on ECVs (see section 8 below).

1.2 Sixty-one percent of the initial composite ocean observing system is now completed (August 2009 – see Figure 1), and three components have achieved their initial implementation target: the drifting buoy array (at JCOMM-II, in September 2005), the Argo profiling float programme (November 2007), and the VOS Climate Project fleet (June 2007).

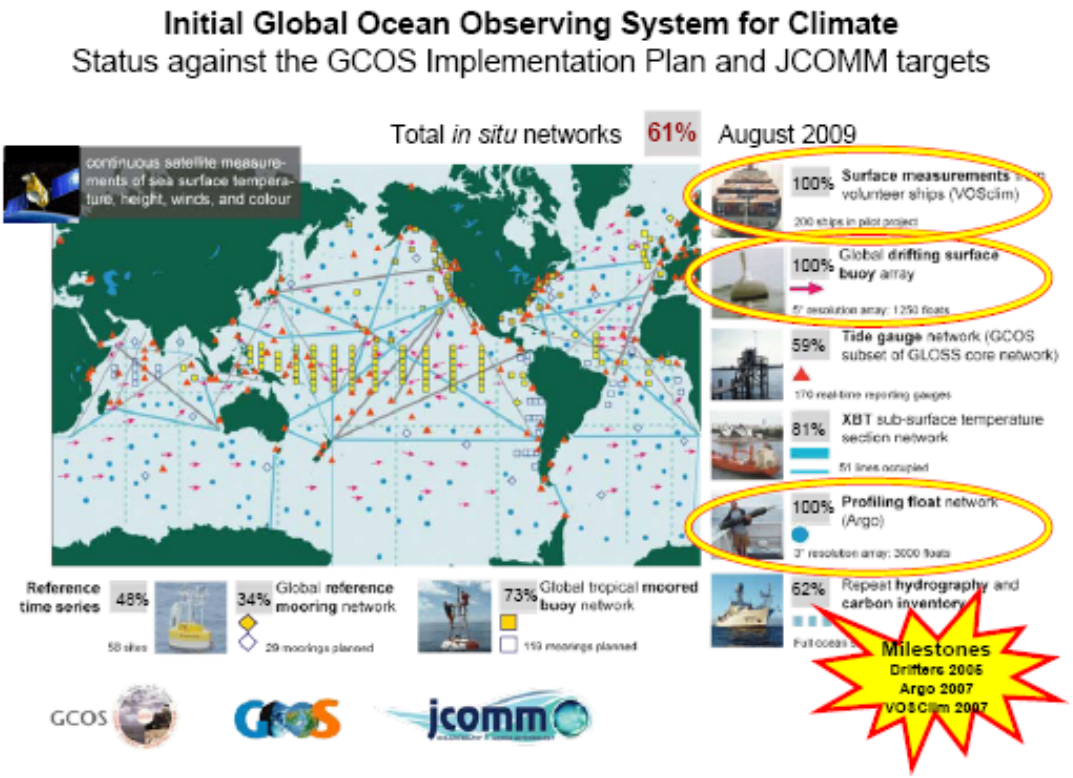

Figure 1 – A schematic of the initial composite ocean observing system design, including the current status against the goals of the GCOS Implementation Plan (GCOS-92).

1.3 Much progress was made regarding the development of "*An Oceanographer's and Marine Meteorologist's Cookbook for Submitting Data in Real Time and in Delayed Mode*". This document provides a practical resource to those who collect oceanographic and marine

meteorological data to facilitate contribution of the data to the international community. The focus is on in situ, directly observed measurements, rather than on remote sensing data.

2. DATA BUOY COOPERATION PANEL (DBCP)

Overview of DBCP activities

2.1 At its inception in 1985, the DBCP was charged with improving the quantity, quality and timeliness of data buoy observations from the global oceans, and with persuading the research community to make their considerable body of data available in near real time for use by the global forecasting community (i.e. data formatting and insertion on to the GTS). Success in this area was achieved through the employment of a Technical Coordinator (TC) and the creation of a number of regional and application-specific Action Groups (currently nine in number) that were able to coordinate their activities under the general guidance of the DBCP. By 2000, the initial objectives laid before the Panel had largely been met and become routine, and the Panel gradually turned towards the identification of new challenges that would pave its way forward and make best use of the skills, knowledge base, resources and goodwill, that the Panel enjoyed and could exploit in developing data buoy activities worldwide.

2.2 Central to the new working practices of the DBCP are four key elements:

- The creation of an Executive Board, supported by a number (currently five) of focused task teams, to ensure that the mission of the Panel could progress effectively during the intersessional period;

- The sponsoring of Pilot Projects to evaluate in detail emerging technologies that might ultimately enhance the capabilities of data buoy networks [see agenda item 6.3];

- The initiation of outreach and Capacity Building activities both to enable developing regions to successfully implement and manage data buoy programmes, and to assist the Panel in recovering increased numbers of buoy observations from data-sparse areas. For example, the Panel ran a training workshop for key active personnel from Africa in June 2007, and has established a task team to take matters forward;

- The streamlining of the Panel's annual sessions to make better use of participants' time and experience by concentrating on those issues that require the Panel's attention and decision.

2.3 In common with many other observing networks, the mission of the DBCP can only be achieved through the employment of its TC. The retention of the TC is vital to the success of the Panel, and there are a number of difficulties to be overcome in this regard.

2.4 The issue of inadequate deployment opportunities is now the major difficulty affecting the global dispersion of the drifter array, an issue which is shared with the Argo programme. The Southern Ocean and Gulf of Guinea continue to prove particularly troublesome. The DBCP and Argo TCs are working together to identify shared deployment cruises.

Performance measured against requirements

2.5 In all three areas (quantity, quality and timeliness of observations), the trend in performance is one of steady improvement. Where there are instances of the trend not being followed (e.g. in the regional distribution of buoy coverage, or in regional anomalies in data timeliness), the Panel is notified by its TC and suitable remedial actions agreed where possible.

2.6 The numbers of buoys reporting data on the GTS comfortably exceeds the target of 1250 specified in the OPA implementation goals (see Figure 2), and nearly 50% of those now report atmospheric pressure, a considerable improvement since JCOMM-II, and in large measure that is a tribute to the barometer upgrade scheme operated by the Global Drifter Programme that has successfully encouraged the addition of barometers to standard SST-only drifters (SVPs). Figure 3 shows the global distribution of both moored and drifting buoys, with the Tropical Moored Buoy array clearly evident, whereas Figure 4 shows drifting buoy tracks and the coverage gaps in the Southern Ocean, the central Pacific and the Gulf of Guinea. Figure 5 shows the distribution of air pressure observations and the lack of data from the tropics (an intentional gap, as the pressure signal from this region is in general weak). Recently expressed user requirements indicate that this coverage needs to be improved [see agenda item 5].

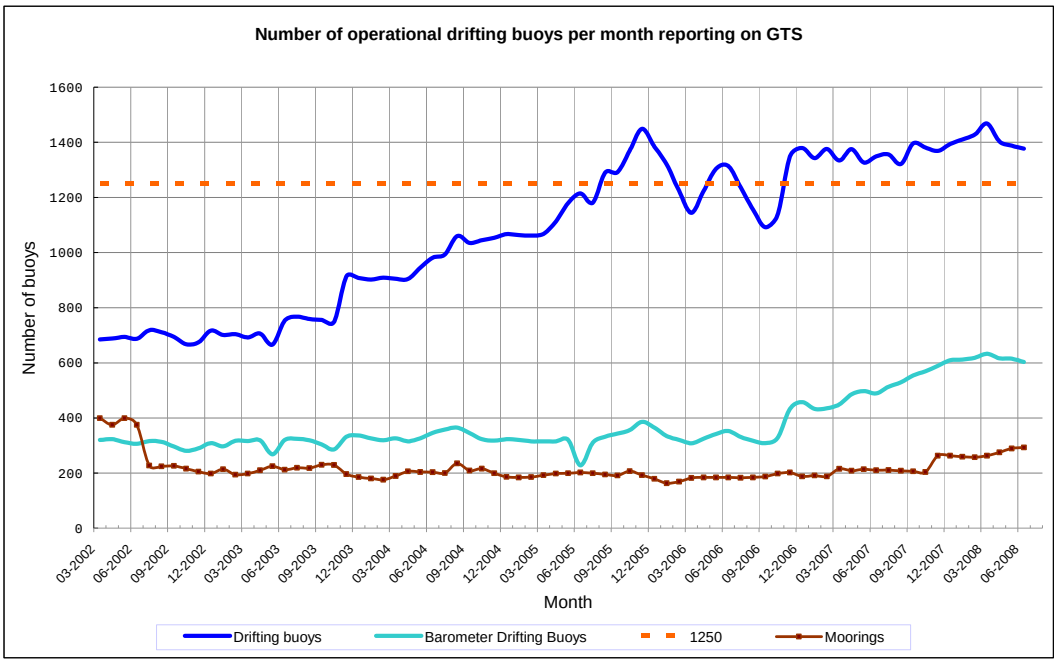

Figure 2 – Monthly evolution of the number of operational drifting buoys reporting on GTS from March 2002 to July 2008 and those reporting air pressures. Operational moored buoys are also included (Data derived by statistics computed from GTS in situ marine data provided by Météo-France – Source: JCOMMOPS).

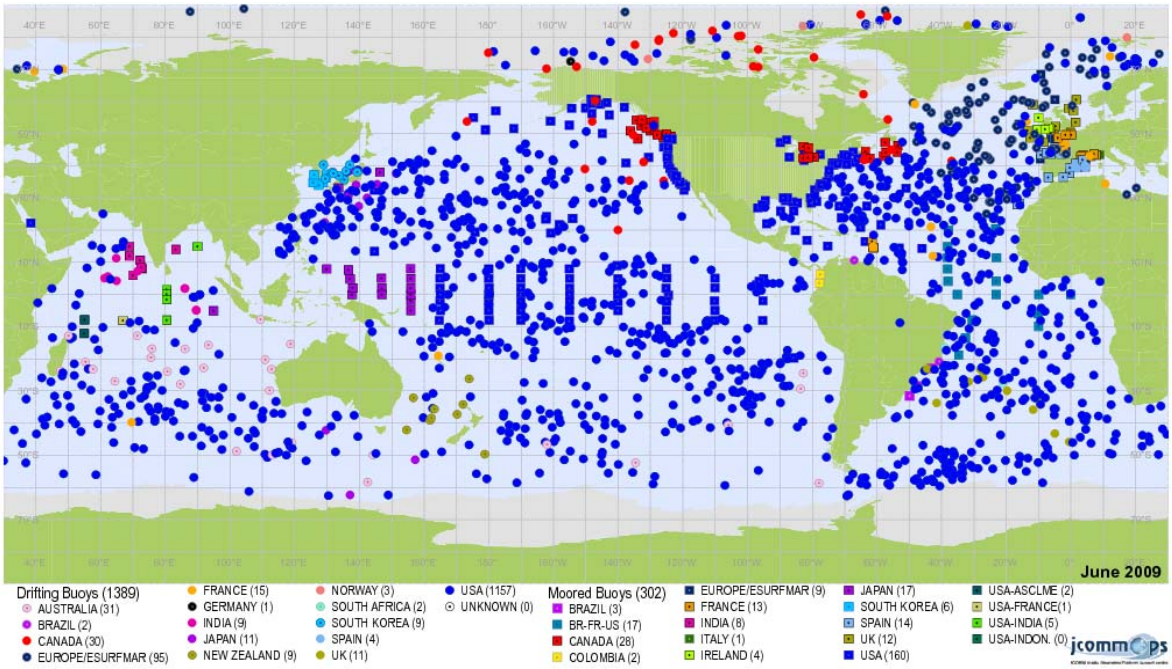

Figure 3 – Total numbers of buoys (moored and drifting) reporting on the GTS in June 2009 (Source: JCOMMOPS).

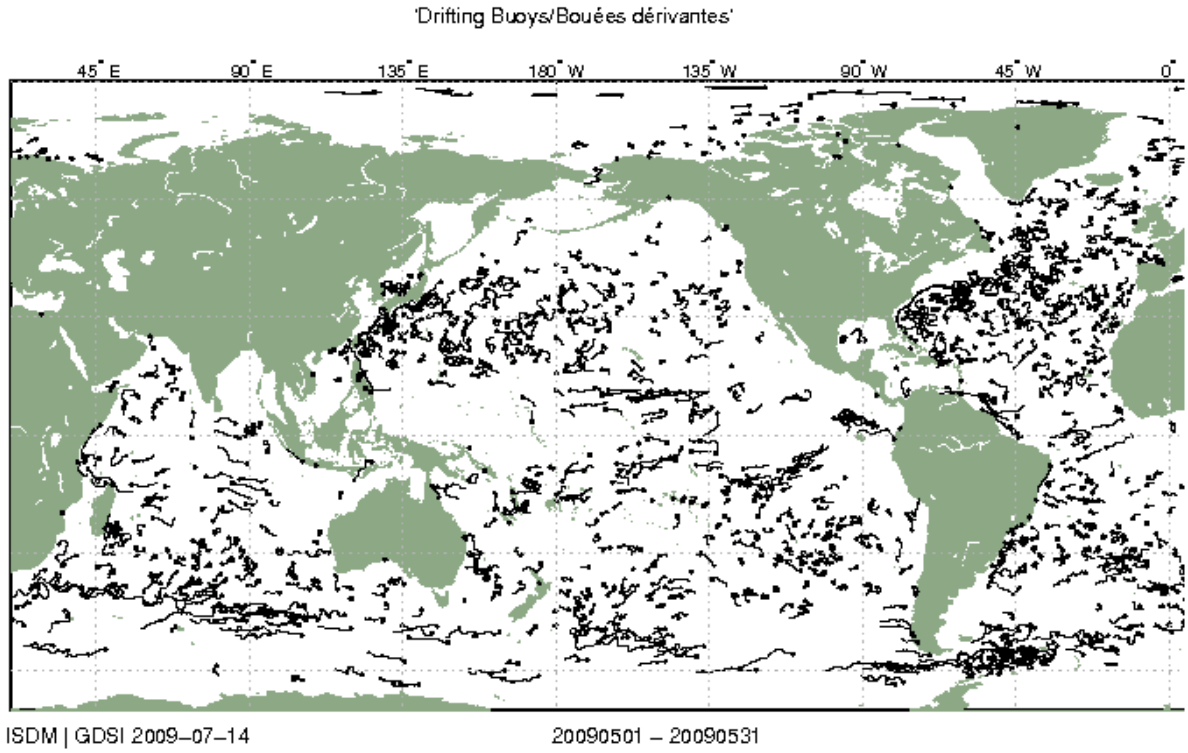

Figure 4 – Drifting buoy tracks for May 2009, clearly demonstrating where gaps exist in the buoy network (Source: ISDM, Canada).

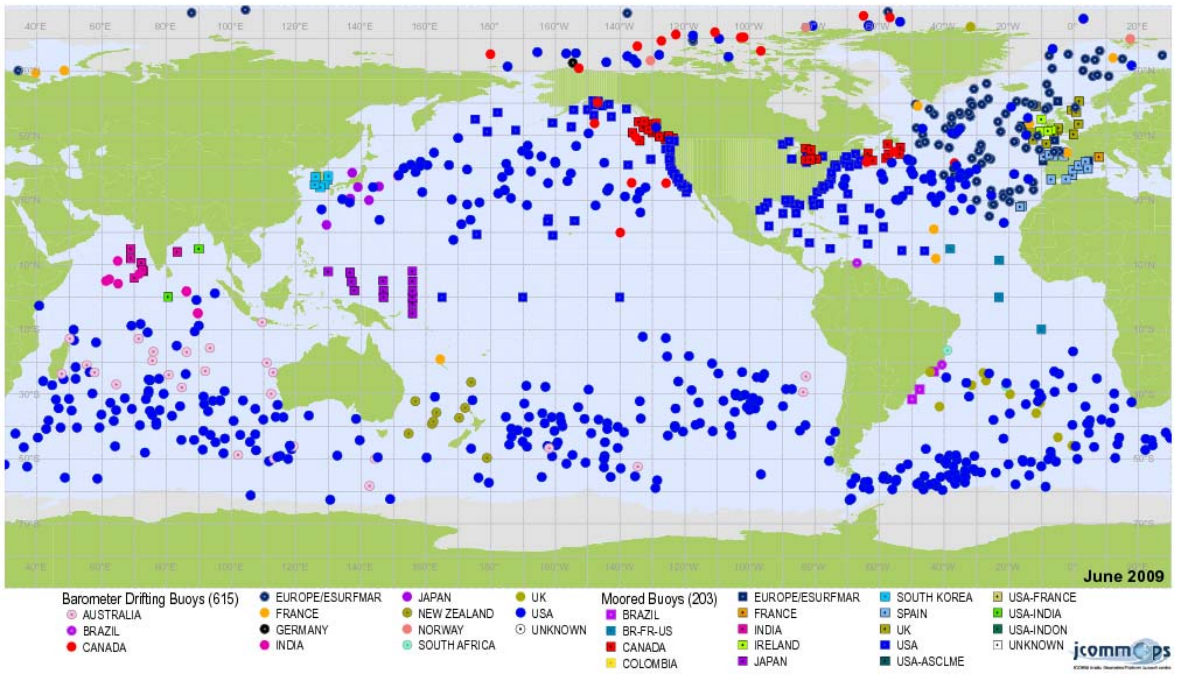

Figure 5 – DBCP barometer buoy monthly status by country for June 2009 (data buoys reporting pressure on the GTS via Météo-France – Source: JCOMMOPS).

2.7 Figure 6 shows the evolution of the Tropical Moored Buoy Array between October 1999 and May 2009. The programme has grown substantially in scope and capability since the community wide survey of ocean measurements as part of the OceanObs'99 Conference, in 1999. New challenges and opportunities exist to build on successes over the past 10 years. Most critical is the need to complete the network and maintain climate quality time series in all three ocean basins for the future. The Prediction and Research Moored Array in the Tropical Atlantic (PIRATA) has expanded and been enhanced since 2005. The Research Moored Array for African-Asian-

Australian Monsoon Analysis and Prediction (RAMA) was initiated in the Indian Ocean (beginning in 2000) and is now about 50% complete, Flux Reference Sites were established in all three oceans (beginning in 2005) as part of OceanSITES, and additional biogeochemical measurements were added in the Pacific and Atlantic (beginning in 2003).

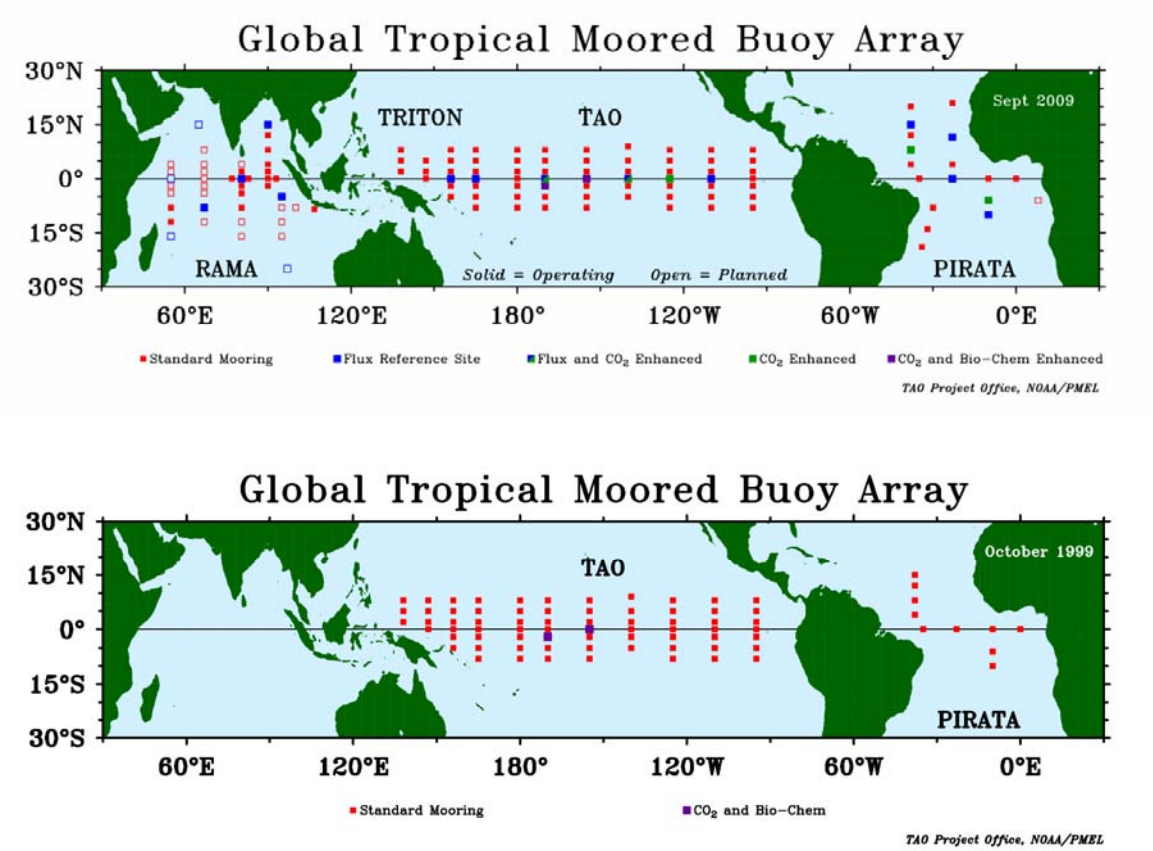

Figure 6 – The global tropical Moored Buoy Array in May 2009 (top) and October 1999 (bottom) (Source: NOAA/PMEL, USA).

2.8 In general, the quality of buoy observations (moored and drifting) continues to improve, as measured by the deviation from background fields or by the numbers of observations ingested by NWP models. The quality of wind spectral data from moored buoys continues to be an area of concern, and the Panel has joined with the JCOMM Expert Team on Wind Waves and Storm Surges (ETWS) to initiate a pilot project to examine ways of making improvements in this area [see agenda item 6.3].

2.9 The delays between the time of an observation and its publication on the GTS continues to improve, both through the extension of the Argos regional antenna network and the increasing use of Iridium as a communications channel, stimulated in part by the DBCP Iridium Pilot Project. Nonetheless, improvements can still be made (e.g. Tropical Moored Buoy array, and in the S Atlantic and S Pacific) through: (i) connecting more Local User Terminals to the Argos System; and (ii) fixing the ongoing blind orbit issue caused by the non-optimal geographic distribution of global ground stations for the NOAA polar orbiters that carry the Argos payload.

3. SHIP OBSERVATIONS TEAM (SOT)

Overview of SOT activities

3.1 The Ship Observations Team (SOT), established by JCOMM at its first session (JCOMM-I, Akureyri, Iceland, June 2001), was created to build on synergies between the three Panels involved in coordinating global ship-based observing programmes: the Voluntary Observing Ship (VOS) Scheme, the Ship-Of-Opportunity Programme (SOOP), and the Automated Shipboard

Aerological Programme (ASAP), with a view to an eventual possible full-integration of ship-based observing systems on commercial and research vessels.

3.2 Much progress has been made to integrate the three programmes under one umbrella. The efforts of the SOT have resulted in a more cost-effective way of collecting observations through observing systems that are now better standardized and addressing a wide range of meteorological and oceanographic applications. Because of the ongoing commitments and the dedication from Members/Member States, a number of challenges have been successfully addressed through the SOT:

- Consideration of requirements from a wide range of users (e.g. NWP, climate applications, OOPC, marine climatology, ocean modelling, satellite validation and bias correction, GHRSST);

- Completion of the VOSClim network, and its integration into the wider VOS;

- Strong collaboration with the DBCP in supporting and benefiting from the JCOMMOPS office facilitating ship networks monitoring, the resolving of technical issues, and the use of ship opportunities for the deployment of drifters;

- Close relationships with associated programmes making ship observations such as the International Ocean Carbon Coordination Project (IOCCP), the Shipboard Automated Meteorological and Oceanographic System Project (SAMOS), the Ferrybox Project, the SeaKeepers Society, the Alliance for Coastal Technologies (ACT), and the SCOR/IAPSO OceanScope Working Group;

- Addressing ship owners and masters concerns with regard to availability of VOS information on public websites. This led to the WMO Executive Council adopting Resolution 27 (EC-LIX) authorizing Members to implement ship masking schemes. The SOT has been coordinating the different masking schemes proposed, and made sure that the user requirements could continue to be met;

- Routine collection of ship metadata through the management of WMO-No. 47, and strong collaboration with the Water Temperature metadata Pilot Project (META-T) for the delivery of ship metadata in real time via BUFR reports;

- The undertaking of Capacity Building activities, including the organization of a third international workshop for Port Meteorological Officers (Hamburg, Germany, March 2006);

- Reviewing satellite data telecommunication systems, and the testing and evaluation of Iridium for the transmission of marine/ocean observations from ships;

- Addressing instrument standards, and the conduct of e-logbook intercomparisons leading to specific recommendations being made to improve coherence and quality of the data;

- Addressing the recruitment of ships in times where the shipping industry is facing economic difficulties, where ships are changing routes, staff, and owners.

Voluntary Observing Ship (VOS) scheme

3.3 The VOS Scheme (see http://www.bom.gov/au/jcomm/vos/) is a unique network in that it is devoid of a target network size, primarily because it depends on the support of commercial shipping companies that are not immune to commercial/financial pressures (including sale, re-

routing and scuttling). The VOS Scheme consists of national VOS fleets (VOF), each of which consists of a mix of commercial, research, fishing, passenger and private vessels. VOS data support a wide range of applications, including: the analysis of weather systems and storm tracking and the provision of high quality maritime safety services; NWP and local weather forecasts; ground-truthing of satellite derived data; validating coastal and island observations; climate research, modelling and forecasts. In addition, VOS data support other industries and users including: fishing, transport, coastal engineering, search and rescue, marine pollution, offshore drilling and mining.

3.4 On average, in excess of 100,000 VOS reports from more than 2,000 ships are distributed on the GTS per month (see Figure 7), predominantly in the Northern Hemisphere. Delayed-mode meteorological data, i.e. observational data in an electronic logbook or the traditional paper logbook are also routinely collected as part of the Marine Climatological Summaries Scheme (MCSS) and distributed to the Global Collection Centres (GCCs) in the UK and Germany [see agenda item 7.2]. Metadata relating to the individual ships and the installed meteorological equipment and observing program are collected by a Port Meteorological Officer (PMO) at recruitment and updated as required at subsequent inspection visits. Metadata in support of WMO-No. 47 are requested from Members/Member States every quarter.

3.5 VOSClim is currently a programme within the global VOS and comprises ships meeting a range of criteria. The initial VOSClim target of 200 ships was achieved in December 2006. A revised target of 250 ships set at the fourth session of the SOT (SOT-IV) was achieved in June 2007. SOT, at its fifth session (SOT-V), agreed that VOSClim end as a project but, in order to maintain an ongoing network of Climate Reference Ships, a new meteorological class of reporting ship will be introduced called VOSClim. Efforts remain to be made to record and collect the required additional elements (QC flags and metadata).

3.6 VOS Programme Managers receive monthly monitoring reports from the Regional Specialized Meteorological Centre (RSMC) in Exeter (UK), and the VOSClim Real Time Monitoring Centre (RTMC), also operated by the UK. VOS Programme Managers and PMOs can also perform near real-time monitoring of their ships with the VOS Monitoring Tools provided on the Météo-France website.

3.7 The global VOS is underpinned by the international PMO network, which plays a crucial role in ship recruiting, training of observing staff and calibration of the instruments. Fixed budgets and increasing costs are affecting the ability of some Members/Member States to maintain adequate levels of serviceable equipment. Regrettably, some countries have ceased operating their VOS Programme (VOSP) and disbanded their PMO network since JCOMM-II, on economic grounds.

3.8 The VOSP encourages the use of AWS as they provide for unattended, regular and consistent observations. The number of AWS-equipped ships continues to increase. Several factors, however, conspire to limit the equipping of ships with AWS. These include: (1) the transient nature of shipping in some regions of the world; (2) the cost to purchase and install an AWS, particularly an AWS with manual input and equipment installed at many locations on the ship; and (3) communications costs. Portable, self-contained AWS are easier and quicker to install or remove but don't provide for visual observations (cloud, weather, visibility, sea and swell) and SST, and possibly also wind speed and wind direction.

3.9 Advanced systems have been facilitating communication issues. E-mail is increasingly being used to transmit the VOS real-time GTS reports as more ships gain Internet access. Emailing costs are typically borne by the ship, thus reducing Members/Member States communications' costs. The use of Iridium for transmitting AWS observations has been tested by Canada and France. In an effort to further reduce communication costs, several Members/Member States now use compression techniques to reduce AWS message size.

3.10 The VOSP encourages the use of electronic logbooks (e.g. TurboWin, ObsJMA, SEAS), on manual observing ships. Electronic logbooks provide consistent coding, inbuilt quality control and automatically log the observation. TurboWin (the Netherlands) is in widespread use outside of Japan and the US. Most Members/Member States are installing TurboWin on an opportunity basis; UK and the Netherlands have declared that all of their manual observing ships will use TurboWin.

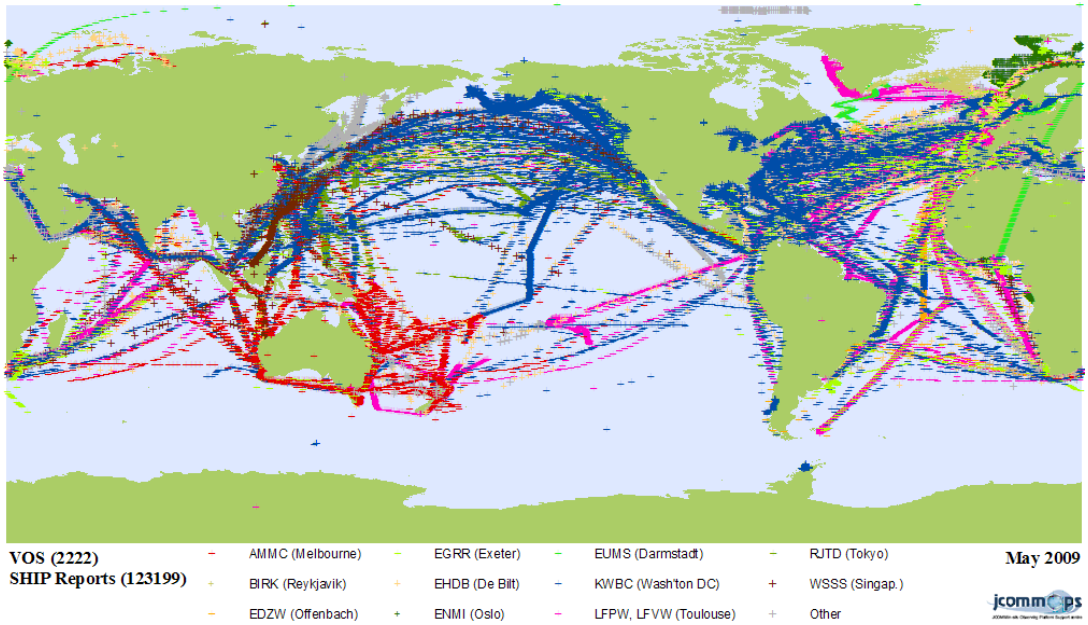

Figure 7 – VOS reports received by Météo-France by GTS origin, May 2009 (source: JCOMMOPS).

Automated Shipboard Aerological Programme (ASAP)

3.11 The ASAP data are used for NWP, as this is the only source of upper-air information over the data sparse oceans. Several impact studies (carried out by Norway and Australia) demonstrate a positive impact of upper-air soundings over the oceans.

3.12 There are only two significant ASAP programmes: The European programme E-ASAP with 12-16 ships in 2007-2008 and the Japanese programme with 5 ships. The Japanese ASAP stations are operated on research vessels. E-ASAP is the only programme worldwide which is based on a fleet of commercial vessels (except 2 ships). The number of ships, which routinely provide upper-air soundings on the GTS throughout the year, is about 20 worldwide. Occasionally there are some research vessels which perform soundings during certain research campaigns. However, these activities are usually limited to some weeks.

3.13 The ASAP has stated requirements for the height of the sounding (< 50 hPa) as well as for the timeliness of delivery to the GTS (HH + 100 mins). E-ASAP, part of EUMETNET, which represents about 75% of all ASAP ships, has additional requirements.

3.14 The full resolution raw data are regularly recovered from the ships and archived by Members/Member States. The mean average over all stations is 19 soundings per month. The total number of soundings on the GTS was 3476 in 2008. Taking into account the total number of launches on board of the ships and received soundings on the GTS, the average GTS/Launches ratio is 84%. Figure 8 shows ASAP reports received from GTS by Météo-France, in May 2009.

3.15 Improving satellite communications is one of the challenging technical tasks of the E-ASAP. Most ship observations (SYNOP and TEMP) are transmitted via Inmarsat-C, which is expensive and only permits transmission of short data volumes. A low cost transmission system is

required to transmit binary high-resolution BUFR data. The Iridium transmission system has been successfully tested.

3.16 Unexpected termination of ASAP operations due to changes in the ship services, etc., is a permanent risk. The main impact of the current economic crisis is the shortening of charter contracts between shipping companies and the flexibility of line services. Furthermore, many new ships have very limited free deck space to host an ASAP container launcher. A further risk is the shortage of helium on the world market and the lack of options to store sufficient reserves at E-ASAP premises or in the ports of call.

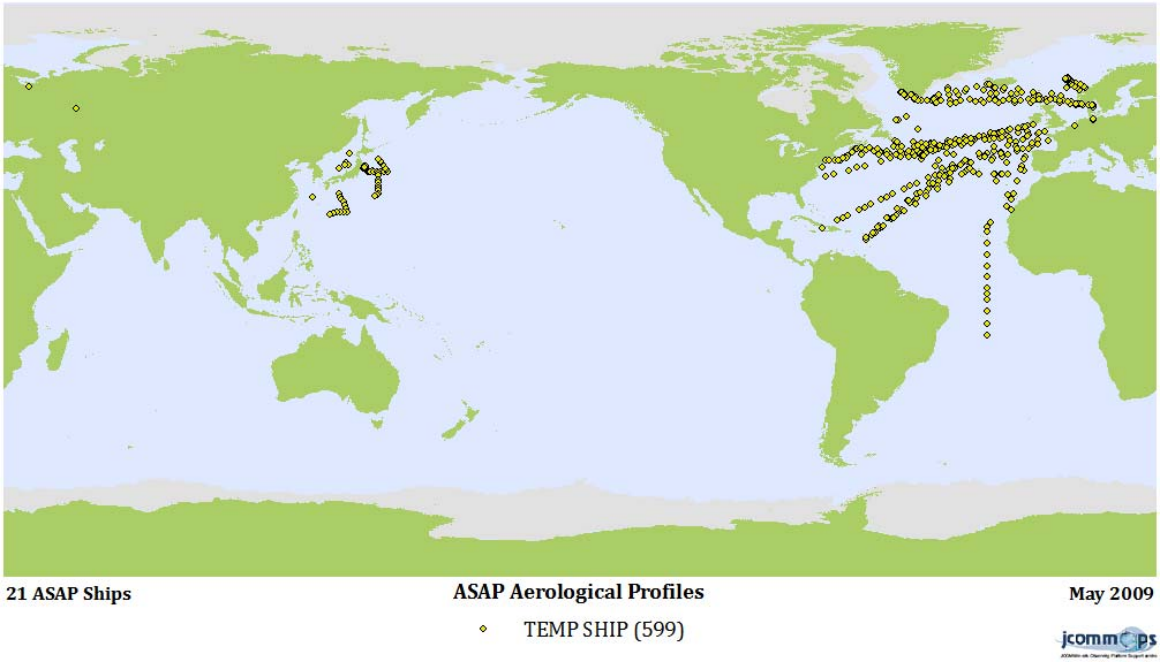

Figure 8 – ASAP reports received by Météo-France by GTS origin, May 2009 (source: JCOMMOPS).

3.17 The deck launcher has proven to be a good alternative to the much more costly containerized ASAP system. Whilst the deck launcher is portable and easy to install and operate, it is less convenient in cold climates. The use of deck launchers will increase as ships find it increasingly difficult to provide free space for a containerized ASAP. The cost of an ASAP system varies between 25,000 – 120,000 Euro. This wide variation depends on (1) whether the system is containerized or a simple deck launcher, and (2) the cost of the sounding system. The cost per sounding, including operator fee, varies between 200 – 280 Euros.

Ship Of Opportunity Programme Implementation Panel (SOOPIP)

3.18 The Ship Of Opportunity Programme (SOOP) addresses both scientific and operational goals for building a sustained ocean observing system. SOOP is concerned with oceanographic sampling from (mostly) merchant ships, using mainly eXpendable BathyThermographs (XBT), but also of eXpendable Conductivity Temperature Depth (XCTD), Acoustic Doppler Current Profilers (ADCP), ThermoSalinoGraphs (TSG) and Continuous Plankton Recorders (CPR). These surface and subsurface data are for example used to initialize operational climate forecast models. Data along fixed transects are of critical scientific value and used to: (1) investigate for example intraseasonal/interannual variability in the tropical ocean (Low Density Mode); (2) measure seasonal and interannual variation of volume transport of major open ocean currents (Frequently Repeated Mode); and (3) measure meridional heat advection across ocean basins (High Density Mode). Sea surface salinity data from TSGs are used only in a limited manner for initializing models, which generally use sea surface salinity observations from Argo floats alone. Most of the uses of TSG observations are for scientific analysis, mostly in tropical regions. The international

community reviewed the XBT and TSG transects at the OceanObs'09 Conference, in September 2009, and made specific recommendations regarding required sampling.

3.19 The accomplishment and maintenance of the recommended transects are highly dependant on ship traffic and recruitments. Similar to the VOS, the SOOP is currently encountering problems in achieving its objectives primarily because of unforeseen ship movements resulting in route changes or the suspension of trade on some routes. This makes it extremely difficult to achieve the desired sampling goals on some transects (e.g. PX50, AX18).

3.20 Approximately 22,000 XBTs are deployed every year, of which 20,000 are transmitted in real-time and ingested into operational databases (Figure 9). At any time, there are between 25-35 ships deploying XBTs and approximately 30 ships transmitting TSG data. Data reporting and monitoring becomes crucial to assess performance.

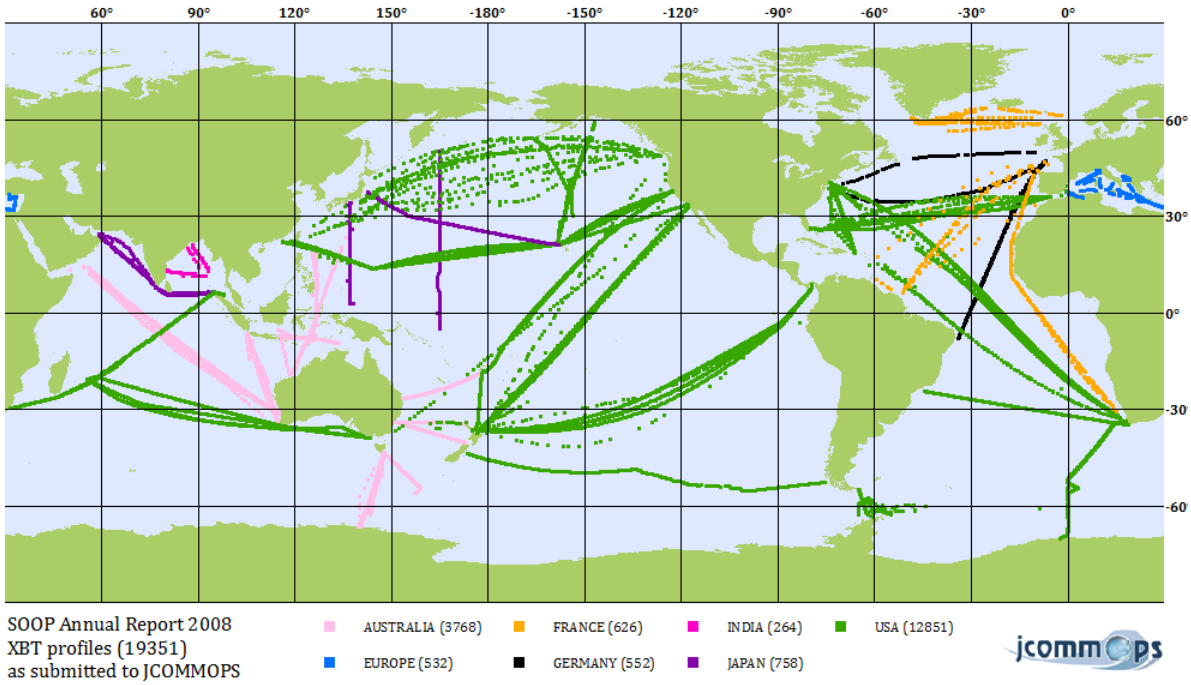

Figure 9 – XBT profiles in 2008 from SOOP annual survey (source: JCOMMOPS).

3.21 Most of the XBT observations transmitted in real-time undergo an automatic quality control process. Metadata from XBT observations are critical, particularly for current studies of the XBT fall rate equation. There are several data acquisition systems used, with NOAA SEAS and the CSIRO Devil systems being the most popular. A recent study has shown that data accuracy is not dependent on the system used. Metadata for TSG observations are also critical, particularly the calibration coefficients for delayed-mode data quality control. It has been suggested to standardize the real-time quality control procedures making them similar to the procedures used for temperature profiles provided by profiling floats for Argo.

3.22 Real-time monitoring of TSG data are routinely performed automatically using the quality control provided by the Global Ocean Surface Underway Data (GOSUD) project. The identification of anomalous TSG-derived salinity data may help identify problems such as bio fouling.

3.23 Most of the XBT deployments are funded by the US. Additionally, a large number of XBTs deployed by non-US agencies are the result of donations from the US (NOAA), thereby making the operation highly dependent on the continuing support of one single institution. Through collaboration on XBT probes and equipment donations, several efforts are underway to increase the participation of additional countries in SOOP operations.

3.24 Several tools, including installation and operation manuals, have been created as reference for crew members and ship riders to operate XBT equipment and for technicians to install and maintain TSG equipment. Improved and new technologies keep being incorporated in the SOOP operations, such as auto-launchers for different types of XBTs. Iridium satellite XBT and TSG transmissions are currently being tested. Ferrybox and Seakeepers have developed systems, some of which allow free use of their proprietary technology.

3.25 The community is currently working on defining the final version of BUFR templates for the various products being migrated to best accommodate both data and metadata, whilst serving the needs of data producers and users. The operational community will have to change the data collection procedures and implement changes to the data acquisition in order to fully utilize the new BUFR template capabilities for expanded and necessary metadata.

4. GLOBAL SEA LEVEL OBSERVING SYSTEM (GLOSS)

4.1 GLOSS will mark its 25th anniversary in 2010, and has expanded beyond the original aim of providing tide gauge data for understanding the recent history of global sea level rise and for studies of interannual to multidecadal variability. Tide gauges are playing a greater role in regional and global tsunami warning systems and for operational storm surge monitoring. The GLOSS tide gauge network is also important for the ongoing calibration and validation of satellite altimeter time series, and as such is an essential observing component for assessing global sea level change.

4.2 The number of sea level stations reporting to the GLOSS Data Centres has improved markedly over the last ten years, particularly for stations that report in near real-time (see Figure 10). Just over 75% of the GLOSS Core Network (GCN) of 293 stations can be considered operational, and there are focused efforts to address the remaining 25% of stations not currently on-line.

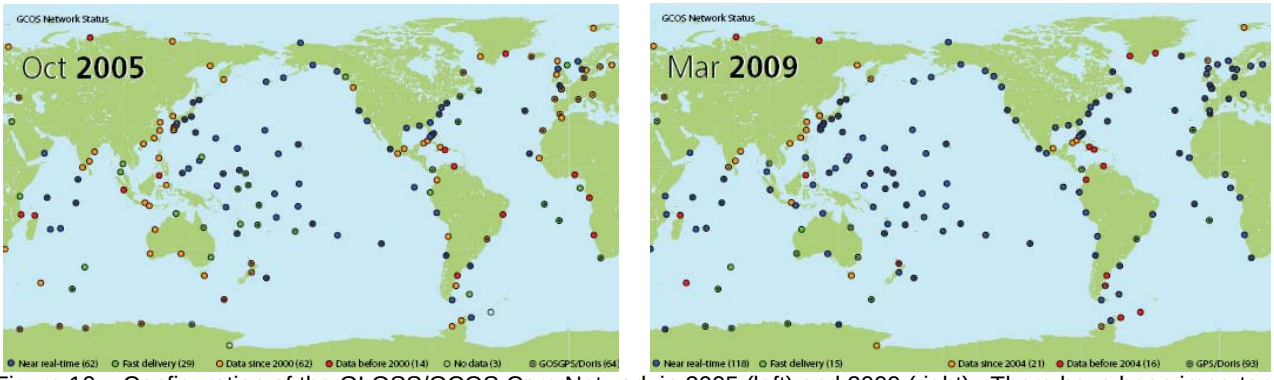

Figure 10 – Configuration of the GLOSS/GCOS Core Network in 2005 (left) and 2009 (right). There have been important improvements in the number of tide gauges reporting high-frequency data in near real-time (typically within 1 hour).

4.3 GLOSS contributes actively to the development of tsunami warning systems in the Pacific, Indian Ocean, Mediterranean and the Caribbean. Following the 2004 Indian Ocean Tsunami, more than 50 GLOSS stations in the Indian Ocean have been upgraded to real time data reporting. Several Indian Ocean countries have further densified their national sea level networks (India, Indonesia, Kenya, Maldives and Mauritius). GLOSS is working to develop the sea level networks in the Caribbean and North Africa. Progress has been slower than in the Indian Ocean due to lack of funding and the work is mainly done through national efforts.

4.4 GLOSS has sought to define land motion at tide gauges through collaborations with IGS (originally the International GPS Service for Geodynamics, now the International GNSS Service) and its TIGA project (Tide Gauge Benchmark Monitoring Project). GPS, DORIS (Doppler Orbitography Integrated by Satellite) at tide gauges are expected to increase in the coming years through specific initiatives and by the continued overall growth of the ITRF (International Terrestrial

Reference Frame). TIGA provides an important linkage of the tide gauge and geodetic communities in this effort. Results from a status survey on co-located tide gauges and continuous GPS stations are available at http://www.sonel.org/-CGPS-TG-Survey-.html. In connection with the eleventh session of the GLOSS Group of Experts (GLOSS-GE-XI, May 2009), a Workshop on Precision Observations of Vertical Land Motion at Tide Gauges was convened. The aim of the workshop was to develop a coordinated plan for a new initiative to install and upgrade continuous GPS stations co-located with critical sea level stations in the GLOSS Core Network and Long-term Time series (LTT) networks. Detailed information is available at http://ioc-goos.org/glossgexi.

4.5 The GLOSS programme has benefited recently by the collaboration of the UNESCO/IOC and the Flanders Marine Institute (VLIZ, Kingdom of Belgium) to develop a web-based global sea level station monitoring service (see http://www.ioc-sealevelmonitoring.org). The web portal provides a view of the GLOSS and other sea level datasets received in real time from different network operators and different communication channels. The service provides information about the operational status of real time sea level stations as well as a display service for quick inspection of the raw data stream. The number of stations being tracked by the web service has grown from about 25 stations at the end of 2007 to presently about 315. The tracking allows for rapid identification of malfunctioning stations and as a result, less downtime and more complete data sets. Station operators and data users have come to rely on the web portal. In light of this development the GLOSS-GE-XI decided to make the sea level station monitoring service at VLIZ a formalized GLOSS designated data facility.

4.6 The GLOSS programme supports training and technical support activities carried out with national tide gauge agencies and partner programmes including the regional tsunami warning systems. These activities included:

- Three GLOSS training courses on sea level observation and data analysis were convened in Japan, the Kingdom of Belgium and Puerto Rico. Detailed information is available at http://www.gloss-sealevel.org/training/;

- Six technical expert visits were carried out to Madagascar, Comoros, Yemen, Egypt, Senegal and Morocco;

- A visiting sea level fellowship programme in sea level science and applications was carried out in collaboration with the UNESCO/IOC Tsunami Coordination Unit for participants from Indian Ocean countries. The objective of the fellowship programme was to encourage further use of the sea level observing network for research and applications within the framework of a regional multi-purpose observing system. Thirty fellowships were awarded which provided for 1-3 month visits at selected sea level institutions in the GLOSS network. The programme seeks to strengthen links between sea level observing institutions (i.e. hydrographic and port agencies) and scientific institutions (universities, oceanographic, fisheries and environment), as well as regional and international cooperation between participating institutions are expected outcomes;

- The Proudman Oceanographic Laboratory (Liverpool, UK) provided short-term practical training in advance of tide gauge installations for participants from Iran, Pakistan, Congo and Nigeria;

- Volume IV of the UNESCO/IOC Technical Manual No. 14 on Sea Level Measurement and Interpretation was published in 2006 and is already in its third print (http://unesdoc.unesco.org/images/0014/001477/147773e.pdf).

5. ASSOCIATED PROGRAMMES

Argo profiling float programme

5.1 Argo data are used both regionally and globally in ocean and coupled assimilation models. Argo is the dominant subsurface ocean dataset for global reanalysis and prediction. Operational centres are reporting positive impacts from the early years of Argo implementation and have stressed their requirement for long-term continuation of the array for adequate evaluation.

5.2 The research community has rapidly adopted Argo and is using the data widely (more than 100 Argo-relevant papers now published per year) facilitated by Argo's open data policy. This work includes a broad range of studies of water mass properties and formation, air-sea interaction, ocean circulation, mesoscale eddies, ocean dynamics and seasonal-to-decadal variability. Argo data are also valuable in education, and activities such as development of display tools for easy viewing of Argo data highlight that ocean, atmosphere, and climate science must be an integral part of educational curricula.

5.3 International coordination and management of the Argo programme is the responsibility of the Argo Steering Team. By design, the Argo array should consist of a profiling float every 3^o latitude by 3^o longitude in the deep ice-free regions of the oceans. This distribution leads to a total requirement of about 3200 floats between 60^oS and 60^oN. The present distribution of floats by latitude, including only those providing good quality profile data, is shown in Figure 11 (black line). This is compared to the 3^o requirement (red line). Although Argo has achieved the 3000 float milestone in November 2007, presently it falls short of requirements in the southern hemisphere by about 600 floats (see Figure 12). This is because:

- Some floats are deployed in marginal seas by "Argo equivalent" programmes, and are therefore in addition to the core Argo array;
- Some floats are operating at high latitudes, additional to the core array;
- Floats deployed by Argo and Argo-equivalent programmes are sometimes at greater areal density, additional to Argo requirements;
- Some (grey listed) floats are not providing good profile data.

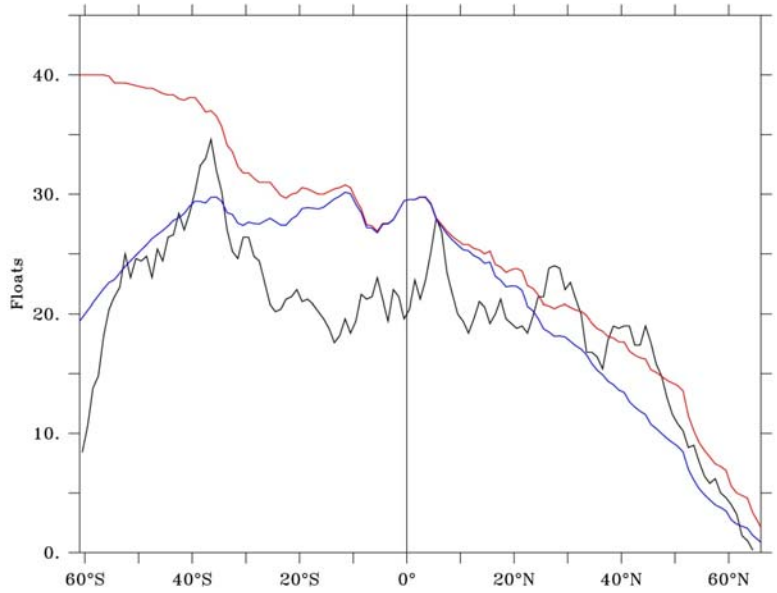

Figure 11 – The number of Argo floats per degree of latitude providing good profile data, excluding those in marginal seas, is shown by the black line. Argo's design requirement for 3^o x 3^o open ocean sampling is shown in red. The blue line indicates what would be required for equal area sampling, multiplying the red line by the cosine of latitude (Source: Argo Steering Team).

5.4 Objectives for the Argo programme in the coming years related to array performance are:

- Achieve mean float lifetimes of 4 years or longer, needed to sustain the core Argo array with 800 floats deployed per year;
- Deploy more floats in the southern hemisphere to achieve the array's design requirements;
- Extend instrument capabilities for profiling to 2,000 m everywhere in the oceans. At present, 2,427 out of 3,292 active floats are profiling to depths greater than 1,500 m.

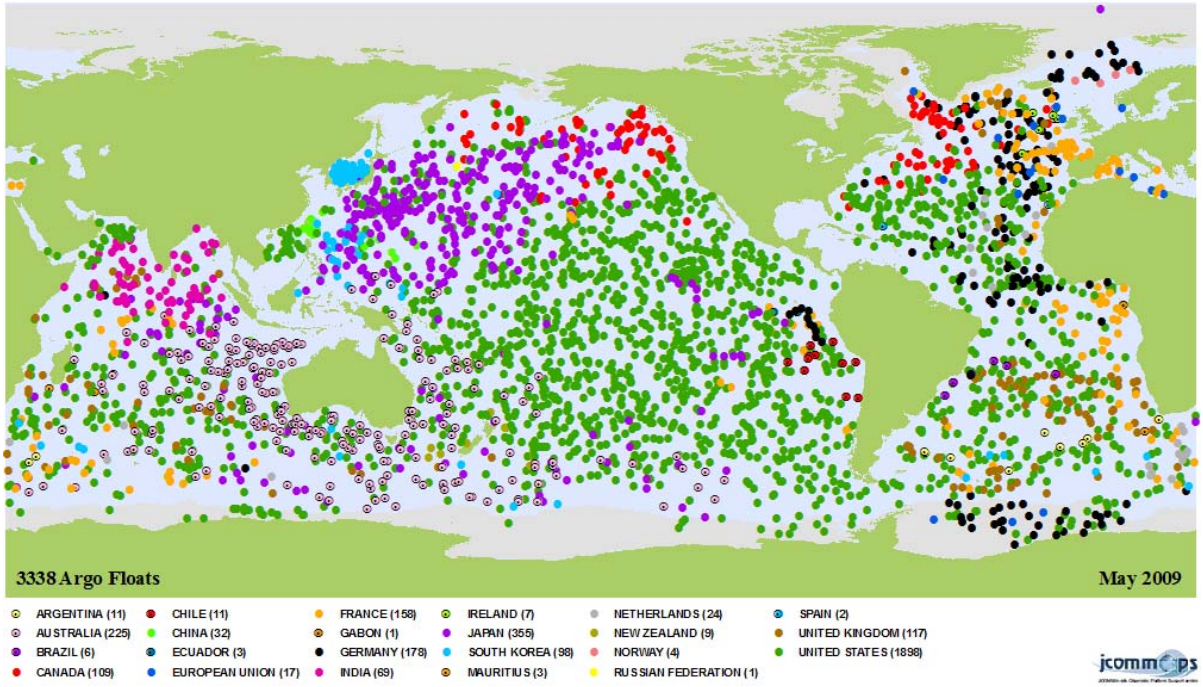

Figure 12 – Argo operational floats by country, May 2009 (Source: JCOMMOPS, Argo Information Centre).

5.5 All raw Argo data are subjected to uniform, automated quality control procedures by national Data Assembly Centres (DACs). Data are transmitted via the GTS, and submitted to the Global DACs (GDACs) within 24 hours.

5.6 Global deployment and replacement of the Argo array is a challenging issue and a significant expense. Transiting research vessels and commercial ships are used for float deployment wherever possible. However, in remote ocean regions, particularly in the South Pacific and Indian Oceans, opportunistic traffic is not sufficient. Through a collaboration of the US and New Zealand Argo programmes, a series of dedicated deployment cruises has been carried out. The future of this collaboration is uncertain due to funding limitations.

5.7 Profiling floats cost about US$ 16,000 each. This equipment cost is approximately matched by the total cost of float shipping and deployment, data transmission cost over the float lifetime, data management costs including real-time and delayed-mode quality control, programme management and coordination, and capacity building activities. Hence, for 800 floats per year the annual cost is approximately US$ 26M.

5.8 Some Argo national programmes have needed assistance in acquiring expertise in float technologies and data management including DMQC. Argo conducts technical workshops on these

topics (3 DMQC and 1 technology workshop to date), aimed at raising capacity and at standardizing practices across the programme.

5.9 Profiling float technology continues to evolve and improve substantially. In the past few years, large advances have been made in float lifetimes, and it is likely that Argo's objective of four-year mean lifetimes, has been met and may soon be substantially exceeded (see Figure 13). Ongoing efforts in float technology development are aimed at increasing float capabilities (buoyancy capacity, communications, sampling under seasonal ice) and efficiency. Future floats will be smaller and lighter, therefore easier to ship and deploy and requiring less energy for buoyancy adjustment. Development of an abyssal profiling float is under consideration.

5.10 New sensor development is an exciting area of work, with the potential to increase Argo's future value (e.g. biological and geochemical, wind, rainfall, better sampling of temperature and salinity structure in the ocean's surface layer). At present over 100 Argo floats carry oxygen sensors. However, the power drain of added sensors reduces buoy lifetime.

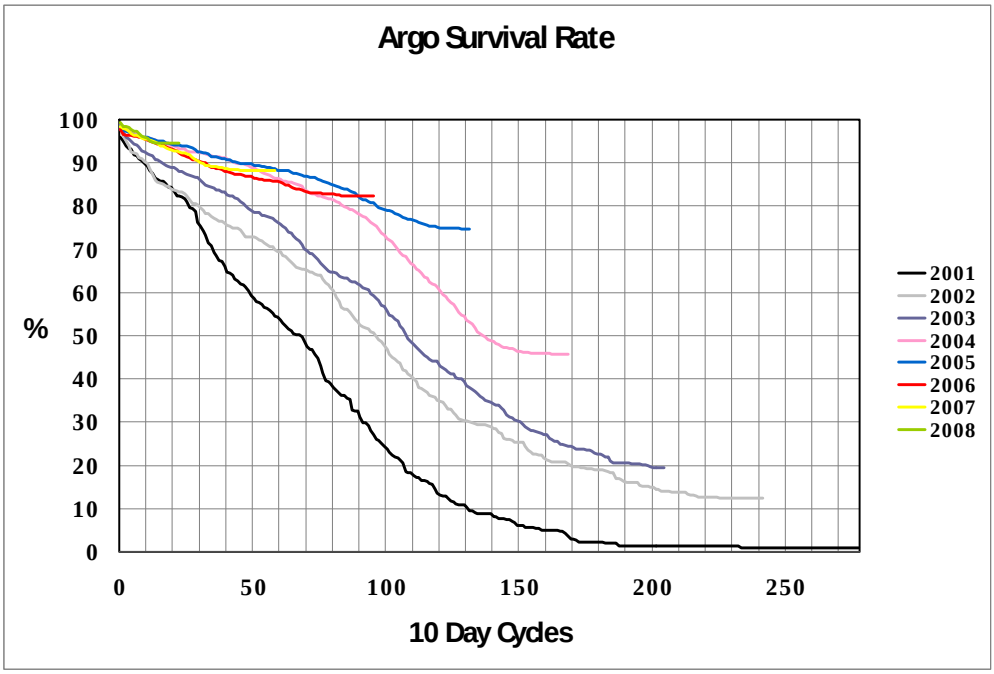

Figure 13 – Percentage of Argo floats remaining active after a given number of 10-day cycles. Each line is for a different deployment year (Source JCOMMOPS, Argo Information Centre).

OCEAN Sustained Interdisciplinary Timeseries Environment observation System (OceanSITES)

5.11 The OceanSITES is the research-driven international project working towards the coordination and implementation of a global system of sustained multi-disciplinary timeseries observatories. Operational applications of such data include detection of events, initialization and validation of assimilation products, delivery of constraints or reference data for forecasts (especially biogeochemical and ecosystem relevant ones). In addition, there are a variety of technical applications, such as calibration and validation of data and products from other observing system elements.

5.12 In most countries, the sites that contribute to the network are still supported and operated as part of research efforts and as research stations. In few cases, do routine quasi-operational sites exist, which are part of national ocean monitoring efforts. Thus, many sites are still focused on a single discipline, like air-sea fluxes, circulation, physical oceanography, biogeochemistry, downward particle flux, benthic studies, and geophysics.

5.13 Nonetheless, these disciplinary timeseries are making great progress at a scientific level. OceanSITES tries to bring these together under one umbrella and convince the operators of the value of coordinating their efforts, of sharing techniques or experiences and logistics and of making the data publicly available.

5.14 While many science-driven timeseries observatories do not report data in real time, allowing data recovery only after instrument/mooring recovery, OceanSITES is advocating for data telemetry on as many moorings as possible. Technological developments under way may make this more feasible in the near future.

5.15 The data system has to provide data from all global sites. Products and indicators have to be provided on the OceanSITES website. OceanSITES is now operating two Global Data Assembly Centres (GDACs) in France and in the US. QC levels and procedures are being established, as well as best practices. Two working groups have been formed for physical/met data and for biogeochemical data. A Project Office with half-time support was established with the cooperation of the DBCP and JCOMMOPS. Figure 14 provides the status of the OceanSITES network in August 2009.

5.16 A new short-term objective of OceanSITES is to establish a core/backbone set of sites that have a minimal set of common observations, serving all disciplines and many potential users with some basic information.

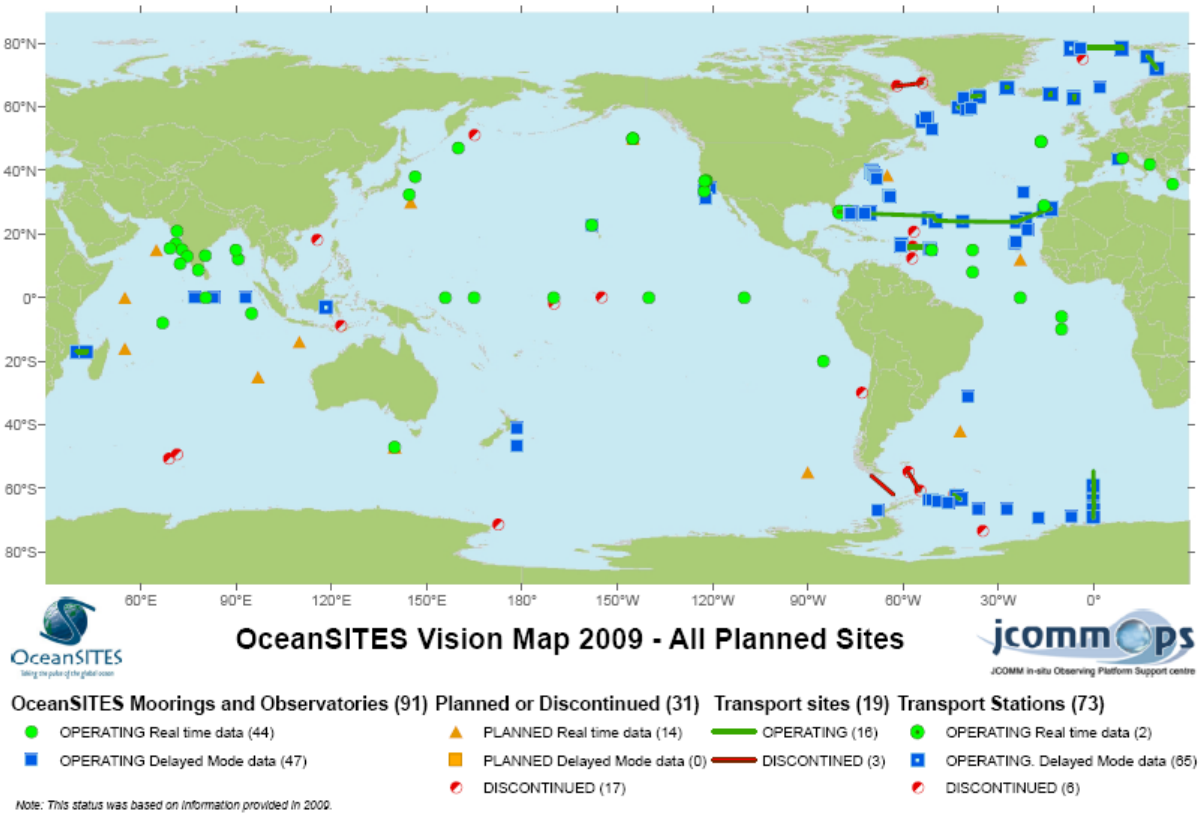

Figure 14 – Status of the OceanSITES network, August 2009 (Source: OceanSITES Project Office).

International Ocean Carbon Coordination Project (IOCCP)

5.17 The IOCCP promotes the development of a global network of ocean carbon observations for research through technical coordination and communications services, international agreements on standards and methods, and advocacy and links to the global observing systems. The IOCCP is co-sponsored by the UNESCO/IOC and the Scientific Committee on Oceanic Research (SCOR).

5.18 The surface ocean partial pressure of CO_2, pCO_2, is a critical parameter of the oceanic inorganic carbon system because it: (i) determines the magnitude and direction of the exchange of CO_2 between the ocean and atmosphere; and (ii) is a good indicator for changes in the upper ocean carbon cycle. In addition, it is an oceanic parameter that can be routinely measured with high accuracy and precision. First measurements of pCO_2 have been initiated in the early 1960s, and the sampling network has grown substantially since then. However, single investigators so far have driven most efforts, while only recently international coordination efforts, largely led by IOCCP, have been initiated. As a result, the international network of surface pCO_2 observations is in the early stages of development. Current network activities include: (i) approximately 45 sustained programmes underway measuring pCO_2; (ii) automated drift buoys (typically 5-10 operating at any given time); (iii) approximately 35 surface time series stations; and (iv) international planning and coordination provided by the IOCCP.

5.19 Although this network has provided the basis for estimating the climatological air-sea fluxes of CO_2, the observations are inadequate to resolve year-to-year variations and to provide flux estimates at any resolution higher than several hundred kilometres.

5.20 Issues relative to the development of an integrated and operational network to meet GCOS needs are:

- Improved technology/automation for on-board systems including careful calibration;
- Development of an internationally-agreed implementation strategy to identify priorities for the sustained system;
- Sustaining priority trans-basin programmes and development of new programmes according to implementation strategy priorities;
- Investigations of potential objective mapping routines and interpolation techniques including remote-sensing and model-data assimilation. Auxiliary observations that have proven to be particularly useful are sea-surface temperature, mixed layer depth, and surface chlorophyll.

5.21 The IOCCP-CLIVAR Global Ocean Ship-based Hydrographic Investigations Panel (GO-SHIP) was developed to bring together interests from physical hydrography, carbon, biogeochemistry, Argo, OceanSITES, and other users and collectors of hydrographic data to develop guidelines and advice for the development of a globally coordinated network of sustained ship-based hydrographic sections that would become an integral component of the ocean observing system. These guidelines, including a strategy for the next global survey, were presented at the OceanObs'09 conference and the community consensus was to move forward with the development of a sustained coordination effort for repeat hydrography. The IOCCP and CLIVAR have developed an oversight committee to move this forward with the goal of presenting a plan for a sustained coordination effort to the next session of the IOC Executive Council for endorsement. The GO-SHIP revision of the 1994 WOCE Hydrographic Program Manual will be published electronically in January 2010. Figure 15 shows the recommended hydrographic sections for the sustained survey.

5.22 The Surface Ocean CO_2 Atlas Project (SOCAT) is planning to provide for a global surface CO_2 data set that would bring together, in a common format, all publicly available pCO_2 data for the surface oceans, and serving a wide range of user communities. This data set will serve as a foundation upon which the community will continue to build in the future, based on agreed data and metadata formats and standard 1st-level quality-control procedures, building on earlier agreements established at the 2004 Tsukuba workshop on "Ocean Surface pCO_2 Data Integration

and Database Development". The data set will be published as a 2nd-level quality controlled, global surface ocean fCO_2 (fugacity of CO_2) data set following agreed procedures and regional review.

5.23 Other recent IOCCP activities include:

- Changing Times Inventory – developing a multi-platform inventory of carbon and biogeochemistry time series measurements, including coastal and non-Eulerian observations;

- Guide of Best Practices for Ocean Acidification Research and Data Reporting – to be published in late 2009;

- Partners in the EU Carbon Observing System Coordination (COCOS) – to improve interoperability of carbon observations and data streams between the land, air, and ocean domains;

- Ocean carbon sensor directory – development and maintenance of an on-line directory of the most often used carbon and related sensors and systems.

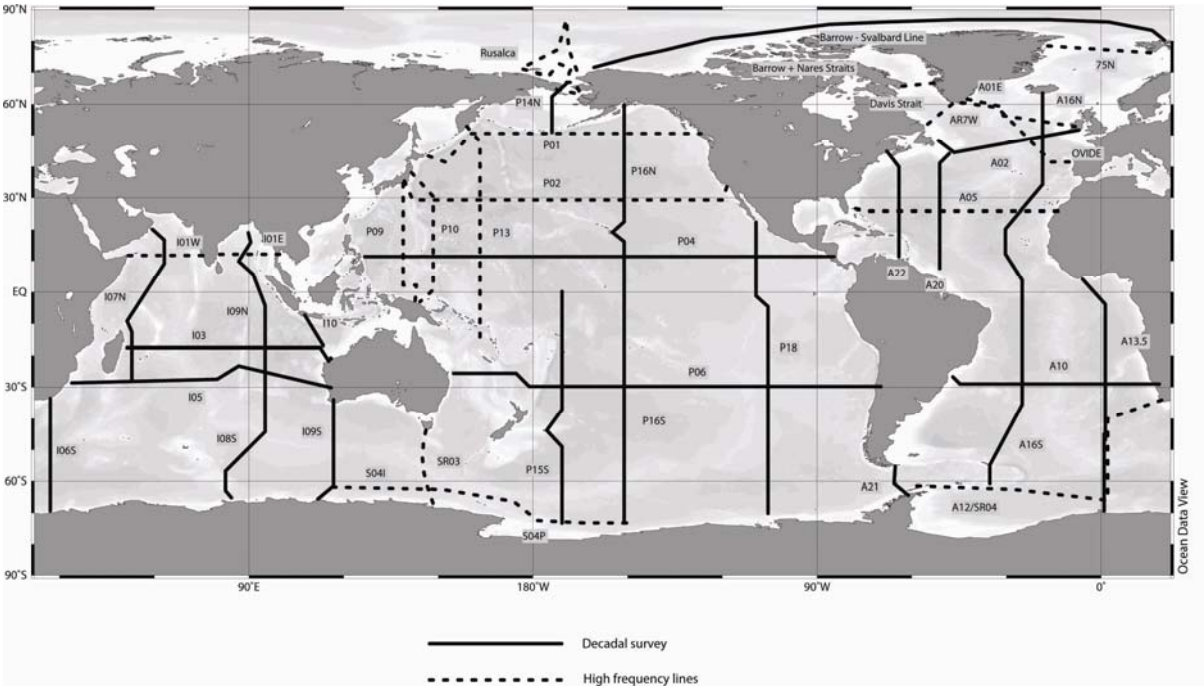

Figure 15 – Recommended hydrographic sections for the sustained decadal survey (solid lines) and high-frequency sections (dashed lines).

6. REMOTE SENSING

6.1 Much progress has been achieved in the last ten years for addressing the ocean community requirements for satellite data. For example, satellite altimetry is now permitting near real time ocean mesoscale forecasting; scatterometers address the requirements for tropical and extra-tropical high-wind warnings for mariners; GHRSST products enable better ocean/NWP forecasts and flux products for ocean research; and imagery permits the monitoring of sea-ice extent. However, efforts remain to be made to ensure the sustainability of some of the satellite missions. This issue should be addressed nationally, with a view to increasing national support to space programmes contributing to ocean observations. In addition, ground-based ocean remote sensing systems, including in particular High Frequency (HF) and nautical radars, are assuming increasing importance in a number of operational and research applications.

7. INTEGRATION OF IN SITU AND SATELLITE SYSTEMS

7.1 Following a recommendation by the JCOMM Cross-cutting Team on Satellite Data Requirements, a document that provides for an integrated (space and *in situ*) observing strategy for a number of geophysical variables is being produced. This document should cover the current use of space and in situ observations in existing products and services (derived from known sources), including tables of current requirements by variable. It will aim to articulate a singular set of observing requirements for JCOMM for key ocean variables covering applications such as near-real time marine operations, NWP, climate monitoring, and research. Its scope should include: Sea Surface Temperature, Sea Surface Salinity, Sea Surface Height (including sea state), Surface Vector Winds (including wind stress), Ocean Colour (chlorophyll-a) and Sea Ice (Extent). It should highlight similarity and differences in operational and research requirements. The key content will be the *JCOMM Strategy* for a *unified set of requirements* for each variable, and consequences for an idealized observing system, where such requirements are fully realized.

8. PERFORMANCE METRICS

8.1 Quarterly Observing System Status reports are developed and used to monitor progress and evaluate the effectiveness of the system for observing ECVs (see Figure 16). Currently metrics are routinely made for four ECVs (sea surface temperature, temperature profiles, sea surface salinity and salinity profiles), and on an experimental basis for several more ECVs. A major goal of the OCG workplan for the next intersessional period will be to work with the Ocean Observation Panel for Climate (OOPC) on metrics for other ECVs that integrate *in situ* and satellite observations.

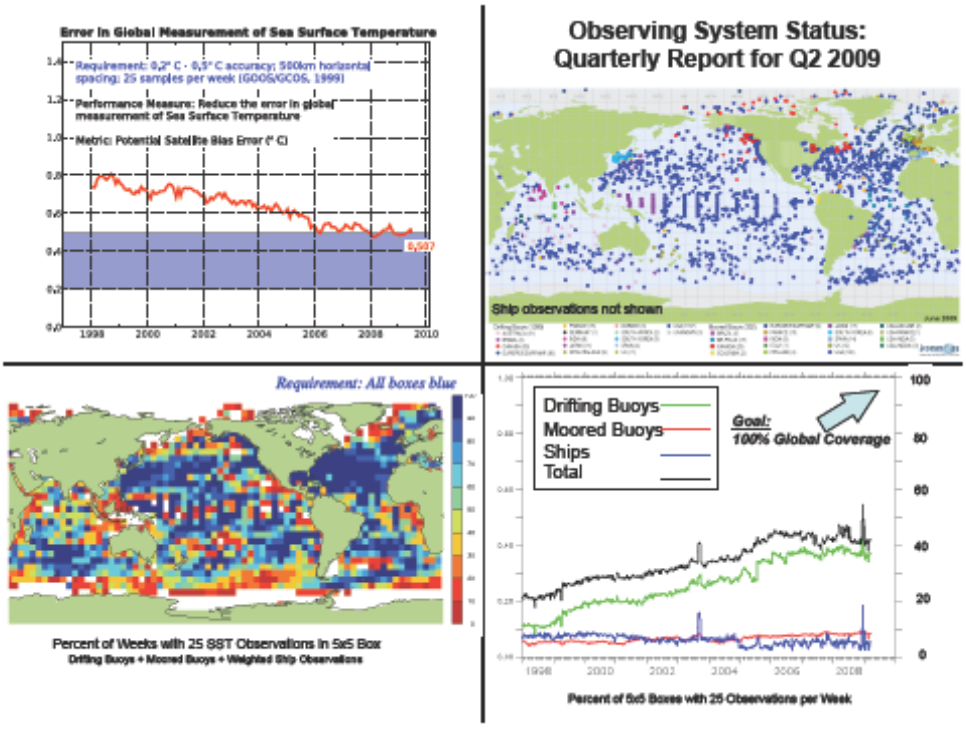

Figure 16 – This example for the second quarter of 2009 shows that 41% of the ocean is presently being observed adequately for measurement of sea surface temperature to the required accuracy

9. TECHNICAL COORDINATION AND MONITORING

9.1 The JCOMM *in situ* Observing Platform Support Centre (JCOMMOPS) provides technical coordination across the OPA observing networks, following the direction of the DBCP, SOT, Argo Steering Team, the cross-cutting Team on Satellite Data Requirements, and more

recently the OceanSITES program (see http://jcommops.org). JCOMMOPS, established at JCOMM-I in 2001 aims to:

- Assist as appropriate in the implementation of the global ocean observing system and benefit from commonalities between the systems;
- Assist in the planning, implementation and operations of the observing system;
- Monitor and evaluate the performance of the networks;
- Encourage data sharing, cooperation between communities and Members/Member States and assist in data distribution on the Internet and GTS;
- Relay user feedback on data quality to platform operators;
- Encourage harmonization of data and instrumentation related practices;
- Provide a focal point for technical assistance and user support worldwide.

9.2 As requested at JCOMM-II (Halifax, September 2005), a thorough review was made of JCOMMOPS as part of a process to evolve into a more integrated technical coordination mechanism. The results of this review showed that JCOMMOPS, with its two technical coordinators,

- Was supporting the programmes and the people responsible for each national or regional contribution on a wide range of issues;
- Had begun to integrate the technological infrastructure and network reporting for the DBCP and the Argo Information Centre; and
- Had incorporated technical coordination of SOT and OceanSITES since JCOMM-II, and offered *ad hoc* support for other observing platforms (e.g., tide gauges (GLOSS), CTD mounted on marine mammals (MEOP), ice-tethered profilers).

9.3 JCOMMOPS has been successful in providing rigorous monitoring of the networks; improving day to day assistance; providing a key focal point to oceanographers and marine meteorologists worldwide; and encouraging cooperation with developing countries (e.g., through platform donor programmes and training workshops).

9.4 JCOMMOPS and the OCG have developed standard base maps showing required global coverage against what is presently in place to evaluate observing system status and effectiveness; and to develop summary reports illustrating how advancements toward global coverage improve the adequacy of the observation information (see Figures 17 and 18).

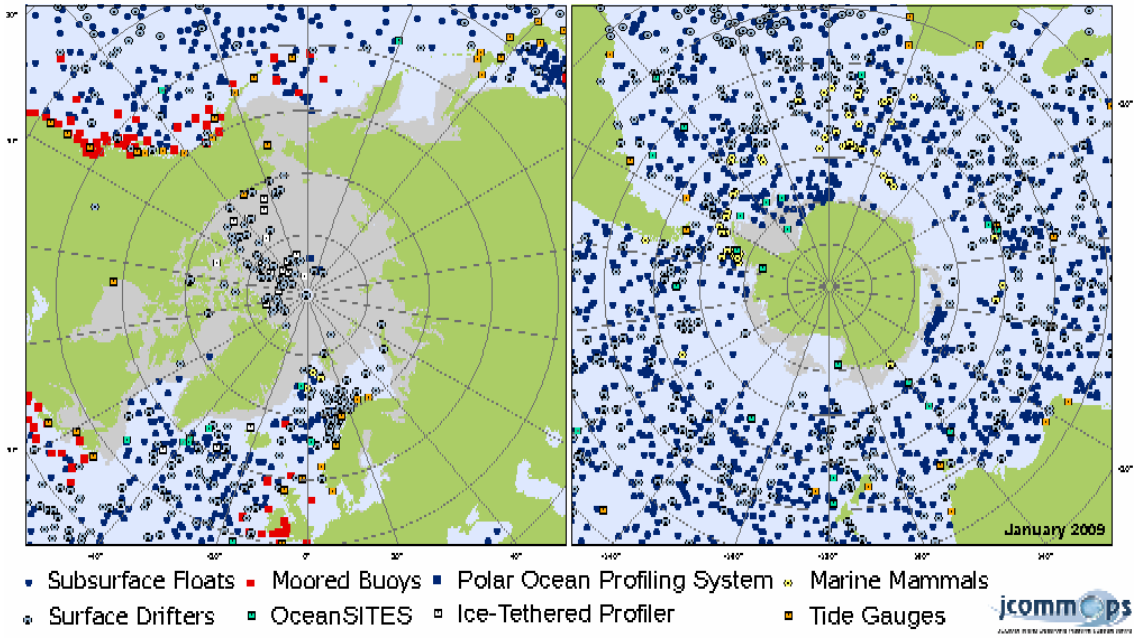

Figure 17 – These two polar views show the mix of platforms that form the integrated global ocean observing system.

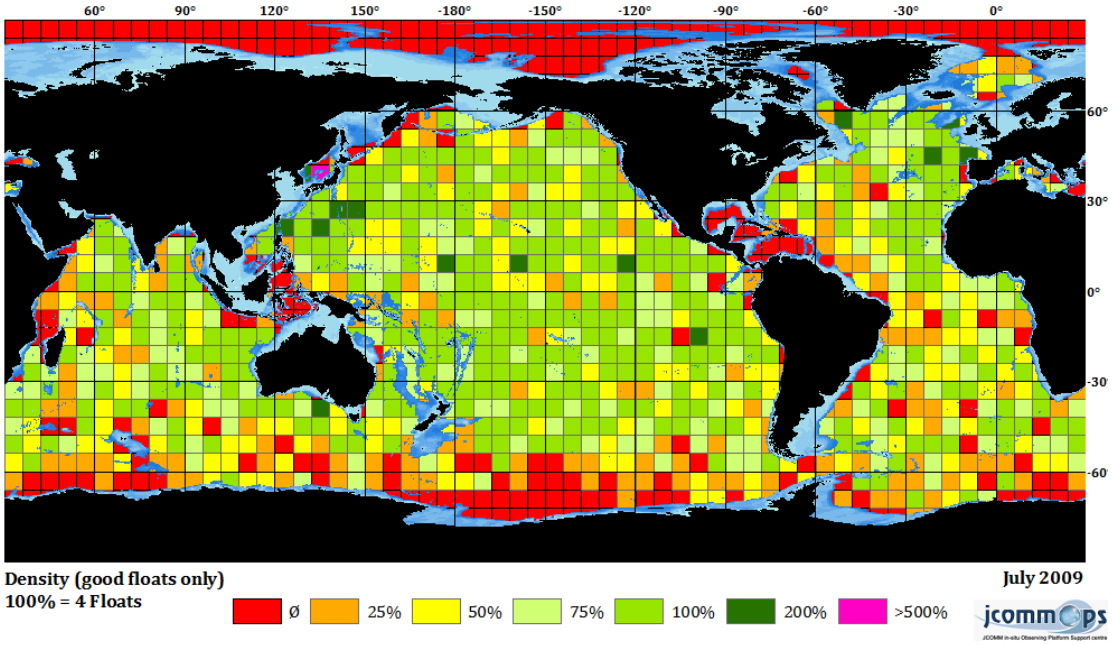

Figure 18 – Argo Network Density on a 6°x6° grid normalized on the 3°x3° Argo standard (100% means here 4 floats operating in a box).

9.5 JCOMMOPS cooperates closely with the Observing System Monitoring Centre (OSMC – see http://osmc.info) to develop near-real-time monitoring tools for use by observing system managers. Both of these centres access different data streams for monitoring (GTS and Global Data Centres) so can compare and check for discrepancies and synchronize their metadata. While JCOMMOPS maintains each individual platform metadata and provides the status of each network, the OSMC focuses on reporting the state of the ocean by demonstrating how the requirements are met in terms of variables and timeframes across all *in situ* ocean observing systems (see Figures 19 and 20).

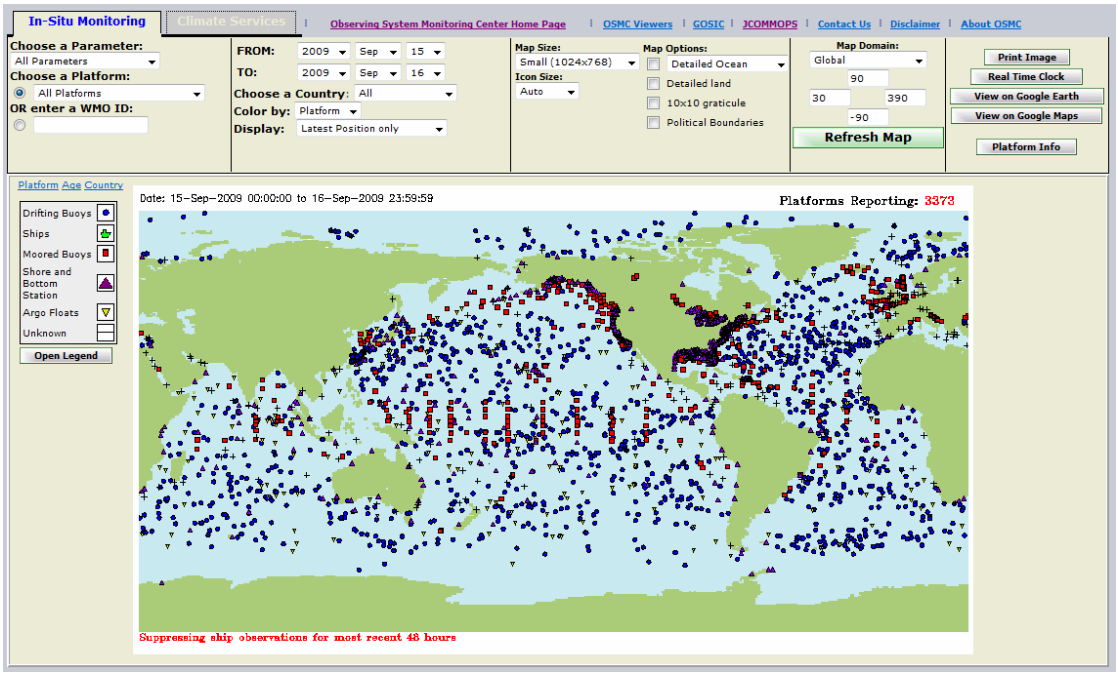

Figure 19 – The OSMC allows users to monitor observing system status in near-real-time (the database is updated daily) and sort platform reports by country, variable, time frame and platform type.

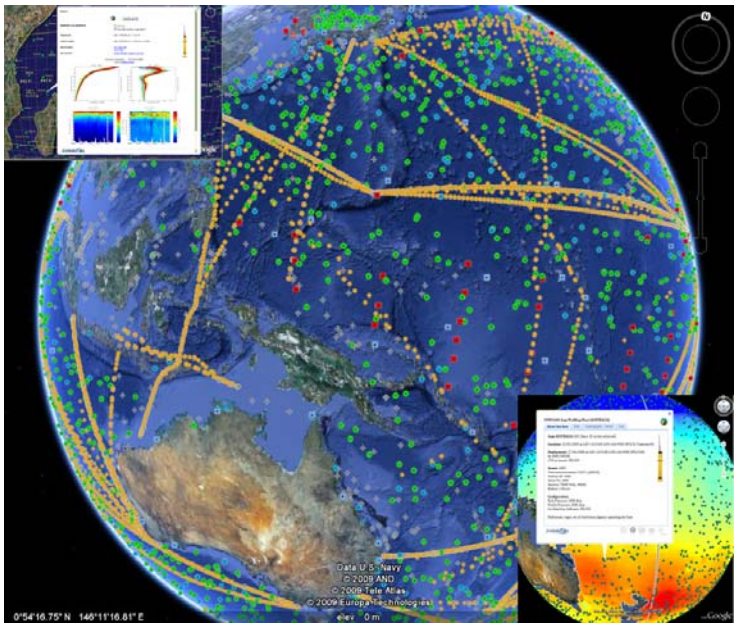

Figure 20 – JCOMMOPS uses online GIS–based mapping tools for real-time tracking of ocean platforms and is now working on a partnership with Google to include JCOMM observing system status in Google Ocean.

9.6 JCOMMOPS is funded through national contributions from Members/Member States; however JCOMMOPS requires a more stable financial base to allow it to grow and develop. The Observing Panels supporting JCOMMOPS will keep seeking new national contributions to sustain the existing level of support. Without significant additional resources it will be hard to integrate any other observing network into the work of JCOMMOPS.

9.7 Additionally, JCOMMOPS has identified the need for international and technical coordination of ship-related activities. Extra resources are sought to support a full time technical coordinator to facilitate maintenance and operations of the observing networks through logistics coordination; develop more cooperation between programmes (e.g., shared cruises, ship time); further develop float/buoy donation programmes; and identify new regional deployment

opportunities. All observing programmes would benefit from this technical coordination, and Members/Member States are urged to identify appropriate resources.

9.8 Members/Member States involved in JCOMM are invited to strengthen their support for the centre, which has demonstrated its value to the implementation of the ocean observing networks it supports.

10. MEETINGS HELD SINCE JCOMM-II

10.1 The following meetings were held to address work of the OPA since JCOMM-II. Reports for these can be downloaded from http://www.jcomm.info/OPA_publications:

- Twenty-first Session of the Data Buoy Cooperation Panel, Buenos Aires, Argentina, October 2005;
- First Session of the IOCCP Scientific Steering Group, Broomfield Colorado, USA, October 2005;
- International Repeat Hydrography and Carbon Workshop, Shonan Village, Japan, November 2005;
- Seventh Argo Science Team Session, Hyderabad, India, January 2006;
- OceanSITES Steering Team Meeting, Hawaii, USA, February 2006;
- Second Argo Science workshop, Venice, Italy, March 2006;
- Third International Port Meteorological Officers Workshop (PMO-III), Hamburg, Germany, March 2006;
- DBCP data users and technology workshop, Reading, United Kingdom, March 2006;
- Ninth Meeting of the GOOS Scientific Steering Committee, Paris, France, March 2006;
- GLOSS training courses, Tokyo, Japan, May 2006;
- Eleventh session of the Ocean Observations Panel for Climate, Tokyo, Japan, May 2006;
- Twenty second session of the Data Buoy Cooperation Panel (DBCP), La Jolla, USA, October 2006;
- Third Forum of the GOOS Regional Alliances, Cape Town, South Africa, November 2006;
- WMO-IMO Consultative meeting, Geneva, Switzerland, February 2007;
- Eighth Session of the Argo Steering Team, Paris, France, March 2007;
- Tenth Meeting of the GOOS Scientific Steering Committee, Seoul, Republic of Korea, March 2007;
- Fourth session of the Ship Observations Team (SOT-IV), Geneva, Switzerland, April 2007;

- Second Session of the JCOMM Observations Coordination Group (OCG), Geneva, Switzerland, April 2007;
- Second Session of the IOCCP Scientific Steering Group, Paris, France, April 2007;
- Twelfth session of the Ocean Observations Panel for Climate, Paris, France, May 2007;
- Tenth session of the GLOSS Group of Experts, Paris, France, June 2007;
- DBCP/IODE/ODINAFRICA Training Course on Buoy Programme Implementation and Data Management, Ostend, Belgium, June 2007;
- Eighth session of the IOC-WMO-UNEP Intergovernmental Committee for GOOS, Paris, France, June 2007;
- Twenty-third Session of the Data Buoy Cooperation Panel, Jeju, Republic of Korea, October 2007;
- First meeting of the Global Ocean Ship-based Hydrographic Investigations Panel, Victoria, Canada, November 2007
- XBT fall rate equation workshop, Miami, USA, March 2008;
- Ad-hoc planning meeting for the JCOMM Pilot Project for WIGOS, Ostend, Belgium, March 2008;
- Ninth Session of the Argo Steering Team, Exeter, United Kingdom, March 2008;
- OceanSITES Steering committee meeting, Vienna, Austria, April 2008;
- Eleventh meeting of the GOOS Scientific Steering Committee, Paris, France, April 2008;
- First meeting of the Task Team on Delayed Mode VOS Data (TT-DMVOS), Gdynia, Poland, May 2008;
- Thirteenth session of the Ocean Observations Panel for Climate, Buenos Aires, Argentina, June 2008;
- Informal meeting of the META-T Pilot Project Steering Team, Geneva, Switzerland, September 2008;
- First Meeting of the Joint Steering group for the IODE Ocean Data Portal and the WIGOS Pilot Project for JCOMM, Geneva, Switzerland, September 2008;
- JCOMM Technical Workshop on Wave Measurements from Buoys, New York, USA, October 2008;
- Twenty-fourth Session of the Data Buoy Cooperation Panel (DBCP), Cape Town, South Africa, October 2008;
- Third IOCCP Scientific Steering Committee Meeting, Villefranche-sur-mer, France, October 2008;

- Twelfth Session of GOOS Scientific Steering Committee Meeting, Perth, Australia, February 2009;
- Third Session of the JCOMM Observations Coordination Group, Paris, France, March 2009;
- Tenth Session of the Argo Steering team, Hangzhou, China, March 2009;
- Third Argo Science Workshop: The Future of Argo, Hangzhou, China, March 2009;
- Eleventh Session of the GLOSS Group of Experts, Paris, France, May 2009;
- Fifth Session of the JCOMM Ship Observations Team (SOT), Geneva, Switzerland, May 2009;
- Meeting of the Steering committees of the Pilot Projects on Wave measurement Evaluation and Test, and Wave Measurements from drifters, San Diego, USA, May 2009;
- Ninth Session of the IOC-WMO-UNEP Intergovernmental Committee for GOOS, Paris, France, June 2009;
- OceanOBS'09 Conference, Venice, Italy, September 2009;
- OceanSITES Steering Committee and Data Management Team meeting, Venice, Italy, September 2009;
- Twenty-fifth Session of the Data Buoy Cooperation Panel (DBCP), Paris, France, September/October 2009;
- Second meeting of the Joint Steering group for the IODE Ocean Data Portal and the WIGOS Pilot Project for JCOMM, Ostend, Belgium, October 2009.

_____

BACKGROUND MATERIAL

Best practices for Instruments

1. As part of the efforts to produce a JCOMM Catalogue of Best Practices and Standards, a consultant was recruited to address integration issues, i.e. identifying compatibilities, avoiding duplication of information, proposing higher levels of standards, including joint WMO-ISO standards. Several instrument related documents are concerned in this process [see agenda item 11.2 for details].

2. The DBCP has been addressing instrument evaluation issues through the work of its Task Team on Instrument Best Practices and Drifter Technology Developments, as well as the Pilot Project on Wave measurement Evaluation and Test from moored buoys (PP-WET). In particular the DBCP is undertaking the following: (i) review and recommendation on best practices; (ii) evaluation of specific technical issues in order to facilitate standardization; and, (iii) proposal on buoy design changes for better performance, and for extended coverage of Essential Climate Variables including pressure and surface wave height/direction.

3. The SOT produced “Instrument Standards Guidelines” that include a list of corresponding WMO, IOC, and national publications for each of the SOT programme components. The fifth SOT session also made specific recommendations following the 2008 intercomparison of Electronic Logbooks.

Regional Marine Instrument Centres (RMIC)

4. The WIGOS Pilot Project for JCOMM [agenda item 10.2] is proposing establishing Regional Marine Instrument Centres (RMIC). Candidate RMICs would be required to produce a statement of requirements, list capabilities of the proposed centre, state the formal commitment to voluntarily host the centre, and demonstrate capability to JCOMM. Following possible agreement by JCOMM, the WMO and UNESCO/IOC Executive Councils would be invited to approve new RMICs. Regular review of the RMIC capabilities would be organized by JCOMM.

_____

BACKGROUND MATERIAL

Cost-effective global in situ wave observing technology

1. In October 2008, JCOMM, through a joint undertaking of its Data Buoy Cooperation Panel and the Expert Team on Wind Waves and Storm Surge, organized a Technical Workshop on Wave Measurements from Buoys (http://www.jcomm.info/wavebuoys). This Workshop recognized and supported the recent work carried out in the development of the US Integrated Ocean Observing System (US IOOS) Operational Wave Observation Plan, and recommended that appropriate elements of that plan be adapted and extended to an international context within JCOMM to enhance global wave observation programmes.

2. The Workshop examined the issues surrounding the derivation of quality wave spectral data from data buoys in general, both moored and free-drifting. Based on the recommendations by the Workshop, the DBCP at its 24th session (Cape Town, October 2008; http://www.jcomm.info/DBCP24) agreed to initiate a Pilot Project to examine the feasibility of making open ocean 2-D wave spectral measurements from inexpensive drifting buoys. In particular, the need was expressed for the validation of wave spectral outputs from both satellite observations and numerical models, and it was felt that inexpensive and suitably instrumented free-drifting buoys offered the best way forward. In this context, it was noted that a un-drogued spherical drifter (e.g. the SVP) exhibited good wave following properties, and that relatively simple GPS techniques had been demonstrated for the inference of 2-D wave spectral data. Consequently, the DBCP Pilot Project on Wave Measurement from Drifters (PP-WMD) was established at the DBCP session in late 2008 with the aim of investigating the validity of GPS techniques and, if encouraging, to proceed to the construction, evaluation and deployment of a small fleet of GPS-equipped wave drifters in support of model forecasts and satellite observation of 2D wave spectral data. The project will run for a maximum of three years, under the control of a scientific steering committee, which met at Scripps in May 2009 to draw up and implement an action plan for the first phase of the project.

3. One of the key recommendations of the workshop was that continuous testing and evaluation of wave measurement systems is an essential programme activity, of equal importance to the deployment of new assets; multiple locations are required to evaluate appropriately the performance of wave measurement systems given the wide spectrum of wave regimes that are of interest. A Pilot Project on Wave Measurement Evaluation and Test (PP-WET) was proposed and subsequently endorsed and supported by the 24th Session of the DBCP for an initial period of two years. The objectives of the Pilot Project included the development of an international framework for the continuous testing and evaluation of existing and planned wave buoy measurements, coordination of buoy inter-comparison activities, development of technical documentation on wave measurement systems, training material and contribution of appropriate material to the JCOMM Catalogue of Best Practices and Standards. A Steering Committee comprised of a wide representation from end-users, wave experts, buoy manufacturers, and buoy operators was established. In May 2009, the PP-WET Steering Committee established the protocols for intercomparison activities, and developed a contribution to the Community White Paper on wave measurement for the OceanObs09 conference in Venice. A special session on wave measurement was organized as part of the 11th International Workshop on Wave Hindcasting and Forecasting (Halifax, Canada, October 2009) to further develop guidelines and participation in the Pilot Project (http://www.waveworkshop.org).

4. Status reports of the two pilot projects were presented to DBCP-XXV (Paris, September 2009) and can be downloaded at http://www.jcomm.org/DBCP25.

Data Telecommunication via Satellites

5. A number of pilot activities have been initiated by the Observations Programme Area during the intersessional period concerning satellite data telecommunication, resulting in significant positive results. The DBCP has established two Pilot Projects to evaluate and test: (i) Iridium satellite data telecommunication; and (ii) Argos-3 technology, and the SOT has been testing Iridium. Both Iridium and Argos-3 technologies provide for the downlink capability. From these activities, it is expected to improve data throughput, and timeliness, as well as better control of the drifter on-board data processing for troubleshooting and diagnostic or for setting some metadata fields remotely (e.g. barometer height on a ship), to provide better data and increase the instruments life-time.

6. Since the inception of the DBCP Iridium Pilot Project in early 2007, more than 130 Iridium-equipped SVPB drifters have been deployed, of which approximately 80 were still active in mid-2009 and reporting hourly data on the GTS. In order to stimulate the rollout of the project, the Panel has from the beginning offered to cover the nominal costs (USD 500) of upgrading a traditional Argos-equipped buoy to Iridium + GPS. To date, nearly 50 buoys, supplied by four manufacturers, have benefited from this upgrade offer. Overall, the Panel is very satisfied with the progress of the project, both in terms of the number of platforms deployed, and the progress that is being demonstrated in reducing satellite usage costs and improving data timeliness and quantity. A number of agencies, principally Météo-France and CLS Argos Toulouse, are performing GTS formatting and insertion of the data although NOAA NDBC has also demonstrated capability in this area. At its twenty-fourth session (Cape Town, October 2008) the DBCP agreed to extend the project for a further year to allow the geographic coverage of the deployments to be extended, thus permitting a truly global evaluation of Iridium-equipped buoys. For further information about the project, including interactive maps, refer to http://www.jcommops.org/dbcp/iridium-pp/.

7. The Argos-3 Pilot Project was initiated at the twenty-fourth DBCP Session following an offer from CLS to commit complete drifters to the Argos-3 Pilot Project. The DBCP has also been providing some financial support for upgrading Argos-3 buoys with barometers. Ten Argos-3 prototypes have been deployed at sea as of mid-2009, in various conditions and regions.

8. The SOT has also been evaluating the Iridium satellite data telecommunication system for the collection of data from VOS, SOOP, and ASAP ships. In addition, the SOT has produced a spreadsheet, which compares the relative cost advantages and limitations of Inmarsat, Iridium, and Meteosat transmission systems proposed for Automatic Weather Stations. Short Burst Data (SBD) transmission costs associated with the Iridium system currently offer notable savings when compared to other systems. The Iridium, with a two-way communication ability and global coverage, is now being used for a number of different shipborne AWS systems. The E-ASAP decided to change the satellite communication from Inmarsat-C to Iridium. First implementations and tests showed promising results, and for transmission of high-resolution BUFR data.

9. It is generally acknowledged that the Iridium is increasingly being used and proved to be cost-effective and reliable for transmitting buoy and ship observations compared to systems traditionally used such as Argos (for drifters) and Inmarsat (for ships).

_____

BACKGROUND MATERIAL

1. At its session in September 2005, Halifax, Canada, the JCOMM-II recommended a review of the JCOMM *in situ* Observing Platform Support Centre (JCOMMOPS). Hence, the OCG initiated a process to review usefulness and effectiveness of JCOMMOPS. Since then substantial discussions have taken place, not only with those Panels presently supporting JCOMMOPS (for example the Data Buoy Cooperation Panel (DBCP), the Ship Observations Team (SOT), and the Argo profiling float programme), but also with the JCOMM Management Committee, the JCOMM Observations Coordination Group, and the Observing Panels that could potentially benefit from the support and services of JCOMMOPS. These also include the Partnership for Observation of the Global Oceans (POGO), the UNESCO/IOC International Ocean Carbon Coordination Project (IOCCP), the Global Sea-level Observing System (GLOSS), and the Ocean Sustained Interdisciplinary Timeseries Environment observation System (OceanSITES). Meeting reports of the OCG and its Observing Panels are available at http://www.jcomm.info/Publications.

2. These discussions confirmed the value of JCOMMOPS, leading to a general agreement that JCOMMOPS was very useful in providing effective support towards the implementation of *in situ* ocean observing systems under its responsibility, and that there was an urgent need for an expanded Observing Programme Support Centre (OPSC). The extended JCOMMOPS activities should include system performance monitoring, system design evaluation, and authority to recommend deployments to improve system efficiency and effectiveness. This could provide synergies for functions that are now distributed, and make available a more integrated framework for the deployment and further development of ocean observing networks.

3. A joint WMO-IOC circular letter was issued in September 2007 to call for the submission of Letters of Intent (LOI) to host a JCOMM Observing Programme Support Centre (OPSC). Fifteen Letters of Intent had been received by the Secretariat and objectively evaluated by a committee led by the JCOMM co-presidents. Evaluation was made in two steps. In the first step, a short list of five candidates was proposed for undergoing further evaluation. In the second step, the Evaluation Committee was extended by the JCOMM Management Committee to include representatives from the Argo Steering Team, the DBCP, the SOT, OceanSITES, the IOCCP, GLOSS, WIGOS, the OOPC and the WMO and the UNESCO/IOC Secretariats. The Evaluation Committee then engaged in a negotiation with the top-ranking institution resulting in a final decision made by the Executive Secretary of UNESCO/IOC and the Secretary-General of WMO to select the proposal from …… [*decision still to be taken at the time of the submission of this report*].

_____

PROGRESS/ACTIVITY REPORT

1. INTRODUCTION

1.1 The Data Management Programme Area (DMPA) Coordination Group (DMCG) was very active during the intersessional period in responding to the work programme as defined at JCOMM-II (Halifax, Canada, September 2005) and endorsed by both the WMO and the UNESCO/IOC Executive Councils (June 2006), in undertaking activities that arose after JCOMM-II, and in addressing the responsibilities embodied in the GCOS Implementation Plan. Detailed information on DMPA activities is available at http://www.jcomm.info/DMPA.

1.2 There has been an increasing close cooperation with IODE of UNESCO/IOC in the intersessional period, not only through the jointly managed ETDMP, but also through the various activities undertaken, including the Ocean Data Standards Pilot Project (ODS) and the WIGOS Pilot Project for JCOMM. In order to promote a greater cooperation, the outgoing JCOMM Management Committee recommended that one of the present co-chairs of IODE of UNESCO/IOC be nominated for the DMPA coordinator.

2. DATA MANAGEMENT

2.1 Both the GCOS and Recommendation 6 (JCOMM-II) set down the requirements for the development of a Data Management Plan. This development occurred in the first part of the intersessional period and has been published as JCOMM Technical Report No. 40, and can be downloaded from http://www.jcomm.info/DMPlan. This Plan provides general recommendations that were translated into specific and detailed actions as given in http://www.jcomm.info/dmp-id. The Data Management Plan will be updated taking into account discussions at the JCOMM-III, in order to ensure its alignment with the WMO and UNESCO/IOC strategic planning and the outcomes of OceanObs'09. The status of DMPA actions against the GCOS Implementation Plan is documented at http://www.jcomm.info/DMPA-GCOS.

2.2 JCOMM-II instructed DMPA to work with the IODE of UNESCO/IOC in the drafting of a UNESCO/IOC Strategic Plan for Oceanographic Data and Information Management. This work was carried out by the chairperson of the UNESCO/IOC-IODE Committee with contributions from the DMPA coordinator. The document was presented to and adopted by the UNESCO/IOC Assembly, in June 2007 (Resolution XXIV-9), and is available at http://www.iode.org/strategy.

2.3 JCOMM-II noted with appreciation the offer from China, and related preliminary work, to develop a metadata management system for Ocean Data Acquisition Systems (ODAS). This work continued in the intersessional period and the technology components are in place to assemble, archive and disseminate such information through a website (http://www.odas.org.cn/). Some information, notably from the Data Buoy Cooperation Panel (DBCP), has been loaded into the archive, but there remains much more information to be acquired.

2.4 At JCOMM-II it was reported that the Observations Programme Area (OPA) would begin the development of a metadata system to record information about water temperature instrumentation. During the intersessional period, this activity was undertaken by the DMPA, and the technology development has progressed jointly between China and the US. Just as for the ODAS, the technology to assemble the information into an archive, to preserve the information and disseminate it through a web interface is now in place. What is missing is the metadata that must come from operators.

2.5 The JCOMM-II instructed DMPA to undertake actions to begin the encoding in BUFR of data reported by Members/Member States on the GTS. For operational meteorological centres,

there is a high degree of familiarity with BUFR and strong capabilities to handle such data. In the oceanographic community, there is little knowledge of BUFR. The first step was to begin the construction of templates to reduce the complexity of using BUFR. A number of groups within the OPA built the first templates and these were passed to DMPA. These were presented in September 2008 to the WMO Commission for Basic Systems' Expert Team on Data Representation and Codes (CBS/ETDRC) for consideration. Some were recommended for validation but others needed more work, specifically those required to handle vertical profiles (BATHY and TESAC) and reporting along track data (TRACKOB). In addition, DMPA is pursuing the approval of an updated form of Master Table 10, a set of BUFR tables focused on marine meteorological and oceanographic observations and metadata. The DMPA is looking to introduce consistency in reporting between the various templates. This is being pursued through a task team initiated in early 2009 and with representation from OPA and DMPA. Work will also be required to validate the templates through encoding by one centre and decoding by a centre with BUFR experience before templates may be used on the GTS. These activities will need to be carried into the next intersessional period.

3. MARINE CLIMATOLOGY

3.1 The Expert Team on Marine Climatology (ETMC) and the DMCG initiated modernization of the MCSS (established in 1963) via two new task teams: on Delayed-mode Voluntary Observing Ship (VOS) data (TT-DMVOS), and on Marine-meteorological and Oceanographic Climatological Summaries (TT-MOCS). The TT-DMVOS started its operations as from April 2007 with membership from both the OPA and the DMPA, focusing primarily on modernizing the management and quality control of delayed-mode VOS data, while exploring possible connections with the GTS and other ship-based data. The TT-MOCS is at an early stage of development, but has discussed options for modernizing the content, format and dissemination methods for MCSS data and products to include respectively, satellite data, GIS compatibility and Internet-based web services.

3.2 A joint TT-DMVOS/TT-MOCS planning meeting was held in 2008. For the TT-DMVOS, a number of detailed new proposals were developed for enhancing data flow, including the roles of Global Collecting Centres (GCCs) (see http://www.jcomm.info/ETMC). For TT-MOCS, it was agreed that the limited near-term focus would be on climatologies, and some work has been done since then to engage science partners. To help amalgamate the eventual flow of data and products, the International Comprehensive Ocean-Atmosphere Data Set (ICOADS) produces monthly summaries proposed to feed into the WIGOS Pilot Project for JCOMM, and has implemented the International Maritime Meteorological Archive (IMMA) format.

3.3 ETMC lead the organization of the Third JCOMM Workshop on Advances in Marine Climatology (CLIMAR-III, Gdynia, Poland, May 2008), with 69 participants from 19 countries representing all but one WMO Regional Association. The workshop recommended continuing two alternating workshop series Advances in the Use of Historical Marine Climate Data, with a third MARCDAT around 2010, and a fourth CLIMAR around 2012. In 2007, the CLIMAR-II special issue was finalized as a revised Dynamic Part of WMO-No. 781 and the *International Journal of Climatology* (of the Royal Meteorological Society) will soon be publishing a second revision based on CLIMAR-III papers.

3.4 Imaging and digitization of VOS metadata (WMO-No. 47) was completed back to 1955, together with imaging of 1973-93 volumes with support from the NOAA Climate Database Modernization Program (CDMP). In view of ongoing delays, WMO is urged to allocate sufficient resources to the development and maintenance of WMO-No. 47. The Ocean Data Acquisition System Metadata Service (ODASMS), operated by Chinese National Marine Data and Information Service (NMDIS), has recently been developing its meta-database and website. ETMC-II (March 2007) recommended that the Service takes over metadata formerly managed in the *On-line*

Information Service Bulletin on Non-drifting ODAS operated by the Integrated Science Data Management (formerly MEDS) of Canada. Noting unresolved metadata issues, ETMC-II recommended that for "rigs and platforms", manual observing systems should be treated as a 'ship' and their metadata included in Pub. 47; automated systems onboard rigs and platforms should be treated as a 'buoy' and their metadata included in the ODASMS." While SOT later suggested excluding non-ship data types from Pub. 47, a coordinated strategy still needs to be devised for the contents of WMO-No. 47 versus the ODASMS.

3.5 ETMC-II discussed differences among VOS (and buoy) data sent on the GTS from different operational centres, apparently because of QC, storage, or archival decisions. To help improve and validate the data collection process, ETMC-II recommended a detailed intercomparison, which has been entirely focused on the December 2007 ship data. The DMCG-III requested an overview report on marine QC issues, focused on surface data reported by VOS and R/Vs, to help initiate the process of standardizing QC (see http://www.jcomm.info/marine_QC). Possible broadened involvement has since been explored, but more work is needed to finalize the report for proposed submission to the IODE-JCOMM Standards process.

3.6 ETMC, DMPA, and the Expert Team on Wind Waves and Storm Surges (ETWS) cooperated to define and initiate an extreme wave events archive, which the US National Oceanographic Data Center (NODC) recently agreed to host. Work continues to identify events and provide initial data, and wider participation will be sought. Also, the potential for calculation of wave monthly summaries for the ICOADS remains under continuing discussion with ETWS.

3.7 ETMC and ETWS have been working closely with the Commission for Climatology (CCl), and Climate Variability and Predictability (CLIVAR), through the CCl/CLIVAR/JCOMM Expert Team on Climate Change Detection and Indices. Potential new links with CCl were initially discussed at ETMC-II, where it was anticipated that TT-MOCS would form a useful point of interaction. An informal discussion during CLIMAR-III explored potential new links with CCl and future directions for marine climatology in the context of the WMO Strategic Plan. It was agreed that stronger links should eventually be established between JCOMM and CCl and synergies further developed. These could also include WIGOS, discovery and platform/instrument metadata, extreme events, integrated products, and capacity building.

3.8 The ETMC-II discussed the status of historical data rescue, including the "RECovery of Logbooks And International Marine data" (RECLAIM; http://icoads.noaa.gov/reclaim/) project. ETMC continues work on other data and metadata archaeology activities, including documenting the history of marine ship codes (e.g., WMO-No. 306 – *Manual on Codes*). The ETMC-II endorsed the decision to make available the Deutscher Wetterdienst (DWD) historical marine archive, in accordance with a recommendation from the GCOS AOPC/OOPC Working Group on Surface Pressure. High priority selections from the DWD archive were subsequently made available and blended into ICOADS.

4. DATA MANAGEMENT PRACTICES

4.1 During the intersessional period, the work of the JCOMM-IODE Expert Team on Data Management Practices (ETDMP) has been focused on the development of the end-to-end technology. The tasks set out in JCOMM-II have been accomplished and the E2EDM technology has a sufficient base to build and support the operation of the JCOMM-IODE distributed marine data system. The main ETDMP activities were concentrated on the following directions:

(i) Finalizing the End-to-End Data Management (E2EDM) technology;

(ii) Participating in establishing the IODE-JCOMM Ocean Data Standards Pilot Project (ODS);

(iii) Development of the UNESCO/IOC-IODE Ocean Data Portal and design of the WIGOS Pilot Project for JCOMM, as well as the establishment of the Joint Steering Group for the UNESCO/IOC-IODE Ocean Data Portal and the WIGOS Pilot Project for JCOMM.

4.2 Significant outcomes were achieved with the E2EDM technology:

(i) Existing software components have been upgraded and new software components have been developed for discovery metadata generation and metadata/data interchange between non-homogeneous distributed marine data sources. The E2EDM documentation (11 documents) has been upgraded. A dedicated website has been set up as http://www.oceandataportal.org while the Portal can be accessed directly through http://www.oceandataportal.net;

(ii) Operational testing of the technology has been made on the basis of the ocean and marine data systems of VLIZ (Belgium), RIHMI-WDC (Russia), IFREMER (France), and the Met Office (UK);

(iii) A training course on E2EDM has been provided in the UNESCO/IOC Project Office for IODE (Oostende, Belgium, October 2007) to promote the establishment of E2E data providers. Fifteen participants attended the course from nine countries;

(iv) Two training courses on the establishment of national ODP data nodes have been organized: one for the Black Sea region (Obninsk, Russian Federation, March 2009) and one for the WESTPAC region (Seoul, Republic of Korea, August/September 2009), funded by the Republic of Korea.

4.3 The continuing development of the end-to-end technology needs to consider new requirements to ETDMP, which are identified by projects such as:

(i) The IODE-JCOMM Ocean Data Standards Pilot Project (ODS)– it provides the interoperability infrastructure for building the UNESCO/IOC-IODE Ocean Data Portal (ODP) standards development package and for implementing the WIGOS Pilot Project for JCOMM regarding best practices and standards, and making marine data systems and WIS interoperable;

(ii) The UESCO/IOC-IODE Ocean Data Portal Project – it provides the construction and operation of a distributed marine data system based on the UNESCO/IOC-IODE NODC/DNA network and this system and corresponding portal services will provide data and information exchange with WIS and other systems;

(iii) The WIGOS Pilot Project for JCOMM – involving JCOMM data sources into the ODP distributed data system under the WIGOS Pilot Project for JCOMM; it will promote interoperability of data and information between UNESCO/IOC and WMO.

4.4 In addition to the above-mentioned projects, the ETDMP develops and administers discovery metadata descriptions from the ocean community. The Marine Environmental Data Inventory (MEDI) is a catalogue system for marine datasets within the framework of the UNESCO/IOC-IODE. Metadata is now an important component of a number of projects (such as those described above) and it is important that the MEDI implementation becomes a part of the overall IODE-JCOMM strategy for data discovery.

4.5 To accomplish these activities, ETDMP has proposed two Task Teams, one on standards and one for ODP. The TT-Standards is to conduct the review and adoption of standards

as well as to continue their management including updating. The TT-ODP will examine metadata and vocabularies needed as well as keep under review international software standards such as those proposed by OPA.

Standards Process

4.6 The IODE-JCOMM Ocean Data Standards Pilot Project (ODS) must provide the structure for the discussion, validation and acceptance of oceanographic and marine meteorological data management standards. The ETDMP will manage the internal review of the standards at the "submitted" stage, regulate testing of the Standard Process on the "submitted", "proposed" and "recommended" stages and provide the relevant follow-up on the "use" stage. Modified terms of reference have been proposed to do this. Detailed information is available at http://www.oceandatastandards.org.

4.7 The First Session of the IODE-JCOMM Forum on Oceanographic Data Management and Exchange Standards held in January 2008 at the UNESCO/IOC Project Office for IODE in Oostende, Belgium, addressed a number of issues raised at JCOMM-II and the earlier Ocean Information Technology (OIT) initiatives from 2002 regarding the development of standards for data management activities including quality control, metadata, and vocabularies. Groups concerned with data management contributed to the Forum and subsequently were asked to prepare documentation for consideration as standards. Groups that have produced quality control manuals for ocean profiles, surface observations and tides have all committed to submitting their procedures for evaluation. Both the OIT workshop and JCOMM-II wished to see progress on metadata handling and data formats. The standardization of discovery metadata was addressed at the Forum and a proposal will be forthcoming to use the Marine Community Profile, an ISO19115 profile. An important outcome of the Forum was a mechanism for evaluating and recommending standards for wide community use. This also links into the WIGOS Pilot Project for JCOMM.

UNESCO/IOC-IODE Ocean Data Portal

4.8 IODE-XIX established the UNESCO/IOC-IODE Ocean Data Portal Project (ODP) – Recommendation IODE-XIX.4 and adopted by IOC-XXIV – to facilitate and promote the exchange and dissemination of marine data and services. It will deliver a standards-based infrastructure that integrates marine data and information provided by a distributed network of UNESCO/IOC-IODE NODCs/WDCs as well as the resources provided by other systems operating in the UNESCO/IOC-IODE application domain (OBIS, SeaDataNet, etc). Detailed information is available at http://www.iode.org/oceandataportal and http://www.oceandataportal.org.

WIGOS Pilot Project for JCOMM

4.9 During this intersessional period, the WMO continued developing the WMO Information System (WIS) technology and initiated the WMO Integrated Global Observing System (WIGOS). Interoperability with the WIS, instrument best practices, and quality management are the key deliverables of WIGOS. After consultation with the Programme Areas, JCOMM responded to the WMO call for proposals for pilot projects. It was proposed that DMPA lead a Pilot Project focusing on providing access to marine data and information, building on the experience of the development of the End-to-End Technology (lead by ETDMP), interoperability with the WIS, and the IODE-JCOMM Ocean Data Standards Pilot Project. The WIGOS Pilot Project for JCOMM is being used as a vehicle to progress a number of the issues identified for DMPA activity by JCOMM-II. The project is developing synergies between the ETs of DMPA, as well as with OPA, IODE of UNESCO/IOC, and other technical commissions of WMO, primary and foremost CBS and CIMO. ETDMP continues to develop the technology to support the Pilot Project and ETMC is contributing data sets. The inclusion of data sets held by both ocean data centres and NMHSs assists in improving the collaboration of these agencies within their own countries and

internationally. Partnering with the UNESCO/IOC-IODE Ocean Data Portal (ODP) Project in the Pilot Project increases the collaboration between UNESCO/IOC-IODE and JCOMM and helps to standardize how data are distributed to users. The Pilot Project will improve or include documentation of best practices of participating agencies. This furthers the objectives of the quality management framework being encouraged by WMO and will contribute to the Catalogue of Best Practices assembled by JCOMM. Through the cooperation of ODP, oceanographic and marine meteorological data will become more easily available to Members/Member States, and through WMO participation, will be exposed to GEOSS. Detailed information on the WIS and WIGOS Pilot Project for JCOMM is provided under agenda item 10.

5. CAPACITY BUILDING

5.1 JCOMM-II (Recommendation 9) recommended that capacity building activities such as training workshops collaborate with the UNESCO/IOC Project Office for IODE to use their facilities. During the intersessional period, workshops were held on end-to-end data management (October 2007), on drifting buoy programme implementation and data management (June 2007), on UNESCO/IOC-IODE Ocean Data Portal (March and September 2009), a JCOMM/IODE/GOOS Combined Modelling and Data Management Training Workshop (Jamboree-II) (October 2006) and a Met-ocean Modelling Jamboree-III (October 2009). Capacity Building will be the focus of one member of the incoming DMPA.

6. MEETINGS HELD SINCE JCOMM-II

6.1 The following meetings were held to address work of the DMPA since JCOMM-II. Reports for these can be downloaded from http://www.jcomm.info/DMPA_publications:

(i) First Meeting of the Steering Team of the META-T Pilot Project, Reading UK, March 2006;

(ii) Second Session of the Data Management Coordination Group, Geneva, Switzerland, October 2006;

(iii) Second Session of the Expert Team on Marine Climatology, Geneva, Switzerland, March 2007;

(iv) First Session of the IODE-JCOMM Forum on Oceanographic Data Management and Exchange Standards, Oostende, Belgium, January 2008;

(v) Third Session of the JCOMM Data Management Coordination Group, Oostende, Belgium, March 2008;

(vi) Ad-hoc planning meeting for the JCOMM Pilot Project for WIGOS, Oostende, Belgium, March 2008;

(vii) Third JCOMM Workshop on Advances in Marine Climatology (CLIMAR-III), Gdynia, Poland, May 2008;

(viii) Meeting of the Joint Steering Group for the UNESCO/IOC-IODE Ocean Data Portal and the WIGOS Pilot Project for JCOMM, Geneva, Switzerland, September 2008;

(ix) Second Meeting of the Steering Team of the META-T Pilot Project, Geneva, Switzerland, September 2008;

(x) JCOMM-IODE Jamboree-3 planning meeting, Oostende, Belgium, March 2009.

6.2 ETMC and ETWS experts participated in the following meetings of the CCl/CLIVAR/JCOMM Expert Team on Climate Change Detection and Indices (ETCCDI). Reports for these can be downloaded from http://www.clivar.org/organization/etccdi/panel_meetings.php:

(i) Second Session of the ETCCDI, Niagara-on-the-Lake, Canada, November 2006;

(ii) Third Session of the ETCCDI, De Bilt, The Netherlands, May 2008.

6.3 Meetings on WIS and WIGOS are listed under agenda item 10.

_____

2.3 Since its establishment, the ETOOFS has focused on defining the scope and specific tasks that could be undertaken to achieve progress against its Terms of Reference. These include:

(a) A *Guide to Operational Ocean Forecasting* – ETOOFS has prepared the table of contents for the Guide, which will document best practices, conventions and standards in all aspects of the provision of ocean forecasting services including nomenclature and symbology;

(b) Operational ocean observation requirements – ETOOFS has prepared the observational requirements for ocean forecasting systems and gap analysis, as part of the *Statement of Guidance for Ocean Applications*. These included the performance gain for each component of the observational network, the performance thresholds for user applications and the total benefit from reaching the performance thresholds;

(c) Operational performance monitoring – ETOOFS has proposed the first set of performance metrics to monitor operational ocean forecasts across systems and track the progress in performance. It will coordinate with the national agencies for their implementation and publishing;

(d) User requirements and ocean services – ETOOFS has identified a range of operational ocean forecasting products and services required to meet the marine users' needs. It will survey national agencies in order to assess and monitor the quality of services, identify and measure positive impacts, identify poor quality services and make recommendations to improve them;

(e) Capacity building – ETOOFS has identified a small number of countries where operational ocean forecasting is rapidly developing, and that a large number of countries could benefit from the products and services they provide. It will seek to initiate/support activities that improve capacity in terms of technology transfer and access to existing products and services;

(f) Ocean data management – ETOOFS has decided to create a task team to address issues relating to the transition of a GODAE data service into operations and provide coordination and guidance to improve interoperability and standardization.

2.4 The ETOOFS has established interactions and collaborating arrangements with other partners, including other programmes within both WMO and UNESCO/IOC, universities and national meteorological and oceanographic agencies. A continuous dialog between ETOOFS and GOVST has resulted in a new paradigm for technical coordination of operational oceanography that provides a focus for the future development and transition of developing and developed systems from research to operations, better integration and feedback to observing systems and a new generation of products and services for the end user community.

3. WIND WAVE AND STORM SURGE

3.1 The Expert Team on Wind Waves and Storm Surges (ETWS) has completed a large part of a very ambitious work plan, derived directly from JCOMM-II Recommendations and Resolutions, during the intersessional period. The work plan encompassed a wide range of activities to assist Members/Member States in developing or enhancing capacities to issue consistent and timely operational forecast products for wind waves and storm surges as part of their marine service delivery and multi-hazard warning systems. It also included the development of technical guidance and advice on wind waves and storm surges, contributions to various levels of capacity building activities and interactions with other groups and expert teams within JCOMM, including in particular, the DBCP and the ETMC.

3.2 In order to fulfil its work plan, the ETWS has established interactions and collaborating arrangements with other partners, including other programmes within both WMO and UNESCO/IOC, the International Association of Oil and Gas Producers (OGP), universities and national meteorological and oceanographic agencies.

3.3 The ETWS documented the Wave Observation Requirements, addressing five application areas: (i) assimilation into offshore wave forecast models; (ii) validation of wave forecast models; (iii) calibration/validation of satellite wave sensors; (iv) ocean wave climate and variability; and (v) the role of waves in coupling. These requirements have been included in the CEOS/WMO database and a gap analysis was prepared and included in the *Statement of Guidance for Ocean Applications* [see agenda item 5.1]. This detailed set of requirements for wave observations was provided to the OPA, which agreed to address them as part of its ongoing work programme. Subsequently, and following a joint ETWS/DBCP Workshop on Wave Measurement from Buoys, held in New York, in October 2008 [see www.jcomm.info/wavebuoys], two Pilot Projects were approved by the DBCP, one on wave measurements from drifters and the second on wave measurement evaluation and testing from moored buoys [see agenda item 6.3]. A contribution to the *OceanObs'09 Conference* (Venice, September 2009) [see http://www.oceanobs09.net] on requirements for future wave measurements was made in the form of a Community White Paper (CWP); a second CWP was developed for storm surges.

3.4 Following the JCOMM-II request to assess the state-of-the-art of operational and pre-operational wave and storm surge numerical models and databases, the ETWS conducted a survey amongst Members/Member States. Information on specialized numerical prediction on wave and storm surge was extracted from the WMO GDPFS/NWP Technical Progress Reports and analyzed. The results show that there are a broad range of wave and storm surge products and datasets available worldwide. It also shows that there are a number of advanced centres that make global and regional wave products and datasets freely available on their Websites, for example, ECMWF, BoM (Australia), Environment Canada, met.no (Norway), and NOAA/NCEP (USA). NOAA/NCEP also provides access to spectral data and to the wave model source code WaveWatch-III. Detailed information and the results of the analysis were compiled into a report and can be accessed at http://www.jcomm.info/SPA_WWSS.

3.5 In the same context, the ECMWF Council (Reading, December 2007) favourably considered the request by the WMO on providing additional products to the WMO Members and decided to enhance the set of ECMWF products disseminated to WMO Members on the GTS and on the ECMWF Website (password protected). The improvement was quite significant and included:

(a) The provision of a deterministic forecast range of global marine products on 2.5-degree latitude/longitude grids of up to 7 days;

(b) The provision of global marine products from the Ensemble Prediction System (EPS) on 2.5-degree latitude/longitude grids of up to 6 days, in support of high impact and extreme sea state events. This includes in particular global forecasts of the probability of Significant Wave Height (SWH) above 2, 4, 6, and 8 m based on EPS.

In 2008, the ECMWF Council favourably considered the request by the WMO for increasing the resolution of products made available to WMO Members and decided to enhance the set of ECMWF products disseminated to WMO Members, including marine products, on 0.5-degree latitude/longitude grids.

3.6 The wave forecast verification scheme was formally implemented in 1997 to provide a mechanism for benchmarking and assuring the quality of wave forecast model products that support the provision of safety-related services. Currently, twelve centres that routinely run wave forecast models contribute to this verification scheme. Arrangements are being made with other centres that have demonstrated interest in participating in this scheme. The ETWS discussed a

number of proposals for future development of data exchange and the expansion of this scheme, and established a task team to move forward with the key recommendations. Besides continuing to widen participation in the exchange, the ETWS endorsed the expansion of the exchange that includes additional data types, formats and policy issues, and the development of partnerships with space agencies. In this context, the ETWS established collaborating arrangements with ESA to further enhance the scope and participation of this scheme through the ESA Data User Element (DUE) *GlobWave project*. *GlobWave* will assist ETWS in the extension of the scheme to include the use of Satellite Altimeter data and consider spatial intercomparison of operational wave model products. In the same context, ETWS prepared the following publications as part of the dynamic part of the *Guide to Wave Analysis and Forecasting* (WMO-No. 702):

(a) Techniques and Benefits of Satellite Data and Wave Models (JCOMM/TR-No. 33);

(b) Verification of Operational Global and Regional Wave Forecasting Systems against Measurements from Moored Buoys (JCOMM/TR-No. 30).

3.7 The *International Workshop on Wave Hindcasting and Forecasting*, co-sponsored by JCOMM through the ETWS, held three meetings, in Victoria, Canada (2006), in Oahu, Hawaii (2007) and in Halifax, Canada (2009). It is noteworthy to say that the Oahu and Halifax workshops introduced a coincident Coastal Hazards Symposium to address complementary interests. Detailed information about the Symposium is available at http://www.waveworkshop.org.

3.8 The WMO/CBS Severe Weather Forecasting Demonstration Project (SWFDP) aims at enhancing the application of NWP products for the improvement of severe weather forecasting services. It was implemented in Southern Africa and planning has commenced for the organization of a Severe Weather Forecasting and Disaster Risk Reduction Demonstration Project (SWFDDP) in Regional Association V, which will focus on forecasting and warning services in relation to heavy rain, strong winds, and damaging waves for four Island States: Fiji, Samoa, Solomon Islands and Vanuatu. The role of ETWS in the project included promoting the implementation of specialized numerical prediction capabilities for met-ocean forecasting, including for waves and storm surge.

3.9 Following Recommendation 1 (JCOMM-II), the ETWS prepared the *JCOMM Guide to Storm Surge Forecasting* [see agenda item 12], which identifies challenges and opportunities among Members/Member States related to technical aspects constituting the basis for developing and implementing storm surge forecasting systems for improved marine warning services. At the same time, the ETWS developed technical material for the dynamic parts to both the *JCOMM Guide to Storm Surge Forecasting* and the *Guide to Wave Analysis and Forecasting* (WMO-No. 702). The team also reviewed the content of relevant publications, including the *Guide to Wave Analysis and Forecasting* (present version published in 1998). It also contributed to the preparation of the UNESCO/IOC publication Hazard Awareness and Risk Mitigation in Integrated Coastal Area Management (ICAM) (UNESCO/IOC Guides & Manuals No. 50; ICAM Dossier No. 5), which is available at http://www.ioc-unesco.org/ioc-25.

3.10 In response to the JCOMM-II recommendation to convene an international scientific/technical symposium on storm surges, the ETWS organized the *First JCOMM Scientific and Technical Symposium on Storm Surges* (Seoul, October 2007). One hundred participants from twenty countries, for a wide-ranging programme covering aspects from modelling to operational forecasting to climate and risk assessment to mitigation, participated in the Symposium. Major outcomes from the Symposium include: (1) the preparation of a JCOMM Technical Report; (2) two special issues of scientific journals, one in Marine Geodesy for the operational aspects comprising 12 papers, and the other in Natural Hazards on the latest developments in numerical storm surge modelling, comprising a further 13 papers; and (3) an Action Plan aimed at national agencies, intergovernmental agencies, and academia. Several elements of this Action Plan are already being addressed in various new activities, most importantly the planning for a coordinated Demonstration Project on Storm Surges for inclusion in

the ETWS work plan for the next intersessional period. Detailed information about the Symposium is available at http://www.surgesymposium.org.

3.11 Joint efforts of JCOMM, through the ETWS, and the WMO Tropical Cyclone Programme (TCP) have continued for development of wave and storm surge forecasting and warning services. The ETWS co-organized the fourth and the fifth *TCP/JCOMM Workshop on Storm Surge and Wave Forecasting*, which were convened in Manila (2006) and Melbourne (2008). These workshops have transferred skills and forecasting models to the participants through hands-on training to enable them to run operational wave and storm surge forecasting in their home countries.

3.12 Following the request by the WMO Executive Council, in its sixtieth session (June 2008), to the Secretary-General of WMO, in consultation with UNESCO/IOC, to facilitate the development of storm surge watch schemes (SSWS) for regions subject to tropical cyclones, and the regional associations concerned to incorporate such schemes in the tropical cyclone advisory arrangements and in the TCP Regional Operating Plans and/or Manual, JCOMM through the ETWS, and the TCP have initiated the development of such schemes in regions subject to tropical cyclones. Detailed information is available at http://www.jcomm.info/SSWS.

3.13 The WMO Executive Council, at its sixtieth session (June 2008), also requested JCOMM, CAS and CHy, in close cooperation with other relevant UNESCO/IOC subsidiary bodies, to implement the scientific/technical recommendations from the *First JCOMM Scientific and Technical Symposium on Storm Surges*, including coastal inundation and linkages to storm surge forecast and warning operations in all relevant regions. The UNESCO/IOC Executive Council endorsed this request, at its forty-first session (June 2008). In response to this request, planning was initiated on several related components including:

(a) UNESCO/IOC pilot project for scientific development on enhanced storm surge modelling capabilities. The first *Advisory Workshop on Enhancing Forecasting Capabilities for North Indian Ocean Storm Surges* was held in Delhi, July 2009 [see http://www.jcomm.info/SSindia];

(b) An integrated effort for developing and improving forecasting capabilities and service delivery in coastal risk reduction, including for coastal inundation, through the *JCOMM/CHy Coastal Inundation Forecasting Demonstration Project* (Geneva, June/July 2009) [see http://www.jcomm.info/CIFDP], leading towards a comprehensive *Storm Surge Watch Scheme* (SSWS); and

(c) Satellite contributions to storm surge monitoring and forecasting, though the planning process of the *ESA Storm Surge Project.* The User Consultation Meeting was held in Venice, in September 2009 [see http://www.jcomm.info/SSucm].

This multi-faceted, collaborative effort will lead to the development of a plan for enhancing national and regional capabilities for coastal hazards forecasting and warning systems through scientific and technical development, with special emphasis on large coastal cities at risk of marine-related, and the subsequent development of an Implementation plan for Global and Regional SSWS.

3.14 The ETWS maintained important interactions with the Expert Team on Marine Climatology (ETMC), particularly in the development of the *JCOMM Extreme Waves Database* and the co-organization of the *Third JCOMM Workshop on Advances in Marine Climatology* (CLIMAR-III, Gdynia, May 2008) to address wind wave and storm surge climatology issues [see agenda item 7.2]. The ETWS also contributed to the CCl/CLIVAR/JCOMM Expert Team on Climate Change Detection and Indices (ETCCDI) on wave and surge indices, as part of a broader JCOMM contribution on surface and sub-surface marine climate indices, developed in a special session of CLIMAR-III.

3.15 The ETWS co-organized with the World Climate Research Programme (WCRP) and the International Association of Oil and Gas Producers (OGP), a workshop on climate change and the offshore industry (Geneva, May 2008). This workshop aimed to: (i) review the evolving industry requirements for met-ocean services in a changing climate; and (ii) identify and prioritize key areas for future research and development towards the adaptation of the offshore industry and its met-ocean services to the climate change, including increased safety and efficiency of offshore operations [see http://www.jcomm.info/Industry]. The outcomes of this meeting continue to be followed up at the OGP Met-ocean Committee semi-annual meetings and in a special session on the topic at the *11th International Workshop on Wave Hindcasting and Forecasting* (Halifax, October 2009).

4. MARINE ACCIDENT EMERGENCY SUPPORT

4.1 The Expert Team on Marine Accident Emergency Support (ETMAES) has focused its activities during the intersessional period in:

(a) Reviewing the status of implementation of the Marine Pollution Emergency Support System (MPERSS), based on the reports presented by representatives of the Area Meteorological and Oceanographic Coordinators (AMOCs);

(b) Addressing the requirements expressed by the International Maritime Organization (IMO) Marine Environment Protection Committee (MEPC), and its Oil Pollution Preparedness, Response and Cooperation – Hazardous and Noxious Substances (OPRC-HNS) working group;

(c) Assisting Members/Member States in implementing their services in support of marine accident emergencies.

4.2 ETMAES experts have participated in several IMO and European Maritime Safety Agency (EMSA) meetings to keep under review the met-ocean input data requirements for marine pollution monitoring and response, and met-ocean services in support of search and rescue operations. Amendments to the *Guide to marine Meteorological Services* (WMO-No. 471) on these issues are considered under agenda item 12.

4.3 In conjunction with the Expert Team on Maritime Safety Services (ETMSS), ETMAES has been addressing the expansion of the MPERSS services into the Arctic region [see section 5 below].

4.4 ETMAES has been updating the MAES-MPERSS Website (http://www.maes-mperss.org), managed and hosted by Météo-France. This Website continues to provide basic information such as what is MPERSS, what is available under MPERSS, contact points in AMOCs and Marine Pollution Emergency Response Authorities (MPERA), together with specific examples. AMOCs have made available detailed information on their MPERSS operations, and specifications of available models, in an appropriate manner, such as on their own Websites where possible. Open source codes are now available at the MAES-MPERSS Website and training on the use of such models and data for MAES applications, including marine pollution and search and rescue, was conducted in October 2009, at the UNESCO/IOC Project Office for IODE (Jamboree-III) [see agenda item 9].

5. MARITIME SAFETY SERVICES

5.1 The Expert Team on Maritime Safety Services (ETMSS) continues to assist Members/Member States in implementing met-ocean services in support of the international maritime navigation. ETMSS experts have participated in several International Maritime Organization (IMO) and International Hydrographic Organization (IHO) meetings to coordinate the expansion of the GMDSS into the Arctic waters and the revision of relevant regulatory publications

and IMO Resolutions. ETMSS has reinforced its cooperation with the IHO Sub-Committee for Promulgation of Radio Navigational Warnings (IHO/PRNW), whose results are as follows:

(a) IMO Resolutions A705(17) on Promulgation of Maritime Safety Information and A706(17) on the IMO/IHO World-Wide Navigational Warning Service, were updated. Those Resolutions, endorsed by the WMO Executive Council, were submitted to IMO/COMSAR-12 in April 2008 and adopted by IMO/MSC-85 in November/ December 2008, and will enter into force on January 2010;

(b) A new version of the *joint IMO/IHO/WMO Manual on Maritime Safety Information (MSI)*, containing an updated section on met-ocean MSI, including the new METAREA map (see Figure 1) was produced. This new version was endorsed by WMO and IHO in October 2008, and was subsequently submitted to COMSAR-13, in January 2009, and adopted by IMO/MSC-86 in May/June 2009;

(c) A new version of the *International SafetyNET Manual* was finalized at the first session of the IHO/PRNW, in August 2009. This new version is to be submitted to IHO Committee, WMO Executive Council and IMO/COMSAR for approval and subsequently adoption by IMO/MSC, in 2010;

(d) The new specifications for the *Inmarsat System Definition Manual*, including the new Arctic areas, have been prepared;

(e) Following the request by the WMO Executive Council, at its sixty-first session (Geneva, June 2009), an IMO/WMO World-Wide Met-ocean Information and Warning Service (WWMIWS) guideline document was prepared [see JCOMM-III/Doc. 8, Recommendation 8.3/1], to complement the existing IMO/IHO World-Wide Navigational Warning Services (WWNWS, IMO Resolution A.706(17)). The WMO Executive Council will consider the WWMIWS, at its sixty-second session (Geneva, June 2010), and subsequently it will be submitted to IMO/COMSAR for adoption and inclusion in the regulatory publications.

5.2 Recognizing the increased use in the Arctic region by the marine community (including commercial, military and scientific), the International Maritime Organization (IMO) decided to expand the Global Maritime Distress and Safety System (GMDSS) into the whole Arctic Ocean, enhancing a proposal submitted by the Russian Federation. It therefore established (IMO/COMSAR-10, London, March 2006) a joint IMO/IHO/WMO Correspondence Group on Arctic Maritime Safety Information (MSI) services to address this issue. The Expert Team on Maritime Safety Services has been active in this joint IMO/IHO/WMO Correspondence Group in ensuring that all relevant issues for the METAREA Issuing Services in the expansion of the GMDSS into the Arctic waters are properly addressed.

5.3 When, the existing WMO GMDSS Marine Broadcast System was decided upon the MSI broadcast facilities were not envisaged for the Polar Regions. Consequently, as the opening of the Northern Sea Route for international shipping increases, gaps and problems with availability, harmonization and standardization of appropriate MSI broadcasts, including sea ice, for SOLAS and non-SOLAS vessels were expected to build up. Hence, the WMO Executive Council, at its sixtieth session (Geneva, June 2008), approved the establishment of five new METAREAs for the Arctic region with the same boundary limits as the corresponding NAVAREAs, approved at the 83rd session of the IMO Maritime Safety Committee (Copenhagen, October 2007) (see Figure 1). The Council welcomed and endorsed the commitments by the following NMHSs to serve as METAREA Issuing Service:

(a) Environment Canada (Canada) for METAREAs XVII and XVIII;

(b) Norwegian Meteorological Institute (Norway) for METAREA XIX;

(c) Roshydromet (Russian Federation) for METAREAs XX and XXI.

5.4 The joint IMO/IHO/WMO Correspondence Group on Arctic MSI services assists the Arctic NAVAREA coordinators and METAREA Issuing Services in developing their operating plans for the implementation of the GMDSS in the Arctic areas. Additionally, focal points for METAREAs I (UK Met Office), II (Météo-France) and IV (NOAA/NWS) agreed to provide such kind of assistance as well. The aim is to provide appropriate support and coordination to ensure that the Arctic Issuing Services will be able to implement the GMDSS services on a pre-operational basis in 2010. The expected date for the IMO, IHO and WMO to, simultaneously and officially declare the system operational is beginning of 2011 at the IMO COMSAR-15 meeting. Detailed information on the current status and future actions for the implementation of the GMDSS services in the Arctic areas by METAREA Issuing Service/NAVAREA Coordinator is available at: http://www.iho-ohi.net/mtg_docs/com_wg/CPRNW/WWNWS1/WWNWS1.htm in the following documents:

(a) WWNWS1/3/3/3, Annex – METAREAs XVII to XXI;

(b) WWNWS1/3/2/XVII-XVIII – NAVAREAs XVII and XVIII;

(c) WWNWS1/3/2/XIX-Rev1 – NAVAREA XIX;

(d) WWNWS1/3/2/XX&XXI – NAVAREAs XX and XXI.

5.5 Sea Ice Services from Canada, Norway and Russian Federation will act as Preparation Services for the sea ice information to be included in the Weather and Sea Bulletins and Warnings disseminated through the GMDSS broadcast systems (Inmarsat SafetyNET and NAVTEX). NMHSs from Denmark and the US has offered to serve as Preparation Services.

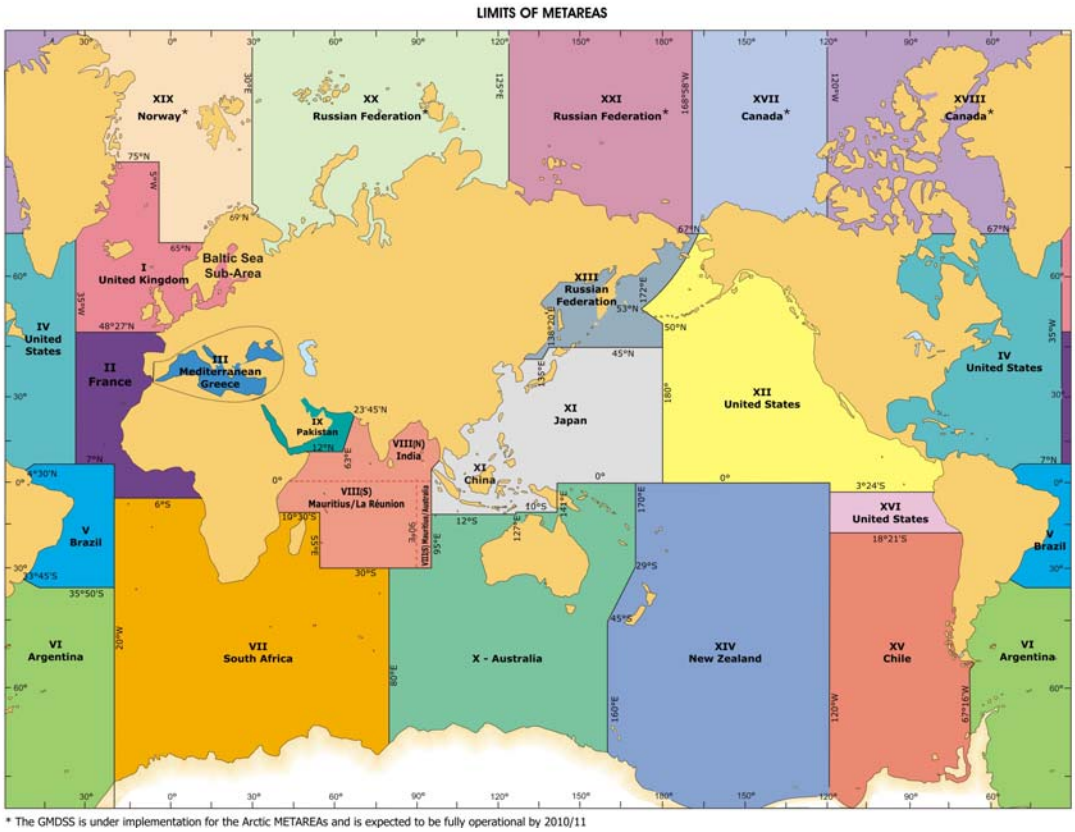

Figure 1 – METAREAs for coordinating and promulgating meteorological forecasts and warnings within the GMDSS. *Note: The delimitation of such areas is not related to and shall not prejudice the delimitation of any boundaries between States.* (Source: Joint IMO/IHO/WMO Manual on Maritime Safety Information, Edition 3, 2009).

5.6 The WMO Marine Broadcast System under the GMDSS-Weather Website (http://weather.gmdss.org) continues to disseminate official maritime safety information and warnings supplied by the existing METAREA Issuing Services. Météo-France has been managing and hosting this Website, which has been in operation for 6 years. The Website includes:

(a) Met-ocean MSI prepared for SafetyNET dissemination (high seas);

(b) Met-ocean MSI prepared for International NAVTEX dissemination (coastal waters), which is under preparation. A number of NAVTEX bulletins are already available online (e.g., METAREAs I, II, III, IV and XI) [see for example http://weather.gmdss.org/II.html];

(c) A specific page gathering the available links to the NAVAREA Websites [see http://weather.gmdss.org/navareas.html]. This is the first step of cooperation with IHO towards the joint use of the URL *gmdss.org* for the provision of both meteorological and navigational warning information

(d) Relevant maps showing limits of METAREAs and sub-areas, which are available in publication WMO-No. 9, Volume D – *Information for Shipping*.

5.7 ETMSS has reviewed the *Manual on Marine Meteorological Services* (WMO-No. 558) and the *Guide to Marine Meteorological Services* (WMO-No. 471) and proposed amendments, as described in agenda item 12.

5.8 Direct interaction with and feedback from the marine users is required to ensure that services meet their requirements. The former Commission for Marine Meteorology (CMM) therefore initiated a Marine Meteorological Services Monitoring (MMSM) programme in 1981. The outline for the monitoring programme had subsequently been prepared, adopted by CMM, at its ninth session (Geneva, October 1984), and distributed to WMO Members for action in 1985. Subsequent sessions of CMM had reviewed the survey results, reiterated their value to WMO Members and endorsed their continuation. The MMSM and review process have been continued by JCOMM, at its first (Akureyri, June 2001) and second (Halifax, September 2005) sessions. ETMSS and SOT have reviewed the questionnaire, which was distributed in early 2009 to ships' masters through national PMOs as well as via the Weather-GMDSS Website. The results of the 883 returns confirm the satisfactory accuracy and usefulness of marine meteorological services through the GMDSS (SafetyNET and International NAVTEX services). The results demonstrate the increased demand for user-focused marine meteorological and oceanographic products and services and show that there remains considerable room for improvement with regards to both the quality and content of services, and their coverage and timeliness in some oceanic regions, and show the need for NMHSs to take corrective action in areas of identified weaknesses. Additionally, the great majority of respondents re-emphasized the usefulness of graphical information, like radio facsimile products, and reported significant dissatisfaction with the quality of these services and unannounced terminations. Major conclusions are as follows:

(a) <u>GMDSS Information:</u> The reception of GMDSS information via Inmarsat SafetyNET has been judged to be excellent, whereas the reception via NAVTEX, although evaluated better than the previous time, was seen to require some improvement. An examination of the specific comments indicates geographic areas, e.g. of Australia or Brazil, where improvements would have a significant beneficial effect for mariners. Suggested items requiring attention are concentrated in the areas of: (1) additional coverage in neglected marine areas; and (2) improved transmission reliability for stations that already exist;

(b) <u>Reception of other Safety Information:</u> VHF Radio is the most used service for receiving further safety information followed by e-mail and national NAVTEX; far less used, and probably a lesser known service, is the GMDSS Website. The reception via HF Radio showed some problems. Best to receive are e-mails and the websites. Some ships do

not have access to Internet. Information in English instead of in local language is desired;

(c) Storm and Gale Warnings: Most mariners are satisfied by the available information. Nevertheless, terminology and accuracy could be improved. The latter is already rated much better than 4 years ago (2009: 78.1%, 2005: 66.9%);

(d) Sea Ice and Icebergs Information: Good service provides clear and mostly accurate information on time;

(e) Wave and Storm Surge Information: Clear information written with appropriate terminology. Timeliness and even more accuracy are suggested;

(f) Other Parameters in Weather and Sea Bulletins: Rated quite well, much better than the last survey. However, there are still many requests concerning the presentation and availability of the information, or the terminology used, especially that the same areas should have the same names in every bulletin;

(g) Graphic/Numeric Broadcasts: This information source has much better results than in 2005. Nevertheless, the reception is still a problem which needs to be solved. Besides this problem, 87.8% have the opinion that this is a useful service. Although many mariners use charts from websites or sent by e-mail, they see the necessity of a backup system if the Internet connection breaks down;

(h) Land Earth Stations Inmarsat: Contacting LES is almost no problem; some experienced short delays, but only a few had no success with sending observations.

The results of the analysis were compiled into a report, which can be accessed at http://www.jcomm.info/SPA_MSS.

5.9 As stated in the IMO resolution A.705(17), common standards and procedures are applied to the collection, editing and dissemination of Maritime Safety Information (MSI). There is then a need for the implementation of Quality Management Systems (QMSs) for the provision of marine meteorological services for international navigation. WMO Members have been encouraged to develop and implement QMSs for the provision of marine meteorological services, in liaison with IMO, and to document the process in order to share with other National Meteorological Services (NMSs) with a view to facilitating and expanding QMSs implementations. Detailed information is provided under agenda item 11.

5.10 Since 1999, ETMSS has been working on the implementation of graphical/numerical Maritime Safety Information (MSI) broadcast within the GMDSS. The WMO Executive Council, at its sixtieth session (Geneva, June 2008) re-emphasized the continuing importance to mariners in receiving graphical products via radio transmissions and requested JCOMM to continue researching methods for transmitting graphical products to marine users. On the other hand, the WMO Executive Council, at its sixty-first session (Geneva, June 2009), encouraged WMO Members to investigate low-cost options for on-demand approaches that are compatible with Electronic Navigation Charts (ENC). In addition, the imminent increase of ENC systems on SOLAS vessels as regulatory material and the emergence of the e-navigation concept within IMO should reinforce the priority given to this requirement and the need to find appropriate resources to develop a suitable service. Both the ETMSS and ETSI have been working on this issue and ETSI has already developed the *Sea Ice Objects Catalogue* in accordance with IHO standards [see section 6 below]. The ETMSS has initiated the development of a catalogue on *Met-Ocean Object Classes and Attributes*, which would be an essential tool to enable NMHSs to develop products specifically for Electronic Navigation Chart Systems, allowing the implementation of software to decode and display met-ocean information by the manufacturers of these systems, using the S-57 and S-100 chart data exchange standards.

6. SEA ICE

6.1 The Expert Team on Sea Ice (ETSI) has been responding to emerging requirements for sea ice products and services for the safety and efficiency of navigation in ice-infested waters. It has also provided support to the IPY 2007/2008 and to the implementation of met-ocean services in the new Arctic METAREAS [see section 5 above]. ETSI completed most parts of its work plan for the intersessional period, which encompassed a wide range of activities to assist the National Ice Services of Members/Member States in developing and enhancing capacities to deliver consistent and timely operational sea ice services as part of their marine service delivery and multi-hazard warning systems. It included the development of technical guidance, standard formats and advice on sea ice, contributions to various levels of capacity building activities and interactions with other groups and expert teams within JCOMM, including in particular the ETMSS and the ETMC. ETSI also oversees the Global Digital Sea Ice Data Bank (GDSIDB).

6.2 In order to fulfil its work plan, the ETSI has established interactions and collaborating arrangements with other partners, including other programmes within WMO and UNESCO/IOC, and co-sponsored programmes and projects, such as GCOS and the WCRP Climate and Cryosphere (CliC) project. It also maintains relationships with regional and international groups, projects and alliances, such as the International Ice Chart Working Group (IICWG), the Baltic Sea Ice Meeting (BSIM) and the International Hydrographic Organization (IHO) Transfer Standard Maintenance and Application Development (TSMAD) working group.

6.3 ETSI contributed to the development of the Ice Logistics Portal (http://ipy-ice-portal.com/) as a joint initiative with the European Space Agency through the EarthWatch GMES Service Element PolarView in support of the IPY 2007/2008. This Portal provides a single interactive website to operational sea ice information from National Ice Services for regions in the northern and southern hemispheres. The Portal has been active since May 2007. The Portal utilizes a provider-flexible operative scheme resembling the End-to-End Data Management project (E2EDM) [see agenda item 7.3]. It is compliant with the WIS [see agenda item 10.1] and eventually contributes to the Global Cryosphere Watch (GCW) and the MyOcean project, funded by the European Commission.

6.4 ETSI has been working with the ETMSS in the expansion of the GMDSS into the Arctic waters [see section 5 above]. ETSI has proposed sea ice specifications for Weather and Sea Bulletins to be disseminated via SafetyNET and international NAVTEX service, which will be reflected in the *Manual on Marine Meteorological Services* (WMO-No. 558), the *Guide to Marine Meteorological Services* (WMO-No. 471), and in joint IMO/IHO/WMO regulatory publications. ETSI has been also engaged in the work of the joint IMO/IHO/WMO.

6.5 ETSI reviewed the proposal from the ETMSS regarding common abbreviations for sea ice terminology in the meteorological content of the international NAVTEX service broadcasts and recommended to use plain language. ETSI reviewed the questionnaire developed for the Marine Meteorological Services Monitoring (MMSM) programme, in order to ensure that sea ice matters were properly addressed [see section 5 above].

6.6 ETSI has been developing joint activities with the IICWG and the GCOS Working Group on SST and SI, including on the identification of requirements for sea ice services, as follows:

(a) "Observational Requirements for Key Ice Features/Optimum Future Value" (from "Ice Information Services: Socio-Economic Benefits and Earth Observation Requirements"; prepared for the Group on Earth Observation (GEO) and Global Monitoring for Environment and Security (GMES), September 2007, http://nsidc.org/noaa/iicwg/IICWG8_2007/presentations/IICWG_Socio_Economic_Benefits_Oct_2007.pdf);

(b) "National Operational Ice Information Requirements" (from "An International Collaborative Effort towards Automated Sea Ice Chart Production", www.nsidc.org/noaa/iicwg/presentations/IICWG_white_paper_final.doc);

(c) "Summary of Current/Planned Capabilities and Requirements for Space-based Remote Sensing of Sea Ice and Iceberg Parameters" and "Summary of Current/Planned Capabilities and Requirements for lake and river ice parameters" (from: "IGOS Cryosphere Theme - Report of the Cryosphere Theme Team", version 1.0r4, 13 March 2007, source: http://stratus.ssec.wisc.edu/cryos/documents.html).

6.7 An Ice Objects Catalogue, defining 23 ice "object classes" (with formal definitions and enumerations, in accordance with WMO-No. 259 – *WMO Sea Ice Nomenclature*) was prepared by the ETSI. This catalogue was produced in consistency with the existing IMO, IHO and the International Electrotechnical Commission (IEC) standards and specifications for Marine Information Objects (MIOs), and integrated into the IHO Registry of MIOs in May 2008 (see http://195.217.61.120/iho_registry/). This Catalogue would provide the essential tool to enable NMHSs, in particular their National Ice Services, to develop products specifically for Electronic Navigation Chart Systems and would allow the implementation of software to decode and display ice information by the manufacturers of these systems, using the S-57 (in the future in S-100) chart data exchange standard. The *Canadian Ice Service* (CIS) and the *Arctic and Antarctic Research Institute* (AARI) have been testing the Catalogue developing sea ice product transmit and display specifications for the Gulf of St. Lawrence, and Baltic Sea, European Arctic and Kara Sea, respectively.

6.8 ETSI prepared technical guidance material as follows:

(a) A multi-language (EN/ES/FR/RU) electronic version of the publication *Sea Ice Nomenclature* (WMO-No. 259), including an *Illustrated Glossary of Sea Ice Terms*;

(b) *Sea Ice Information Services in the World* (WMO-No. 574) – 3rd edition;

(c) *SIGRID-3: a vector archive format for sea ice charts* (update 2007) (WMO/TD-No. 1214).

These publications are available on the website and can be downloaded from http://www.jcomm.info/SPA_SI. ETSI is working with the BSIM in order to include Baltic Sea Ice services linguistic terms in the publication WMO-No. 259 – *Sea Ice Nomenclature*.

6.9 ETSI developed sea ice climatology based on ice charts included in the Global Digital Sea Ice Data Bank (GDSIDB). It made use of the GDSIDB data to provide information to the Arctic Marine Shipping Assessment (AMSA) in 2007-2008 and the assessment of extreme 2007 and 2008 conditions in terms of sea ice climatology. ETSI interacts with the GCOS working group on SST and SI, and the WCRP in developing requirements for sea ice information, as an Essential Climate Variable (ECV) within GCOS.

6.10 The first and the second joint *ETSI/IICWG/GCOS Ice Analysts Workshops* were held respectively in Rostock, Germany, in June 2008, and in Tromsø, Norway, in June 2009, in order to enhance the capability of Members/Member States concerned to provide harmonized sea ice services and to understand sea ice historical variations. The primary objective of the *Ice Analysts Workshops* was the assessment of differences between current practices of ice analysis and charting at the National Ice Services and estimate accuracies of ice charts to meet both operational and climate needs.

7. CAPACITY BUILDING

7.1 During the intersessional period, training workshops were held on wave and storm surge forecasting (September 2006 and December 2008) and on ice chart analysis (June 2008 and June 2009). Other capacity building events, include the International Workshop on Wave Hindcasting and Forecasting (September 2006, November 2007 and October 2009) and the JCOMM Scientific and Technical Symposium on Storm Surges (October 2007) [see agenda item 9].

8. MEETINGS HELD SINCE JCOMM-II

8.1 The following meetings were held by the SPA since JCOMM-II. Reports for these can be downloaded from http://www.jcomm.info/SPA_publications:

(a) Expert Meeting on Possible JCOMM Contributions to the Development and Maintenance of Marine Multi-Hazard Warning Systems, Geneva, Switzerland, February 2006;

(b) Expert Meeting on the Development of the JCOMM Guide to Storm Surge Forecasting, Geneva, Switzerland, February 2006;

(c) Fourth Regional TCP/JCOMM Workshop on Waves and Storm Surge Forecasting, Manila, Philippines, September 2006;

(d) Ninth International Workshop on Wave Hindcasting and Forecasting, Victoria, Canada, September 2006;

(e) Third Session of the Services Coordination Group, Exeter, United Kingdom, November 2006;

(f) Second Session of the Expert Team on Maritime Safety Services, Angra dos Reis, Brazil, January 2007;

(g) First Session of the Expert Team on Marine Accident Emergency Support, Angra dos Reis, Brazil, January 2007;

(h) Second Session of the Expert Team on Wind Waves and Storm Surges, Geneva, Switzerland, March 2007;

(i) Third Session of the Expert Team on Sea Ice and Eleventh Session of the Global Sea Ice Data Bank Steering Group, Geneva, Switzerland, March 2007;

(j) First JCOMM Scientific and Technical Symposium on Storm Surges, Seoul, Republic of Korea, October 2007;

(k) 10th International Workshop on Wave Hindcasting and Forecasting and 1st Coastal Hazards Symposium, Oahu, Hawaii, US, November 2007;

(l) OGP/JCOMM/WCRP Workshop on Climate Change and the Offshore Industry, Geneva, Switzerland, May 2008;

(m) First Joint ETSI/IICWG/GCOS Ice Analysts Workshop, Rostock, Germany, Rostock, Germany, June 2008;

(n) Joint ETWS/DBCP Workshop on Wave Measurement from Buoys, New York, US, October 2008;

(o) First Session of the Expert Team on Operational Ocean Forecasting Systems, Nice, France, November 2008;

(p) Second Session of the Expert Team on Operational Ocean Forecasting Systems, Toulouse, France, November 2008;

(q) Fifth Regional TCP/JCOMM Workshop on Waves and Storm Surge Forecasting, Melbourne, Australia, December 2008;

(r) WMO Regional Association V Storm Surge Watch Scheme, Melbourne, Australia, December 2008;

(s) First Session of the Task Team on Maritime Safety Information, Geneva, Switzerland, March 2009;

(t) Fourth Session of the Services Coordination Group, Geneva, Switzerland, March 2009;

(u) Second Joint ETSI/IICWG/GCOS Second Ice Analysts Workshop, Tromsø, Norway, June 2009;

(v) UNESCO/IOC Advisory Workshop on Enhancing Forecasting Capabilities for North Indian Ocean Storm Surges, Delhi, India, July 2009;

(w) JCOMM/CHy Coastal Inundation Forecasting Demonstration Project, Geneva, Switzerland, June/July 2009;

(x) ESA user consultation meeting on ESA Storm Surge Project, Venice, Italy, September 2009;

(y) 11th International Workshop on Wave Hindcasting and Forecasting and 2nd Coastal Hazards Symposium, Halifax, Canada, October 2009.

8.2 Expert Teams' chairpersons and other SPA experts participated in a significant number of meetings related to or relevant to SPA, including in sessions of IMO, IHO, EMSA, ESA and GOV groups and teams.

_____

BACKGROUND MATERIAL

1. List of JCOMM and related training courses held during the intersessional period (October 2005–October 2009):

Data Management Programme Area:

- JCOMM/IODE/GOOS Combined Modelling and Data Management Training Workshop (Jamboree-II), October 2006, UNESCO/IOC Project Office for IODE, Oostende, Belgium;

- Training on the Management of the End-to-End Data Management (E2EDM) prototype system, October 2007, UNESCO/IOC Project Office for IODE, Oostende, Belgium;

- Workshop on the UNESCO/IOC-IODE Ocean Data Portal (v.1.) and WIGOS Pilot Project for JCOMM. March 2009, Obninsk, Russian Federation;

- Training Course on the Establishment of National Ocean Data Portal nodes in the Black Sea region, March 2009, Obninsk, Russian Federation;

- WESTPAC Training Course for UNESCO/IOC-IODE Ocean Data Portal data providers, August/September 2009, Seoul, Republic of Korea;

- Met-ocean Modelling (Jamboree-III), October 2009, UNESCO/IOC Project Office for IODE, Oostende, Belgium.

Observations Programme Area:

- Third Port Meteorological Officers Workshop (PMO-3), March 2006, Hamburg, Germany;

- GLOSS Training Workshop Course on Sea Level Measurements and Interpretation and Related Fields, May 2006, Tokyo, Japan;

- GLOSS/ODINAFRICA Training Course on Sea Level Observation and Interpretation, November 2006, UNESCO/IOC Project Office for IODE, Oostende, Belgium;

- GLOSS Caribbean Training Course for Operators of Sea Level Stations, June 2008, Mayagüez, Puerto Rico.

Services Programme Area:

- Fourth Regional TCP/JCOMM Workshop on Waves and Storm Surge Forecasting, September 2006, Manila, Philippines;

- First Ice Analysts Workshop, Rostock, Germany, June 2008, Rostock, Germany;

- Second Ice Analysts Workshop, June 2009, Tromsø, Norway;

- Fifth Regional TCP/JCOMM workshop on Waves and Storm Surge Forecasting, December 2008, Melbourne, Australia.

2. List of other JCOMM capacity building activities held during the intersessional period (October 2005–October 2009):

Data Management Programme Area:

- Third JCOMM Workshop on Advances in Marine Climatology, May 2008, Gdynia, Poland.

Observations Programme Area:

- A Training Course on Buoy Programme Implementation and Data Management, June 2007, UNESCO/IOC Project Office for IODE, Oostende, Belgium.

Services Programme Area:

- Ninth International Workshop on Wave Hindcasting and Forecasting, September 2006, Victoria, Canada;

- First JCOMM Scientific and Technical Symposium on Storm Surges, October 2007, Seoul, Republic of Korea;

- 10th International Workshop on Wave Hindcasting and Forecasting and 1st Coastal Hazards Symposium, November 2007, Oahu, Hawaii, US;

- WMO Regional Association V Storm Surge Watch Scheme, December 2008, Melbourne, Australia;

- UNESCO/IOC Advisory Workshop on Enhancing Forecasting Capabilities for North Indian Ocean Storm Surges, July 2009, Delhi, India;

- JCOMM/CHy Coastal Inundation Forecasting Demonstration Project, June/July 2009 Geneva, Switzerland;

- 11th International Workshop on Wave Hindcasting and Forecasting and 2nd Coastal Hazards Symposium, October 2009, Halifax, Canada;

3. Training material and reports can be downloaded from http://www.jcomm.info/.

_____

BACKGROUND MATERIAL

1. BACKGROUND

WMO Information System (WIS)

1.1 In its mission as a world leader in weather, climate, water, and related environmental issues, the WMO contributes to the safety and well-being of people throughout the world, and to the societal and economic benefit of all nations. The current WMO Strategic Plan recognizes that understanding the state of the environment is essential, and that understanding depends upon the collection and open sharing of information, often using rapid and highly reliable methods. The challenge today is that Member nations of WMO need to achieve such ambitious results without a significant increase in resources. The WMO Information System (WIS) is a key strategy to optimize the efficiency and effectiveness of WMO services, leveraging the long-standing collaborative culture of WMO as well as new technologies.

1.2 In WMO planning terms, 'Development and Implementation of WIS' is Expected Result 5, part of the Science and Technology strategic thrust: to monitor and observe the environment; to forecast and warn of significant weather, water and climate conditions; and to understand the Earth system. WIS has also a critical contribution to Expected Result 4, 'Integration of WMO observing systems'. Beyond WMO, WIS will play a leading role in the weather, water, climate and natural disaster areas for the Global Earth Observation System of Systems (GEOSS). Interoperability between WIS and GEOSS will enhance accessibility to related Earth observations for WMO Members as well.

1.3 The Fourteenth WMO Congress in 2003 (Cg-XIV) formally adopted the concept of WIS, stating that an overarching approach was required for solving the data management problems for all WMO and related international programmes. The *Abridged Final Report with Resolutions* of WMO Cg-XIV states that WIS will:

- Be used for the collection and sharing of information for all WMO and related international programmes;
- Provide a flexible and extensible structure that will allow the participating centres to enhance their capabilities as their national and international responsibilities grow;
- Build upon the most successful components of existing WMO information systems in an evolutionary process;
- Pay special attention to a smooth and coordinated transition;
- Build on the Global Telecommunication System (GTS) for highly reliable delivery of time-critical data and products and base its core communication network on the Improved Main Telecommunication Network;
- Utilize international industry standards for protocols, hardware and software.

1.4 With regard to WMO communications networks, the Fifteenth WMO Congress (Cg-XV) has required WIS to be implemented in two parallel parts: Part A being the continued evolution of the GTS and Part B being the new functionality of WIS. Accordingly, WIS will incorporate the connectivity of GTS and the flexibility of new systems such as the Internet, whilst ensuring that a data management framework is able to encompass all WMO information. This is a natural evolution, building upon GTS while expanding the overall information system capabilities. However, there is a change in focus with introduction of WIS: from managing communication links to managing data and products.

2. JCOMM AND THE DEVELOPMENT OF WIS

2.1 JCOMM has been an active contributor to the development of WIS and a leader in implementing some of the new functionality of WIS with such projects as the End-to-End Data Management (E2EDM) project and the UNESCO/IOC-IODE Ocean Data Portal (ODP). The Data Management Coordination Group (DMCG) has participated with the Inter-commission Coordination Group on WIS (ICG-WIS) and the WMO Secretariat to ensure the ocean and marine communities' needs and activities are well catered for under WIS. This has included working with the IODE of UNESCO on data management and information exchange strategies including the adoption and review of the WMO core profile of ISO 19115 metadata standard, and the migration to Table Driven Code Forms (TDCF).

WIS Implementation Part A: Continued Evolution of the GTS

2.2 JCOMM's achievements under Part A of WIS are significant. The JCOMM Data Management Programme Area (DMPA) has worked with the IODE of UNESCO/IOC and the WMO Secretariat to ensure participation of relevant experts in WMO's Commission for Basic Systems (CBS) and inter-commission expert teams addressing data management and information exchange issues. This included contributions to the implementation of table driven code forms (TDCF[1]: BUFR and CREX) for ship and buoy observations, the adoption of BUFR table MT10 by GHRSST and the adoption of CREX for sea level observations in support of tsunami and multi hazard warning services. Collaboration with CBS led CBS to accept NetCDF as used by Argo, GOSUD, OceanSITES and GTSPP for exchanging information on WIS. DMPA has also worked with CBS on the many issues such as the use of XML. Participation in the WIGOS pilot project has assisted in bringing focus to observations issues such as standardization of codes and better awareness of different data representation systems used by JCOMM members.

2.3 The WMO Integrated Global Observing System (WIGOS) pilot has assisted in bringing better alignment to the way different communities describe their observation practices and data. The DMPA has also been working with instrument manufacturers on initiatives such as sensorML that will facilitate data sharing. All these activities, described in more detail in the JCOMM Data Management Plan (http://www.jcomm.info/DMPlan), help JCOMM to benefit from the data management and information exchange practices of the World Weather Watch (WWW) GTS that is a core part of WIS. This work is also ensuring that other WMO communities can learn from and benefit from JCOMM practices and procedures.

WIS Implementation Part B: New Functionalities

2.4 With regard to the new functionalities in WIS under Part B of the WIS implementation, JCOMM has made considerable progress. The work of the Expert Team on Data Management Practices (ETDMP) is a major contribution to the UNESCO/IOC-IODE Ocean Data Portal (ODP) in helping to demonstrate compliance with WIS interoperability standards so that ocean data centres can contribute to the ODP and to WIS through one system. It notes also that once compliant with WIS, a centre will also be compliant with GEOSS.

2.5 Key elements of the new functionality of WIS are the Discovery, Access and Retrieval (DAR) catalogue and use of the WMO core profile of ISO 19115 metadata standard. The marine community has already adopted the ISO19115 metadata standard for the management and sharing of metadata and, along with the IODE, has worked to establish a Marine Profile of this standard. Also, major regional developments such as SEADATANET in Europe, have adopted the same standard. One issue has been that WIS, the marine community and SEADATANET each have their own profile being developed, so a significant contribution to forwarding the adoption of this standard has been a cross comparison of the three profiles by the co-chair of IODE of

[1] TDCF – Table-driven Code Forms includes BUFR, CREX, and GRIB.

UNESCO/IOC (Mr Greg Reed) that found all profiles are compliant with the standard and therefore do not inhibit interoperability.

2.6 In addition to the WMO core profile of ISO 19115 metadata standard, WIS has adopted the use of the search standard ISO 23950, also known as Z39.50, or SRU (Search and Retrieval via URL). This search standard, also adopted by GEOSS, allows Internet search to any ISO 23950 compliant service. WIS has also developed a gateway that will allow ISO 23950 compliant servers, to interoperate with Catalogue Search for the Web (CSW). The CSW is a developing Open Geospatial Consortium (OGC) specification for search that has also been adopted by GEOSS and many Spatial Data Infrastructures such as INSPIRE in Europe. The WMO Secretariat is working with the UNESCO/IOC-IODE Project Office to incorporate ISO 23950 capability into OceanTeacher which will make information on OceanTeacher discoverable within WIS. The WMO Secretariat also participated in a workshop in Obninsk making the ODP compliant with WIS, especially for metadata.

2.7 Further implementation of metadata is being undertaken through the WIGOS Pilot Project for JCOMM, building on the ODP to ensure the interoperability of the ocean marine systems with WIS and to allow more coordination and integration of relevant observations where appropriate. To this end, UNESCO/IOC-IODE National Oceanographic Data Centres (NODC) will participate in WIS via the ODP. In addition, NODCs can also nominate through their national Permanent Representative to WMO to be designated as WIS National Centres (NC) or if they have broader regional or global roles, they can nominate as DCPCs. In the other direction, DCPCs could link also to ODP.

3. WIS DATA REPRESENTATION SYSTEM POLICY

3.1 The WMO Executive Council, at its sixty-first session (EC-LXI), noted with satisfaction that the CBS started assessing different Data Representation Systems and developing a CBS policy on Data Representation Systems driven by users' requirements. CBS-XIV (Dubrovnik, Croatia, March/April 2009) agreed that the application of the ISO 191xx series of geographic information standards to the development of a WMO conceptual model of data representation should be considered as a fundamental element of a CBS policy on data representation systems, in particular with a view to applying a standard approach for data representation, leading to the development of a WMO core profile of the ISO 191xx series for data and metadata, and with a view to facilitating the interoperability and data interchange between applications based on data representations systems associated to BUFR, CREX, GRIB, XML, NetCDF and HDF. The EC-LXI urged all WMO technical commissions, and CBS as the lead Commission, to participate actively in this activity with a view to urgently consolidating a comprehensive WIS data representation system policy.

4. PROGRESS OF THE DESIGNATION OF WIS CENTRES

4.1 The WMO Executive Council, at its sixty-first session (EC-LXI), noted that 31 WMO Members and two Organizations have identified 103 potential Data Centre or Production Centre (DCPC) and 13 potential Global Information System Centres (GISC). It has requested that CBS develop procedures to allow candidate GISCs and DCPCs to demonstrate their capabilities to the CBS extraordinary session (2010) and to submit formal designations of GISCs and DCPCs to the sixteenth WMO Congress (Cg-XVI). JCOMM has a role in this process in that the formal designation procedure for centres to participate in WIS requires the support of their relative technical commission or regional association. Centres identified for JCOMM so far include the NODCs in Obninsk, Russian Federation and Silver Spring, USA, the Global Collecting Centre in Hamburg, a Marine Observations Centre in Exeter, and a proposed Marine Meteorology Centre (Croatia) for the Eastern Adriatic.

4.2 In identifying potential centres, the ICG-WIS found that of the 13 centres offering to host a GISC, eight of them are proposing to have their centres operational before the Sixteenth

WMO Congress in 2011, and at least three of those will be functional by the last half of 2010. Similarly, many of the DCPCs are planning to make operational the new functionality of WIS in line with the availability of GISCs. To this end, and recalling that Part A of WIS is the ongoing evolution of the existing GTS, WIS has clearly moved from its development stage to an implementation stage and should be significantly functional by the next session of JCOMM.

_____

BACKGROUND MATERIAL

Implementation of the WIGOS concept

1. The Fifteenth WMO Congress (WMO Cg-XV, May 2007) stressed that enhanced integration between the WMO and WMO-sponsored observing systems was expected to generate important benefits for its Members, their National Meteorological and Hydrological Services and for the Organization as a whole; it agreed to refer to that initiative by the acronym WIGOS (WMO Integrated Global Observing System) and adopted Resolution 30 (Cg-XV) – Towards enhanced integration between WMO observing systems.

2. Acting accordingly, the WMO Executive Council, at its fifty-ninth session (WMO EC-LIX, June 2007), established the Executive Council Working Group on the WMO Integrated Global Observing System and the WMO Information System (EC WG on WIGOS-WIS) to steer and monitor WIGOS activities and to coordinate them with the planning and development of WIS – Resolution 3 (EC-LIX). The EC WG drafted the WIGOS Concept of Operations (CONOPS) and WIGOS Development and Implementation Plan (WDIP), further reviewed and approved by EC-LX and EC-LXI, which can be downloaded from http://www.wmo.int/pages/prog/www/wigos/index_en.html.

3. Following the guidance given by WMO Cg-XV, five WIGOS Pilot Projects have been initiated, including the *Integration of Marine Meteorological and Other Appropriate Oceanic Observations into the WMO Global Observing System (GOS)*.

4. The WMO EC WG on WIGOS-WIS decided to include Demonstration Projects (DPs) on the Development and Implementation of WIGOS at NMHSs into WDIP. The WMO EC-LX (June 2008) recommended supporting the involvement of the NMHSs and the regional associations in the implementation of the WIGOS concept as crucial to ensure important benefits for all Members. The following countries took the initiative and formally agreed to implement DPs in their NMHSs: Kenya, Morocco, and Namibia (RA I), Republic of Korea (RA II), Brazil (RA III), the United States of America (RA IV), Australia (RA V) and the Russian Federation (RA VI).

WIGOS Pilot Project for JCOMM

5. In response to the WMO Cg-XV and EC-LIX, JCOMM has initiated a Pilot Project (PP) for the integration of *in situ* and space-based marine meteorological and other appropriate oceanic observations into the WMO Global Observing System (GOS), named WIGOS Pilot Project for JCOMM. The PP is being implemented and sustained by the WMO Members and UNESCO/IOC Member States, coordinated by JCOMM and the IODE of UNESCO/IOC, in order to prove concept, enhance standardization in terms of practices for instruments, improve quality management, and make appropriate key data sets (e.g. World Ocean Database, upper ocean thermal data from Argo profiling floats and XBTs, Deep Ocean time-series multi-disciplinary reference stations, high resolution SST from satellites, sea level stations, marine climatological data sets, satellite data, etc.) available in real-time and delayed mode to WMO and UNESCO/IOC applications. Access to these ocean data sets will be facilitated through the development of specific interoperability arrangements between the corresponding ocean data systems and the UNESCO/IOC-IODE Ocean Data Portal (ODP) and/or the WMO Information System (WIS), as well as ODP connectivity to the WIS. The Pilot Project is recommending producing data sets according to agreed upon standards and documenting the quality control procedures according to QMS principles. This integration is expected to enhance the coherence and consistency of the data sets and the availability of relevant instrument/platform metadata in order to permit traceability of the observations to standards, appropriate bias correction and effective quality monitoring. More timely and better quality data are expected while duplicates will be minimized.

6. This integration process ensures the continued partnership and participation of the UNESCO/IOC, which is responsible for the majority of the components of the Global Ocean

Observing System (GOOS), including UNESCO/IOC's IODE programme and its system of National Oceanographic Data Centres (NODCs), as they become part of an integrated system of systems with sustained sense of ownership. The Pilot Project is expected to demonstrate the strong and growing level of collaboration and coordination between the WMO and UNESCO/IOC stakeholders both striving to enhance and sustain global ocean observing networks and provide free and unrestricted data access, in line with the WMO and UNESCO/IOC data policies (respectively, WMO Congress Resolutions 40 (WMO Cg-XII) and 25 (WMO Cg-XIII), and the IOC Oceanographic Data Exchange Policy). Detailed information is available at http://www.wmo.int/pages/prog/www/wigos/marine_pp.html and http://www.iode.org/wigos.

7. In line with the Concept of Operations (CONOPS), the PP has developed comprehensive project and implementation plans, which include three major deliverables:

- Document and integrate instrument best practices and related standards – the goal is to define and agree on common standards between the meteorological and oceanographic communities for instruments and methods of observation as well as subsequent organization and handling of the data and information to serve consistent and better quality data to both the broad user and modelling communities. In this context, the PP promotes the development of a strong collaboration between JCOMM, CIMO and the Association of Hydro-Meteorological Equipment Industry (HMEI). This component of the PP addresses: (i) standardization of practices for instruments; (ii) the establishment of Regional Marine Instrument Centres (RMIC), including support for instrument/platform intercomparisons to ensure data homogeneity; (iii) the collection of instrument/platform metadata necessary to interpret the data correctly, increase the data coherence (e.g. bias correction), and for traceability of data to standards; (iv) enhanced cooperation with the manufacturers; and (v) updating of the WMO and UNESCO/IOC technical regulations in the framework of WIGOS [see also agenda item 6.2];

- Build marine data systems that are interoperable with the WIS – the goal is to provide access to marine meteorological and oceanographic data and information to serve a number of applications, including climate. This shall be done in an integrated way via the WIS or the UNESCO/IOC-IODE ODP and thereby facilitating access to well documented and standardized data. The Pilot Project proposes to achieve interoperability with WIS mainly through: (i) ocean data centres contributing to the UNESCO/IOC-IODE ODP; and (ii) UNESCO/IOC-IODE ODP becoming fully interoperable with the WIS. Much work remains to develop interoperability between the WMO and UNESCO/IOC communities at both the data discovery (metadata) and data level (compatible formats) [see agenda items 7 and 10.1];

- Promote Quality Management and standards – the goal is to coordinate the development of cost-effective Quality Management Systems by Members/Member States and to propose practical solutions or examples. During the different stages of the data production line, it is anticipated that improved quality management will result in better, timelier data, minimized duplication, and an operational data delivery system. This will be achieved through the compilation of regulatory documentation in a way consistent with the eight Quality Management Principles developed under ISO/TC176/SC2/WG15 (User/customer focus, Leadership, Involvement of people, Process approach, System approach to management, Continual improvements, Factual approach for decision making, Mutually beneficial supplier relationships). The IODE-JCOMM Ocean Data Standards Pilot Project (details available at http://www.oceandatastandards.org) will also provide a framework for the PP to further the development of appropriate widely accepted quality management standards to address issues such as instrument best practices, real-time and delayed-mode quality control procedures (automatic and/or manual), data collection and exchange formats, and products using the observational data [see agenda item 11.2].

8. Two meetings were held to develop and initiate the implementation of the WIGOS Pilot Project for JCOMM. Reports for these can be downloaded from http://www.wmo.int/pages/prog/www/wigos/marine_pp.html:

- *Ad hoc* planning meeting for the WIGOS Pilot Project for JCOMM, Ostend, Belgium, March 2008;
- Meeting of the PP Joint Steering Group (PP-JSG) for the UNESCO/IOC-IODE Ocean Data Portal and the WIGOS Pilot Project for JCOMM, Geneva, Switzerland, September 2008.

9. Issues related to the WIGOS Pilot Project for JCOMM were also addressed in other JCOMM and UNESCO/IOC-IODE meetings. Reports for these can be downloaded from http://www.jcomm.info/Publications:

- Twenty-fourth Session of the Data Buoy Cooperation Panel (DBCP), Cape Town, South Africa, October 2008;
- End-to-end Data Management (E2E) workshop, Obninsk, Russian Federation, March 2009;
- Twentieth Session of the UNESCO/IOC International Oceanographic Data and Information Exchange (IODE), Beijing, China, May 2009;
- Fifth Session of the JCOMM Ship Observations Team (SOT), Geneva, Switzerland, May 2009.

10. Major outcomes of these meetings include:

- Progress in further improving ODP-version 1 for connecting specific data sets to ODP and WIS, and the development of a plan for the ODP-version 2 in the next two years;
- The development of a Catalogue of Best Practices and Standards under JCOMM [see agenda item 11.2];
- The demonstration of a new ODP functionality which addresses the issue of security (Light Data Provider);
- The development of an *Oceanographer's and Marine Meteorologist's Cookbook for Submitting Data in Real Time and in Delayed Mode*.

11. Additionally:

- The DBCP agreed to make efforts to integrate its Best Practices into the WIGOS as appropriate, and recommended that the buoy manufacturers establish links with the HMEI;
- The SOT discussed: (i) a proposal to have the ship metadata from WMO-No. 47 eventually included as part of WIS, and the regulatory part included in the future WIS manual; and (ii) a proposal to integrate the VOS Climate Project (VOSClim) vessels as an additional class of VOS. Moreover, the SOT will review the WMO Technical Regulations in the view to achieve better standardization of instrument best practices;
- While recognizing that it was difficult at this point in the PP to make precise recommendations regarding the convergence of the WMO Core Metadata Profile, and

other ISO 19115 metadata profiles used in the marine community (e.g. Marine Community Profile (MCP), SeaDataNET Common Data Index (CDI)), the PP-JSG recommended to submit MCP and/or any other relevant metadata profiles through the IODE-JCOMM Ocean Data Standards Pilot Project for review by a wider user community. This process would help MCP to build on WIS specifications and for the development of specific recommendations that will achieve interoperability with WIS.

12. The PP-JSG identified thirteen potential partners and data contributors for providing key data sets to the PP. A joint WMO-IOC letter was sent to them. The following agencies replied favourably and further discussions took place with them:

- The Integrated Science Data Management (ISDM, Canada) for buoy data;
- The Australian Ocean Data Centre Joint Facility (AODCJF, Australia) for XBT data;
- The National Oceanic and Atmospheric Administration (NOAA, USA) for the International Comprehensive Ocean-Atmosphere Data Set (ICOADS), the Water Temperature Metadata Pilot Project (META-T), the World Ocean Atlas (WOA), the World Ocean Database (WOD), the Global High Resolution SST Pilot Project (GHRSST), the Global Temperature and Salinity Profile Programme (GTSPP);
- The Met Office (UK) and the Deutscher WetterDienst (DWD, Germany) for the Marine Climatology Summaries Scheme (MCSS) Global Collecting Centres (GCCs).

13. Potential benefits that the Meteorological and Oceanographic agencies could gain from developing the PP have been included in the Project Plan. Based on gained experience with partners and other WIGOS PPs and DPs, a document describing the benefits of the PP, focusing initially on the NODCs, will be produced towards the end of the PP and is intended to be used by the Directors of NODCs to generate national support for the development of interoperable arrangements between NODCs and WIS. The document will facilitate decision making regarding essential software/hardware developments.

14. In terms of Capacity Building, the PP is focusing on the cooperation of developing countries in the Ocean Data Portal project, the need for collaboration in the development of training materials between WMO and UNESCO/IOC on topics related to JCOMM, the promotion of WIGOS at the national level, and the organization of training courses in topics relevant to the WIGOS Pilot Project for JCOMM. The following training courses were held:

- ODINBlackSea training course on the establishment of national Ocean Data Portal nodes in the Black Sea region, Obninsk, Russian Federation, March 2009;
- ODIN-WESTPAC training course establishment of national Ocean Data Portal nodes, Seoul, Republic of Korea, September 2009.

_____

BACKGROUND MATERIAL

Development of the WMO Quality Management Framework (WMO-QMF)

1. The WMO Congress, at its fourteenth session (May 2003), decided through the adoption of Resolution 27 (Cg-XIV), that WMO should work towards a quality management framework (QMF) for NMHSs. It was envisaged that such a framework would eventually be comprised of WMO technical standards, quality management system(s) (QMS), including quality control, and certification procedure(s). It also requested the technical commissions:

(a) To maintain an up-to-date catalogue of all technical publications applicable to the WMO Quality Management Framework and review these publications according to quality management principles;

(b) To provide, following the guidance of the Executive Council, necessary contributions to Volume IV of the WMO Technical Regulations for adoption at the earliest possible date;

(c) To provide, quality-related technical guidance, advice, review and assessment, as appropriate.

2. In support of the development of the WMO-QMF, the fifty-sixth session of the Executive Council (June 2004) through Resolution 8 (EC-LVI) established an Inter-Commission Task Team on the Quality Management Framework (ICTT QMF).

3. The WMO Congress, at its fifteenth session (May 2007), adopted two QMF-related resolutions:

(a) Resolution 31 (Cg-XV) Implementation of Quality Management Systems (QMS) by National Meteorological and Hydrological Services;

(b) Resolution 32 (Cg-XV) WMO Quality Management Framework including Annex to Resolution 32 (Cg-XV) WMO Quality Policy.

4. Through Resolution 31 (Cg-XV), Congress encourages NMHSs to implement a QMS covering, if possible, most of their activities, or at least those they consider critical to the provision of data, products and services. It encourages NMHSs to implement, where possible, a QMS following, as far as possible, the latest version of the ISO 9001 quality management standard, or other appropriate internationally recognized standards, for the managerial processes, as necessary. Nevertheless, Congress recognized that the adoption and implementation of a QMS is customer-driven and country-specific.

5. Resolution 32 (Cg-XV) recognizes the Quality Management Framework as an appropriate holistic approach for the delivery of data, products and services that is based on the 8 quality management principles[1] of quality management and that it can be implemented through structured quality management systems. Congress also recognized that the implementation of the WMO QMF should result in the exchange of data and products of known and sufficient quality for their intended use. The aim of the WMO QMF is the development, use and maintenance of the WMO technical documentation that may be used in developing QMSs for the provision of data, products and services by NMHSs.

[1] The 8 quality management principles, developed by ISO/TC176/SC2/WG15, are available on the ISO website and include: user/customer focus; leadership; involvement of people; process approach; systems approach to management; continual improvements; factual approach for decision making; and mutually beneficial supplier relationships.

6. The WMO Executive Council, at its sixtieth session (June 2008), emphasized the requirements for developing suitable technical publications to provide the necessary advice to technical commissions in reviewing the existing documents and adjusting them to Quality Management System (QMS) requirements and preparing and publishing the necessary updates.

7. WMO is now recognized as an international standardizing body by the International Organization for Standardization (ISO) and the agreement between ISO and WMO was adopted in September 2008, giving WMO the status and authority for the development of international standards related to meteorological, climatological, hydrological, marine and related environmental data, products and services. The establishment of ISO-recognized WMO standards and regulations is expected to increase user confidence in the quality of the services provided; thus strengthening the NMHSs' position in an increasingly competitive environment. Such a status will enable WMO Members to use the WMO technical publications in the same way as ISO documents in their quest for ISO 9000 certification. Detailed information is available at http://www.wmo.int/pages/prog/www/QMF-Web/home.html.

8. The ICTT-QMF has discussed the necessary elements associated with the implementation of the WMO-QMF, including the further development of Volume IV on Quality Management within the Technical Regulations to address in general the topic of quality management. The Volume IV on "Quality Management" of the Technical Regulations proposed to be generic and describe the WMO-QMF as a coordinated approach to the delivery of meteorological, climatological, hydrological, marine and related environment data, products and services. Its draft includes the WMO quality policy, the eight quality management principles, the roles of the WMO constituent bodies and the harmonized approaches to quality management among the technical commissions. Draft available at http://www.wmo.int/pages/prog/www/QMF-Web/Documentation/WMOGuides/WMO-49_TechRegulations_Vol-IV-QMF.pdf. A guide on quality management that should assist Members in the establishment of a QMS is also proposed. This guide would be very generic and give guidance on general concerns of Members.

9. The WMO Executive Council, at its sixty-first session (June 2009), through Resolution 4.2/1 (EC-LXI) established procedures to be followed by all technical commissions and EC working groups in proposing common ISO/WMO Technical Standards. Detailed information is given in the *Abridged Final Report with Resolutions of the Sixty-first Session of the WMO Executive Council* (WMO-No. 1042) available at:
http://www.wmo.int/pages/governance/ec/ec_docs_en.html.

Development of Standards and Best Practices under JCOMM

10. JCOMM and its predecessors have been engaged on the: (1) global coordination, standardization and regulation of the provision of marine meteorological services; and (2) recommendation of best practices in instrumentation, observations and data quality control for the different specialized components of the ocean observing system. The results of this work have been consolidated in a number of WMO and UNESCO/IOC publications.

11. The first (June 2001) and second (September 2005) sessions of JCOMM addressed the importance of and role of JCOMM in evaluating and setting standards for instruments, observations and data management practices. JCOMM-II further recognized the role of the Commission in developing standards and nomenclature for products and services. The JCOMM Management Committee, at its sixth session (Paris, December 2007), agreed on a number of components to address these issues:

(a) Compilation of existing standards and best practices material under JCOMM into a catalogue;

(b) Implementation of a strategy for updating and maintaining existing material;

(c) Implementation of a strategy for identifying and filling gaps.

12. A Catalogue of Best Practices and Standards under JCOMM and IODE of UNESCO/IOC has been prepared by Mr Robert Gelfeld and a test site has been published on the web at http://bestpractice.iode.org/ by the UNESCO/IOC Project Office for IODE. This catalogue contains a list of documents and publications that include best practices and standards relevant to JCOMM, and will help to identify deficiencies, duplication, discrepancies, and the potential for cross-referencing. Sixty-four documents and publications have been identified for inclusion in the catalogue, which provides the following information:

TITLE – title of publication or document
CREATOR – general WMO, UNESCO/IOC, JCOMM Group, Panel or Task Team
IDENTIFIER – publication or document number
RELATION – other associated publication or document number (including revision)
SUBJECT – general subject descriptor
DESCRIPTION – short abstract
PUBLISHER – actual WMO, UNESCO/IOC, JCOMM Group, Panel or Task Team
DATE – year published
STANDARD TYPE – text description of standard addressed
FORMAT – hyperlink to URL where publication or document can be found
SOURCE – specific WMO, UNESCO/IOC, JCOMM Group, Panel or Task Team
COVERAGE – geographic coverage
STATUS – current status or recommendation

13. Recognizing that although there were mechanisms to help coordinating ocean data exchange, these had not resulted in the degree of agreement on a wide range of matters that are needed in order to allow the easy exchange and interoperability of data collected. In this context, JCOMM, in cooperation with the IODE of UNESCO/IOC set up a process for adopting standards related to ocean data management and exchange. The standards that are produced by this process are intended primarily for the use of the marine meteorological and oceanographic community. If they have wider applicability, these may be submitted to appropriate international standards bodies, such as ISO, taking into account the procedures to be followed by all technical commissions in proposing common ISO/WMO Technical Standards (as described in paragraph 9 of this report). Detailed information on the above-mentioned standards process is available at http://www.oceandatastandards.org. Detailed information on the IODE-JCOMM standards process is provided under agenda item 7.3.

14. The IODE-JCOMM standards process also provides a framework for the WIGOS Pilot Project for JCOMM to further develop appropriate and widely accepted quality management standards to address issues such as instrument best practices, real-time and delayed-mode quality control procedures (automatic and/or manual), data collection and exchange formats, and products using observational data. Detailed information on instrument best practices is provided under agenda item 6.2 and on the WIGOS under agenda item 10.2.

Quality Management System for the Provision of Met-ocean Services

15. The ICTT-QMF, at its third session (October 2008), recognized the need for a Quality Management System for the provision of met-ocean services for international navigation, and suggested JCOMM to develop such a system in liaison with IMO, using CAeM as an example, where a clear customer requirements, feedback and process is in place through ICAO.

16. Additionally, the WMO EC-LXI recognized the need for the development of a Quality Management System (QMS) for the provision of marine meteorological services for international navigation. It therefore requested the WMO Secretary-General, in liaison with the IMO, to integrate Quality Management (QM) principles in the regulatory documents on marine meteorological services. The Council urged WMO Members to implement QMS for the provision of marine

meteorological services for international navigation and to document the process in order to share with other NMHSs, with a view to facilitating and expending QMS implementations.

17. The Australian Bureau of Meteorology had already commenced a quality management initiative and in doing so had achieved certification of compliance with the AS/NZS ISO 9001:2008 Quality Management Standard for the delivery of aviation weather services. In September 2009 the Bureau had begun broadening the scope of its quality management system, and among others, it was to include the delivery of marine weather services.

User and customer requirements

18. The International Maritime Organization (IMO) resolution A.705(17) on promulgation of maritime safety information was adopted by IMO/MSC-85 (2008). The resolution set out the organization, standards and methods which should be used for the promulgation and reception of maritime safety information, including navigational and meteorological warnings, meteorological forecasts and other urgent safety-related messages broadcast to ships, as documented in the International Convention of Safety of Life at Sea (SOLAS). The WMO EC-LXI (June 2009) requested the WMO Secretary-General to establish and develop, in collaboration with the IMO, terms of reference for an IMO/WMO World-Wide Met-ocean Information and Warning Service (WWMIWS), to complement the existing IMO/International Hydrographic Organization (IHO) World-Wide Navigational Warning Services (WWNWS, IMO resolution A.706(17)), in order to clearly define the requirements for the provision of marine meteorological services for international navigation, for consideration by WMO EC-LXII (2010).

User feedback

19. A marine meteorological services (MMS) monitoring programme was initiated by the WMO Commission for Marine Meteorology (CMM) in 1981 and user surveys have been conducted every four years, with the questionnaires distributed to shipmasters through national PMOs. The analysis of the 2009 survey results is provided under agenda item 8.3 on service delivery.

Process

20. The *Manual on Marine Meteorological Services* (WMO-No. 558), the *Joint IMO/IHO/WMO Manual on Maritime Safety Information*, the *NAVTEX Manual* and the *International SafetyNET Manual* provide technical regulations and standard instructions for the promulgation and reception of maritime safety information, including marine meteorological services, as stated in SOLAS.

_____

PROGRESS/ACTIVITY REPORT

1. PROGRAMMES AND BODIES OF WMO

1.1 WMO Space Programme (SAT)

1.1.1 The Space Programme Website (http://www.wmo.int/pages/prog/sat/index_en.html) provides an overview of the Programme activities and contains a wide range of reference information such as schedule of events, glossary, high-level information on satellite missions, detailed instrument characteristics, reference documents, meeting reports and working documents for upcoming meetings. It includes a section maintained on behalf of CGMS (http://cgms.wmo.int), now complemented by information from EUMETSAT as the CGMS Secretariat. Many links are provided to the websites of space agencies and other relevant organizations for further information.

1.1.2 In order to enhance the space-based Global Observing System (GOS), in addition to gathering the observing requirements through the WMO/CBS Rolling Review of Requirements (RRR) [see agenda item 5], the SAT assess space-based observing capabilities, through maintaining information on satellite status, launch plans, and detailed instruments characteristics. This information is made available at http://www.wmo.int/pages/prog/ sat/Satellites.html in cooperation with CGMS.

1.1.3 A thorough analysis and assessment of current satellite plans has been performed and presented to CGMS. This resulted in a four-volume Dossier on the space-based Global Observing System in 2008 including:

- Description of satellite programmes;
- Detailed Earth-Observation instrument characteristics;
- Gap Analysis; and
- Estimated performance of products derived from generic instruments types.

This Dossier has been recognized as a useful reference for satellite mission planning purposes, and is available at http://www.wmo.int/pages/prog/sat/Refdocuments.html#spacebasedgos.

1.1.4 ET-SAT and ET-SUP-4 have developed “Guidelines to WMO for facilitating the transition of relevant R&D missions or instruments to operational status”. These guidelines are available at http://www.wmo.int/pages/prog/sat/documents/SAT-ST-07_GuidelinesfortransitionofRDtooperations.pdf.

1.1.5 Through the requirements formulated by GCOS, an effort titled Sustained Coordinated Processing of Environmental satellite data for Climate Monitoring (SCOPE-CM) has been established. Following the adoption of an Implementation Plan in November 2007, participants have agreed upon a first set of variables and products to be generated, identified organizational teams to take responsibility for each of them, and defined a decision process and a timetable to initiate the implementation of SCOPE-CM activities. Five pilot project proposals have been approved primarily in the atmospheric domain. We are seeking an oceanic domain pilot project.

1.1.6 Activities to enhance the availability of satellite data and products worldwide include two projects: the global network of Regional ATOVS Retransmission Systems (RARS) and the Integrated Global Data Dissemination Service (IGDDS), as well as establishing a Task Force on Satellite Data Codes. These actions are conducted within the overall framework of the development and implementation of the WMO Information System (WIS). Detailed information

about these projects is available at http://www.wmo.int/pages/prog/sat/RARS.html and http://www.wmo.int/pages/prog/sat/Igdds.html, respectively.

1.1.7 A new five-year training strategy for the Virtual Laboratory for Education and Training in Satellite Meteorology has been developed which builds on the lessons learned following the first five years of implementation of the Virtual Laboratory (see http://www.wmo.int/pages/prog/sat/CGMS/ documents/VL_STR.pdf). Key elements of the new training strategy are to:

- Further implement Centres of Excellence in order to cover the needs of all WMO Regions in WMO official languages;
- Strengthen the Virtual Resource Library and make it accessible through a unique portal;
- Conduct training events through a blended learning approach, combining distance and face-to-face learning;
- Maintain updated skills and support sharing of knowledge through regular online briefings ("Regional Focus Groups") following the successful example of Central America.

1.1.8 Access and use of satellite data and products by WMO Members are monitored through a biennial enquiry, analyzed by members of the Expert Team on Satellite Utilization and Products (ET-SUP) and results are generally published as WMO Technical Documents. Within the last reporting period, 76 % of the respondents reported an increase in the access to satellite data and yet five Members declared that they still do not have any access to satellite data. Precipitation rate, lightning detection, atmospheric instability index and wind speed over sea surface are reported by many users as among the most important parameters but still unavailable.

1.1.9 SAT represents WMO in the Consultative Meeting for High-level Policy on Satellite Matters (CM), the Coordination Group for Meteorological Satellites (CGMS) and the Committee on Earth Observation Satellites (CEOS). In particular, coordination among the WMO Space Programme, CGMS and CEOS is of critical importance in several topical areas - instrument calibration (with complementary activities of GSICS and the CEOS Working Group on Calibration Validation), updating and analyzing information related to satellite missions and plans, and the Virtual Constellations. The Ocean Surface Topography (OST) and Ocean Colour (OC) Virtual Constellations should be of particular interest to JCOMM.

1.1.10 The Expert Team on Satellite Systems (ET-SAT), comprised of satellite agencies, and the Expert Team on Satellite Utilization and Products (ET-SUP), comprised of representatives from user and training communities are key elements of the WMO Space Programme. Topics including training strategies, user information, user enquiries, Vision of the GOS, Gap Analysis, and R&D to operations transitions are discussed. In discussions between representatives from JCOMM and the WMO Secretariat over the last year, it was recommended that more attention be given to broadening the membership of ET-SUP to include experts with specific knowledge of oceanic and satellite matters. A letter requesting that one or two experts be appointed by JCOMM to ET-SUP has been sent to the JCOMM co-presidents, which nominated Dr Jean-Louis Fellous and Dr Craig Donlon to represent JCOMM at the ET-SUP.

1.2 Disaster Risk Reduction (DRR) Programme

1.2.1 The Fifteenth WMO Congress approved the strategic goals of WMO in disaster risk reduction, derived from the Hyogo Framework for Action 2005-2015 (HFA), and decided to include them as part of the WMO Strategic Plan (Geneva, May 2007). This action plan is being implemented through a coordinated approach leveraging activities of WMO and external partners.

1.2.2 One of the main drivers for the WMO national and regional DRR project planning is the outcome of the detailed fact-finding survey conducted by the DRR Programme in 2006 in cooperation with other technical programmes and the Development and Regional Activities Department. The survey assessed the capacities, gaps and needs of the NMHSs in supporting disaster risk management decisions. The survey addressed five primary areas, including:

(i) Identification and prioritization of hazards affecting WMO Members and NMHSs ability to monitor, archive and provide hazard information;

(ii) Identification of the national policies and legislation in disaster risk management and reflection of the role of the NMHSs;

(iii) Observational network and institutional capacities for monitoring, detecting and forecasting of hazards;

(iv) Technical capacity and needs of the NMHSs in areas such as hazard analysis and early warning systems to support different components of disaster risk management;

(v) Extent of partnerships and concept of operations between the NMHSs and their partners in disaster risk management.

1.2.3 The survey was disseminated to 187 Members of WMO, of which 139 countries provided responses. The survey results have been analyzed and a report is available on line at: http://www.wmo.int/pages/prog/drr/natRegCap_en.html and all individual surveys are available through a database, at WMO Secretariat. In summary, the survey indicated that droughts, flash and river floods, strong winds, severe storms, tropical cyclones, storm surges, forest fires, heat waves, landslides and meteorological hazards linked to aviation were the top ten hazards of concern to all Members. While some NMHS archive hazard data, the survey confirmed that of the 139 NMHS that responded to the survey, over 90% requested guidance on standard methodologies for monitoring, archiving, analysis and mapping of these hazards.

1.2.4 The DRR Programme has been working with all relevant technical programmes, the Development and Regional Activities (DRA) Department, the Resource Mobilization Office within the WMO Secretariat, and a group of external partners to facilitate a coordinated approach for the implementation of the DRR projects. In summary, these projects fall into six types:

(i) *Comprehensive Modernization and DRR Capacity development of NMHSs* – These projects are led by the World Bank and International Strategy for Disaster Risk Reduction (ISDR), with WMO, UNDP and regional Economic Grouping as primary partners. These projects aim to develop three major areas including: (i) development of national disaster risk management strategies, policies/legislation and institutional capacities (World Bank, ISDR, UNDP); (ii) modernization and capacity developments of NMHS to support disaster risk management (WMO); and (iii) development of financial risk transfer mechanisms (World Bank);

(ii) *Technical Guidelines:* These fall into three primary areas, including development of guidelines for: (i) standardization of hazard monitoring, archiving and mapping tools; (ii) hazard modelling and forecasting (e.g., Storm Surge and heat/health warnings); and (iii) role of NMHSs in coordination and cooperation aspects of early warning systems with multi-hazard approach;

(iii) *Projects for Technical Capacity Development of NMHS* – A number of technical capacity development projects are underway including severe weather forecasting demonstration and nowcasting, flash flood guidance, sand and dust storm forecasting and warning system, drought monitoring and management, and storm surge watches;

(iv) *Shanghai Multi-Hazard Early Warning Systems Demonstration Project* – This multi-hazard project was initiated in 2007. This project provides technical capacity development in nowcasting and forecasting of various hazards to the NMHS, through a coordinated approach involving all relevant WMO technical programmes. This approach is being demonstrated with the goal to scale up to other countries in need of technical capacity development requiring a multi-hazard approach;

(v) *Pilot Projects on National EWS Partnerships & ConOps* – These types of projects are developed to optimize the utilization of existing tools, methodologies and information of the NMHS through the development of sustainable partnerships with disaster risk management agencies and authorities from the federal through the local levels;

(vi) *Project on Meteorological Services for Improved Humanitarian Planning and Response* - WMO facilitates the provision of meteorological assistance and information from the National Meteorological Centres and Regional Specialized Meteorological Centres (RSMC) serving the region that would enable the UN Department of Humanitarian Assistance (DHA), the predecessor of United Nations Office for Coordination of Humanitarian Affairs (UN-OCHA) to provide the required assistance.

1.2.5 Systematic implementation of the DRR Programme through the technical commissions and regional associations remains as one of the major strategic challenges in the implementation of this crosscutting Programme. For technical activities, the preferred way to work is through the technical commissions. The Terms of Reference of the technical commissions indicates that no technical commission has explicitly identified DRR as a distinct activity. CBS has an active rapporteur who has been instrumental in putting DRR issues on the agenda and priorities of CBS, while all other Commissions have essentially assumed that DRR is taken care of in the normal course of the Commission's work. The result is that the DRR Programme has no easy way of focusing experts in the Commissions on activities that are directed explicitly at the priorities and needs of NMHSs and development opportunities in disaster risk management. To the present time, work with the technical commissions has been undertaken on an opportunistic basis.

1.3 Global Data-processing and Forecasting System (GDPFS) and its Severe Weather Forecasting Demonstration Project (SWFDP)

1.3.1 The "SWFDP" is a project initiated by the Commission for Basic Systems (CBS) to further explore and enhance the use of outputs of existing NWP systems of the GDPFS, including ensemble prediction systems (EPS). Its aim is to contribute to capacity building and to help developing countries in particular to be able to access and make the best possible use of existing NWP products to improve forecasts and warnings of hazardous weather conditions. Global-scale products, as well as data, other products and information provided by other regional centres (e.g. limited-area NWP), are integrated and synthesized by a WMO designated Regional Specialized Meteorological Centre (RSMC). These, in turn, provide daily guidance for short-range (days 1 and 2) and medium-range (out to day 5) on heavy rain and strong winds to participating National Meteorological Centres of the region. This is implementing a "Cascading" concept of the forecasting process. A CBS Project Steering Group provides the general direction for SWFDP. Two documents have been developed for this purpose: "SWFDP Overall Project Plan" (rev. June 2008), and "Guidebook for Planning Regional Subprojects" (rev. September 2008).

1.3.2 The SWFDP in it first implementation in Southeast Africa completed its one-year field phase in November 2007. It focused on improving weather forecasting and warning services for heavy rain and strong winds and involved global and regional centres to build the capacity of the NMHSs of Botswana, Madagascar, Mozambique, Tanzania, and Zimbabwe. The participating global centres included ECMWF, NCEP (US), and Met Office (UK). The participating regional centres included RSMC Pretoria, RSMC La Réunion (Tropical Cyclone forecasting) and ACMAD. A final report has been drafted on this first regional subproject of SWFDP and is available at http://www.wmo.int/pages/prog/www/DPFS/Reports/SWFDP%20FINAL%20REPORT_27feb08.pdf. In

the SWFDP in southern Africa, in addition to the expansion into all sixteen countries of the region, RSMC Pretoria intended to extend its regional guidance role to include marine forecasting and to consider future incorporation of additional aspects, such as for aviation and flood forecasting, and a web-based system for exchange and display of warnings in the region. CBS has recently initiated, in collaboration with JCOMM, a SWFDP for the South Pacific Islands (WMO Regional Association V), which includes a component on damaging waves.

1.3.3 The SWFDP concept is considered to provide a mechanism for accelerating technology transfer to developing countries and as a near operational facility for implementing existing and proven, or new, technologies and products to improve public weather services and national capability to reduce the risk of disasters. It is focused on the implementation of existing and proven operational technologies and their outputs (NWP- and EPS-based products for medium-range forecasting, or NWP or satellite-based or radar-based products for very short-range forecasting, etc.). However, once the SWFDP near-operational demonstration framework has been established and working within an actual implemented project, it could be considered as a possible vehicle for the implementation of additional specialized NWP, including Limited Area Models (LAM), for various sector specific applications, such as for the provision of marine meteorological forecasting services (e.g. sea-state prediction).

1.3.4 The SWFDP is already addressing issues pertinent to marine meteorological forecasting, in particular associated with strong surface winds and heavy precipitation. Marine meteorological hazards such as poor visibility and fog, and ice accretion (major hazards for all vessels, in addition to extreme sea state conditions) can be predicted from NWP model variables or parameters. Post-processing diagnostic tools, requiring fine-tuning to local/regional data, are also available. Many NMHSs of developing countries do not currently have the capacity to produce model forecasts of the required parameters and run the post-processing diagnostic tools on their own, but would greatly benefit from the “cascading” approach of RSMC’s running such models and tools for other NMHSs of the region. SWFDP training that is provided on the GDPFS and PWS aspects indirectly benefit marine meteorological forecasting, as many of the trained forecasters also carry out marine-related forecasting duties.

1.3.5 The JCOMM Expert Team on Wind Waves and Storm Surges (ETWS) has inventoried the existing operational sea-state models and forecasting systems, and noted that these are widely available among the existing network of Regional Specialized Meteorological Centres (RSMCs) of the Global Data-processing and Forecasting System (GDPFS). Therefore, an additional consideration could be the possible recognition of a role that a regional centre might have in the Cascading Forecasting Process for Marine Forecasting Services aspects. The current GDPFS does not include specifically such a RSMC with this activity specialization.

1.4 JCOMM Interactions with other WMO Programmes and Technical Commissions

1.4.1 JCOMM has been interacting with the WMO Technical Commissions, primary and foremost, the Commission for Basic Systems and the Commission for Instruments and Methods of Observations, on observing and data management issues, including the WMO Integrated Global Observing Systems (WIGOS), the WMO Information System (WIS) and instrumentation aspects. These interactions were addressed under the relevant agenda items.

1.4.2 Following the request by the WMO Executive Council, in its sixtieth session (June 2008), to JCOMM, CAS and CHy, in close cooperation with other relevant UNESCO/IOC subsidiary bodies, to implement the scientific/technical recommendations from the *First JCOMM Scientific and Technical Symposium on Storm Surges* (Seoul, October 2007), including coastal inundation and linkages to storm surge forecast and warning operations in all relevant regions, JCOMM initiated a collaboration with the Commission for Hydrology to address coastal inundation aspects. A JCOMM/CHy Coastal Inundation Forecasting Demonstration Project (CIFDP) was initiated for building improved operational forecasts and warnings capability for coastal inundation. The major outcome of this project would be the development of an effective software package

involving both ocean and hydrological models to enable an assessment and forecast of total coastal inundation from combined extreme events.

1.4.3 Fully coupled ocean-atmosphere models are being increasingly developed to improve operational weather forecasting, where the ocean component of these models involves not just the ocean surface, but also more often at least the ocean mixed layer. They also include variables such as upper ocean heat content, ocean dynamic height and surface roughness. Additionally these models involved real-time assimilation of observational ocean data, including ocean temperature profiles, surface topography and sea state. JCOMM and the Commission for Atmospheric Sciences (CAS) have initiated a dialogue to address these issues. This includes a "Vision Paper" prepared for CAS-XV, edited by Dr Gary Brassington, chairperson of the JCOMM Expert Team on Ocean Forecasting Systems (ETOOFS), titled: "*Ocean Prediction Issues related to Weather and Climate Prediction*".

1.4.4 JCOMM has been interacting closely with other WMO Programmes and Technical Commissions, including the Tropical Cyclone Programme (TCP), the Commission for Climatology, etc. Relevant activities are reported under the relevant agenda items.

2. PROGRAMMES AND BODIES OF UNESCO/IOC

2.1 Integrated Coastal Area Management (ICAM)

2.1.1 The UNESCO/IOC programme on Integrated Coastal Area Management (ICAM) was established in 1997 with the purpose to: (i) assist UNESCO/IOC Member States in their efforts to build marine scientific and technological capabilities in the field of ICAM; (ii) ensure that scientific requirements are integrated into national and regional ICAM programmes and plans; and (iii) harmonize and disseminate existing and new scientific approaches relevant to coastal management.

2.1.2 The objectives of the Programme are to address coastal zone problems through activities of a more cooperative, coordinated and interdisciplinary nature, and ensure good coordination among existing IOC efforts related to the coastal zone. This programme also aims to provide a mechanism to promote interaction between IOC programmes related to ICAM and those of other international organizations, between marine natural scientists and social scientists, as well as between scientists and coastal managers and policy-makers.

2.1.3 On the basis on the IOC Medium Term Strategy (2008-2013), the ICAM programme is focusing its work on four main lines of actions, these are:

(i) Adaptation to climate change in the coastal zones (in particular through the Adaptation to Climate Change in the Coastal Zones of West Africa (ACCC) Project);

(ii) Development of marine spatial planning methodologies and their application;

(iii) Development and testing of guidelines for the mitigation of coastal hazards through ICAM;

(iv) Development and application of performance indicators for coastal management plans and programmes.

2.1.4 One central strategy of the ICAM programme has been to work on developing science based methodologies (for e.g. marine spatial guidelines, coastal indicators) which are technically applicable and adaptable in different geographical and socio-economic contexts. As a result, in the last five years, the ICAM programme has been promoting the development of regional projects, which are using and testing the tools and guidelines developed at the global scale. It is mainly through this regional approach that the collaboration with IODE of UNESCO/IOC has been

stronger. Detailed information on ICAM programme activities is available at http://ioc3.unesco.org/icam/.

2.1.5 JCOMM has been interacting with ICAM, though the Expert Team on Wind Waves and Storm Surges. It contributed to the preparation of the UNESCO/IOC publication *Hazard Awareness and Risk Mitigation in Integrated Coastal Area Management (ICAM)* (UNESCO/IOC Guides & Manuals No. 50; ICAM Dossier No. 5), which is available at http://www.ioc-unesco.org/ioc-25.

2.2 Tsunami Warning and a more Comprehensive Natural Marine Hazards Warning System

2.2.1 Tsunamis are a constant and unpredictable hazard putting coastal communities, infrastructure, use and management at risk. The four regional tsunami warning systems coordinated by UNESCO/IOC now focus on optimizing and improving their performance. They also improve the levels of consistency between participating members and among them, particularly in the detection and verification parts. For the production, formulation and dissemination of advisories, alerts, alarms and nationally mandated warnings common procedures are developed and performance measures introduced. To advance the detail and targeting of the warnings, inundation modelling generating risk and hazard maps is increasingly being introduced at the national level and standardized. Guidelines for Risk Assessments from tsunamis were adopted by the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning System (ICG/IOTWS) and are in the process of being adopted by ICGs of other regions. Internationally agreed standards on tsunami signage is being implemented by most Member States ((ISO 20712-1 (Safety Flags and Water Safety Signs) & ISO 20712-3 (Design Guidance)).

2.2.2 UNESCO/IOC has charged its Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG) to review the governance and organization of the Intergovernmental Coordination Groups (ICG's) of all Tsunami Warning Systems to ensure a common operation to explore synergy effects and mainstream in particular the upstream activities, i.e. detection and verification, into existing ocean observing systems.

2.2.3 Following the UN General Assembly Resolution UNGA 62-91, paragraph 13, UNESCO/IOC Member States nominate Tsunami National Contacts (TNC) and Tsunami Warning Focal Points (TWPF) to improve the formal communication between and with the governing bodies and with the operational entities.

Indian Ocean Tsunami Warning and Mitigation System (IOTWS)

2.2.4 Several countries have started operating their national systems, i.e. India, Malaysia, Indonesia and Australia. The earthquake off Sulawesi on 16 November 2008 with a Mw= 7.6 generated a minor tsunami, just five days after the Indonesian system InaTEWS went into full operation, again providing a strong reminder of the unpredictable hazard of tsunamis and the need for continuous preparedness to meet their consequences. A scheme to improve the coverage in the Indian Ocean has been agreed upon, and the establishment of the Regional Tsunami Watch Providers was one of the major decisions at the meeting of the ICG, in April 2009, in Thailand. Numerous activities for capacity building and training in awareness, preparedness and warning centre operations on all levels have helped to improve the engagement to support and sustain the national efforts.

Pacific Tsunami Warning and Mitigation System (PTWS)

2.2.5 The system, initially designed as a central system for far-field tsunamis, is addressing the requirements for near-field sources and regional sub-systems. A particular focus is on the Southeast Pacific, where the Pisco earthquake off Peru in 2007 highlighted the need for improvements, and the Southwest Pacific and the South China Sea. Together with technical

upgrades of the observing components and improving the emergency communication systems, particularly in the South Pacific, the new Strategic Plan will help to further improve the protection of lives and livelihoods in the entire Pacific Ocean. More than 20 countries around the Pacific Rim participated in a pre-arranged tsunami scenario drill from 28 to 30 October 2008. Testing the capabilities of the IOC-initiated PTWS, the drill aimed to evaluate the system, increase preparedness and improve coordination throughout the region. The Pacific Tsunami Warning Centre in Hawaii and the Japan Meteorological Agency in Tokyo jointly or individually have been providing interim cover for the IOTWS and CARIBE-EWS and the Northeast Atlantic.

Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions (CARIBE-EWS)

2.2.6 Considerable progress was made in enhancing national ownership and improving stakeholder involvement on the national and regional level through the technical working groups and through training courses for operational staff. Installation of technical equipment as required in the Implementation Plan is accelerating. The regional infrastructure for detection and verification of earthquakes and tsunamis has been agreed upon, and for capacity building and outreach as well as training the establishment of the Tsunami Information Centre for the Caribbean is subject to additional funding commitments.

Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas (NEAMTWS):

2.2.7 At its fifth session in Athens, the Intergovernmental Coordination Group for the warning system welcomed the confirmed offers by France, Portugal, Greece and Turkey to provide regional watch coverage for the NEAMTWS region as from 2010 while the suggested regional role for the National Earthquake Centre in Rome, INGV, still needs approval by the government. An interim Task Team, whose mandate has been extended for another year, developed detailed recommendations to speed up the process e.g. in providing guidance on interoperability and secure long term operation and maintenance. Most of the potential Regional Watch Providers installed the software system (SeisComp3) developed by the National Research Centre for Geosciences of Germany and started testing the interlinked system and the comparison of national solutions in earthquake determination. Special efforts are being made to provide the North African countries with adequate services and to enable them to participate in the ICG process.

2.3 UNESCO/IOC Tsunamis and Others Ocean Hazards Warning and Mitigation Systems Working Group (TOWS-WG)

2.3.1 The Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG) was established by the UNESCO/IOC Assembly Resolution XXIV-14, at its twenty-fourth session (Paris, June 2007), following on from the work of the Global Tsunami and other Ocean-related Hazards Early Warning and Mitigation System (GOHWMS) WG. Initially, through the GOHWMS WG, the scope was quite general – tsunami, all ocean-related hazards, references to a “system”, etc. The TOWS-WG mandate is narrower, focused around sea level and coastal inundation, and no longer associates the WG with a system (of systems); it does however strongly mandate TOWS to develop a systematic approach.

2.3.2 The UNESCO/IOC Assembly, at its twenty-fifth session, and by UNESCO/IOC Resolution XXIV-14, was expected to review the results, mandate and purpose of the TOWS-WG. UNESCO/IOC Resolution EC-XLI.6 further instructed the TOWS-WG to prepare a detailed report on the implementation of the actions and recommendations specified in the Resolutions, as well as on progress in the harmonization of regional tsunami warning and mitigation systems, for consideration by the Assembly at its twenty-fifth session.

2.3.3 Key results of and recommendations from the second meeting of the TOWS-WG (TOWS-WG-II) include:

- TOWS WG-II report on the progress achieved by the ICG Chairpersons in working with the Member States and the TOWS-WG on the development of harmonized working group structures as a foundation for interoperability, with a view to preparing recommendations for UNESCO/IOC principles, criteria and procedures for ocean-related hazards warning and mitigation systems;

- Proposal to establish three inter-ICG Task Teams devoted respectively to sea level, preparedness, and tsunami watch operations, with a view to facilitate coordination of activities, development of common requirements and standards, and sharing of best practices;

- Initial Draft Strategy and Plan for the Implementation of the Global Ocean-related Hazards Warning and Mitigation System Framework and of the TOWS-WG Recommendations, to be further elaborated based on the inputs from the ICGs;

- Inclusion of requirements on the collection and exchange of real-time sea level data for tsunami warning purposes in the work programmes of GLOSS and DBCP, as well as the possible review of GLOSS terms of reference to reflect the operational requirements of the tsunami warning centres;

- Need for ICGs to identify high-priority science issues that can benefit from contributions from IOC programmes and scientific and technical subsidiary bodies in the context of the Programme and Budget for 2010–2011 and developing a whole-of-UNESO/IOC perspective;

- Investigation with the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) Secretariat to conclude an agreement about the provision of i.e. seismic data to TWCs and the coordination of related matters;

- Investigation with CTBTO and other seismic networks of the possibilities for improved exchange and standardization of real-time seismic data and coordination of training programmes for global seismic monitoring for tsunami warning purposes;

- Facilitation of the exchange, review and adoption of documents and guidelines related to risk assessment methodologies and other standards developed by the ICGs;

- Development of a document with definitions and terminology on hazards, disasters, vulnerability and risks drawing on existing documents developed by bodies like UN/ISDR for use by the UNESCO/IOC Secretariat, its Subsidiary Bodies, and its programmes;

- Assessment of the UNESCO/IOC Oceanographic Data Exchange Policy (UNESCO/IOC Resolution XXII-6) as it applies to tsunami warning systems and the monitoring of its implementation to ensure the open, free, and unrestricted sharing of tsunami-relevant observational data needed for timely and effective ocean-related hazard detection, analysis, and warning for coastal communities;

- Possible revision of the terms of reference of GEBCO to promote and coordinate the development of high-resolution bathymetric data in coastal areas and digital elevation models.

2.3.4 Given the different states of development of the respective ICGs in implementing TWSs in their regions and the need for continuing coordination, the continuation of TOWS-WG for the next intersessional period with the same mandate and membership was recommended at

the twenty-fifth session of the UNESCO/IOC Assembly. The Assembly adopted Resolution XXV-(4.5.1), incorporating actions in respect of all four ICGs and of the TOWS-WG.

2.4 JCOMM Interactions with Other UNESCO/IOC Programmes

2.4.1 JCOMM has been strengthening its collaboration with the IODE of UNESCO/IOC, on observing and data management issues, and capacity building. Joint and/or collaborating activities are addressed under the relevant agenda items.

3. CO-SPONSORED PROGRAMMES

3.1 Global Climate Observing System (GCOS)

Support to the United Nations Framework Convention on Climate Change (UNFCCC)

Bali Climate Conference

3.1.1 GCOS actively participated at the 13th Conference of the Parties to the UNFCCC (COP-13) held in Bali, Indonesia in December 2007, particularly in the WMO-organized side event entitled *'Improved Decision Making for Climate Adaptation: Providing a Science Base'*, which promoted the understanding of improved climate observations, monitoring, prediction and services. COP-13 culminated in the adoption of the Bali Roadmap, which charts the course for a new negotiating process to be concluded by 2009 that would lead to a post-2012 international agreement on climate change. On adaptation to climate variability and change, the Bali Roadmap emphasized international cooperation to support urgent implementation of adaptation actions, including through vulnerability assessments, capacity building and response strategies. It also urged integration of adaptation actions into sectoral and national planning and specific projects and programmes to enable climate-resilient development and reduce vulnerability of all Parties, taking into account the urgent and immediate needs of developing countries that are particularly vulnerable to the adverse effects of climate change, especially the LDCs and SIDSs, and further taking into account the needs of countries in Africa affected by drought, desertification and floods (http://unfccc.int/files/meetings/cop_13/application/pdf/cp_bali_action.pdf).

3.1.2 The COP-13 accepted GCOS as the principal mechanism for reporting to the Convention on the status of climate observing systems and adopted the revised UNFCCC reporting guidelines on global climate observing systems on the proposal of GCOS. These guidelines are to be used from now on for the preparation of detailed reports on systematic climate observations that Annex I Parties to the Convention prepare in conjunction with their national communications. The UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) asked GCOS to provide a comprehensive report on progress in implementing the GCOS Implementation Plan and GCOS regional action plans, at its 30th session, in June 2009. SBSTA continues to be concerned that the regional action plans developed under the GCOS Regional Workshop Programme remain largely unimplemented.

GCOS Progress Report 2004-2008

3.1.3 GCOS submitted the *'Progress Report on the Implementation of the Global Observing System for Climate in support of the UNFCCC 2004-2008'* to the United Nations Framework Convention on Climate Change (UNFCCC) Subsidiary Body for Scientific and Technological Advice at its 30th session (SBSTA-30), in June 2009 (http://www.wmo.int/pages/prog/gcos/Publications/GCOSProgressReport_ReviewDraft_080409.pdf).

3.1.4 At SBSTA-30, GCOS organized a side-event on the Progress Report and invited speakers representing the WMO Integrated Global Observing Systems (WIGOS), the Global Ocean Observing System (GOOS), the Global Terrestrial Observing System (GTOS), the Committee on Earth Observation Satellites (CEOS) and the Group on Earth Observations (GEO).

This event provided a good opportunity to brief SBSTA participants on the role of GOOS in contributing the ocean observations for climate needs to the UNFCCC.

Update of the 2004 GCOS Implementation Plan

3.1.5 The SBSTA invited the GCOS Secretariat to prepare an update of the *'Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC'* that takes into account emerging priorities, such as the need for observational data and that includes a breakdown of costs involved, until the 33rd session of the SBSTA, in November 2010. It also invited the GCOS Secretariat to provide a provisional updated Implementation Plan in conjunction with a provisional estimation of costs by the 15th session of the Conference of the Parties (COP-15), in December 2009.

Cooperation with the Intergovernmental Panel on Climate Change (IPCC)

IPCC Observer status for GCOS

3.1.6 On the occasion of the 30th Session of the Intergovernmental Panel on Climate Change, IPCC, held in April 2009 in Antalya, Turkey, GCOS was formally endorsed as an Observer Organization of the IPCC. This authorizes GCOS representatives to participate in all sessions of the IPCC and its Working Groups on qualified matters.

Lessons Learned from IPCC AR4

3.1.7 In October 2007, the workshop *'Future Climate Change Research and Observations: GCOS, WCRP and IGBP Learning from the IPCC Fourth Assessment Report'* was held in Sydney, Australia. GCOS, the World Climate Research Programme (WCRP) and the International Geopshpere-Biosphere Programme (IGBP) jointly organized it. Participating experts recognized an increasing demand by decision-makers for climate change information for adaptation and the assessment of impacts and vulnerability. Guidance for decisions on adaptation is often demanded with greater detail than research can currently deliver. The workshop identified a number of significant gaps that still exist in our ability to observe, understand and predict climate with the required level of detail and agreed that research and observation communities and those studying impacts, vulnerability and means of adaptation needed to develop linked strategies. The workshop report proposed several major principles for guiding the future research and observations by global programmes. It determined a number of "urgent science questions" which are part of a larger strategy to address the issue of anthropogenic climate change and constitute issues requiring action from WCRP and IGBP, and possibly the other ESSP programmes (http://www.wmo.int/pages/prog/gcos/Publications/gcos-117.pdf).

Relationship with Satellite Agencies

3.1.8 Space agencies have been very active in incorporating GCOS requirements into their mission planning and strategies for data exploitation, including reprocessing and the generation of satellite-derived, user-tailored products. GCOS requirements were defined in the Satellite Supplement to the GCOS Implementation Plan *('Systematic Observation Requirements for Satellite-based Products for Climate Supplemental details to the satellite-based component of the Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC Satellite'* (http://www.wmo.int/pages/prog/gcos/Publications/gcos-107.pdf)). Resolution 9 of the Fifteenth WMO Congress (Cg-XV) subsequently adopted the publication of the Satellite Supplement to the GCOS Implementation Plan, and the expanded GCOS Climate Monitoring Principles.

3.1.9 In December 2008, the Committee on Earth Observation Satellites (CEOS) responded to the actions called for in the GCOS Implementation Plan in its *'Updated report by the Committee on Earth Observation Satellites on progress by space agencies involved in global observations in*

implementing actions in response to the Global Climate Observing System implementation plan' (http://www.wmo.int/pages/prog/gcos/documents/SBSTA29_misc11_CEOS.pdf). The report underlined the active and successful collaboration that had developed among WMO, CEOS and the Coordination Group for Meteorological Satellites on a number of subjects. These included the Regional Specialized Satellite Centres for Climate Monitoring, the Precipitation Constellation, response to GCOS observation requirements, satellite instrument calibration and the Global Space-based Inter-Calibration System, the implementation of the Group on Earth Observations work plan, the CEOS/WMO database of satellite observing capabilities, and the new Vision for the space-based component of the GOS. CEOS also highlighted the improved availability of land imaging data that would contribute to WIGOS as well as its readiness to maintain a close cooperation with WMO, through its Space Programme.

3.1.10 The Eighth High Level Consultative Meeting on Satellite Matters (New Orleans, January 2008) examined GCOS and related climate matters in the context of the Space-Based Global Observing System vision for 2025. It welcomed the uptake of GCOS requirements for satellite observations, emphasized the high profile of climate observations and the need to safeguard the continuity of the satellite-based climate record. It agreed to a high-level goal for space agencies that there should be no gap in the satellite-based climate records for the GCOS Essential Climate Variables.

3.1.11 In March 2009, a "*Guideline for the Generation of Satellite-based Datasets and Products meeting GCOS Requirements"* was published (http://www.wmo.int/pages/prog/gcos/Publications/gcos-128.pdf).

3.2 Global Ocean Observing System (GOOS)

GOOS implementation strategy

3.2.1 The principles of a GOOS implementation strategy are based on regional networks, including: the development of GOOS rests on the establishment of Regional Ocean Observing Systems (ROOS); all ROOS are implemented according to the GOOS development principles; each ROOS is run by one or more GOOS Regional Alliances (GRA). Regional Alliances form the "bottom up" development process of GOOS. It was during the Fourth Forum of the GOOS Regional Alliances (Guayaquil, November 2008) that the GOOS Regional Council was officially created and EuroGOOS and MedGOOS agreed to serve as the initial co-chairs of the Council. Progress of GOOS requires that rules of technical standards and governance be followed, and I-GOOS is taking action to validate these principles for the development of GOOS.

3.2.2 Efforts are being made with respect to outreach, including a GOOS display, a GOOS poster and a brochure for policy-makers. Dr James Baker produced a consultancy report for UNESCO/IOC and WMO, on the organization of GOOS.

3.2.3 GOOS and other UNESCO/IOC programmes contribute to the implementation of regional tsunami other sea level hazard monitoring systems. The GOOS work programme for 2010–2011 is focused on the following priority areas: (i) sustaining the climate module of GOOS; (ii) implementing the coastal module of GOOS; (iii) GOOS outreach; and (iv) Africa.

GOOS open-ocean module

3.2.4 While there have been encouraging developments in GOOS, including the full implementation of the Argo and drifting buoy arrays, and immediate gaps in satellite coverage have been addressed, the overall implementation rate of the GOOS open-ocean module had levelled off at about 61%, in August 2009. About half of the UNESCO/IOC Member States contribute observations to GOOS, through the Global Sea Level Observing System (GLOSS); twenty-three countries contribute to the Argo programme, and nine, to the repeat hydrography/carbon programme. Detailed information on GOOS is provided under agenda item 6.1.

National contributions to GOOS

3.2.5 The Subsidiary Body for Scientific and Technological Advice (SBSTA) under the UNFCCC requested, at its 23rd session (Montreal, December 2005), the GCOS Secretariat to provide, at SBSTA-30 (June 2009), a comprehensive report on progress with the GCOS implementation plan. The SBSTA also noted that the preparation of such report would be heavily dependent upon obtaining timely information on national implementation activities.

3.2.6 SBSTA-27 (Bali, December 2007) recalled its request to the GCOS Secretariat to provide the above-mentioned comprehensive report at SBSTA-30 and its invitation to Parties to submit to the Secretariat information on their national activities with respect to implementing the plan. In essence, the ocean components of these national GCOS reports were used at I-GOOS-IX (Paris, June 2009) as the basis of national reports on the implementation of the open ocean component of GOOS.

3.2.7 In addition, national contributions to the climate module of GOOS are known through the reporting mechanisms developed by the in situ observing networks under the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM), and through coordination of space-based observing networks under the Committee on Earth Observation Satellites (CEOS).

Establishment of GOOS National Committees

3.2.8 I-GOOS VIII (June 2007) proposed to establish National GOOS Committees, whose role, amongst other things, would be to act as a relay between the GOOS Project Office and countries worldwide and to strengthen the relationship between partners working in the field of Ocean Science within each country. After several years of practice, unfortunately, many countries have not yet created their National GOOS Committees. The consequence of this situation is the weak participation of these countries in GOOS activities. For example, in 2006-2007, few countries filled in the questionnaire sent out by the I-GOOS Board. In addition, in most developing countries, especially in Africa, there are only weak relationships between the institutions in charge of marine activities within these countries. The result is that only those oceans close to developed countries are well studied, while those bordering developing countries are not well studied at all.

UNFCCC 2009 Adequacy Report and Side Events

3.2.9 The Ocean Observations Panel for Climate (OOPC) and the GOOS Secretariat has prepared a draft report on progress in implementing the climate module of GOOS as an integral part of a GCOS report on progress in implementing the global observing system for climate in support of the UNFCCC (GOOS Document No. 173, GCOS Document No. 129). The GCOS and GOOS Secretariat participated in a side event and exhibit at the UNFCCC Subsidiary Body Meetings in Bonn, in June 2009, focused on progress in implementing the global observing systems for climate in support of the UNFCCC, including its ocean, atmospheric, and terrestrial components. Text from the GCOS Secretariat's report was inserted in the UNFCCC Conclusions proposed by the Chair, acknowledging the need for systematic climate observations and noting the need for enhanced commitment of Parties to the GCOS Mechanisms.

GOOS coastal module

Panel for Integrated Coastal Observation (PICO)

3.2.10 PICO is a sub-committee of the GSSC set up to provide technical advice needed for scientifically sound implementation of the Implementation Strategy for the Coastal Module of GOOS (GOOS Report No. 148). The Terms of Reference are given at http://www.ioc-goos.org/content/view/172/92/.

3.2.11 PICO held its first session in April 2008, in Paris, back-to-back with the GSSC-XI. The aim of the first session was to foster an open discussion along PICO's Terms of Reference. PICO-I recommended that the GRAs and PICO review the Implementation Strategy for the Coastal Module of GOOS Report 148 and that the PICO should assemble information on the GRA projects and programmes. A questionnaire was circulated and partial responses received. Recommendations and advice are given on seven topics: (i) Governance: A GRA users' forum and GRA Steering Committee should be established to facilitate improved communications. The Fourth GRA Forum appears to have initialized these actions; (ii) Implementing Measurement Subsystem: Highest priority is review of common variables and standards, and database of national and regional observation systems; (iii) Implementing the Data Management Subsystem: Working with IODE of UNESCO/IOC and Data Management clusters to determine metadata content and develop web services. Need to adopt top down international standards, which are already available; (iv) Modelling and Analysis Subsystem: developing community modelling networks and regional modelling capability; (v) Developing and improving capacity: no systematic coastal programme has been established. Identified a need to implement operate and improve coastal networks; (vi) Pilot Projects: pilot projects are preferred route for progress in some regions. They can be used to usefully build operational and forecasting capacity in less developed regions; and (vii) Performance Evaluation: Need for procedures for periodically assessing and updating common variables, intercalibration activities and standards and protocols. The GSSC has a role to move forward the establishment of interregional programmes for progress on many of these themes. The diversity of GRAs in nature and activities makes these inter-regional and top-down actions difficult to assess and manage. Expectancy regarding implementation is not the same within GRAs and between GRAs and advisory bodies. The lack of the "GOOS framework" is evident and limiting implementation. An assumption of successful implementation is the existence and effectiveness of the GOOS Regional Council. PICO-I pointed out that JCOMM could not help with design of such implementation strategies, as it can only receive and implement mature observation systems. Pilot Projects are identified as a preferred mechanism to spur cooperation and development. More information about the PICO-I session is provided in GOOS Report No. 172.

3.2.12 PICO held its second session in February 2009, in Perth, in association with the GSSC-XII session. The primary goal of the session was to develop an outline and schedule for a prioritized Implementation Plan for the Coastal Module of GOOS. The implementation plan will be centered on phenomena of interest (GOOS Report No 125, page 34) to build an end to end system. A draft outline of the plan has been developed with an initial focus on six phenomena of interest that have been identified: coastal flooding, pathogens, ocean acidification, habitat loss, hypoxia, and marine resources. The plan will map the phenomena verses the user communities, available observation systems and models, capacity building efforts and maturity of systems. The cross-cutting nature of the phenomena reveal several overlaps which use the same variables, systems etc. In this way several pilot projects may be identified which will show the feasibility of implementation and design of end-to-end systems. The OceanObs'09 meeting will move forward the planning process, with an intermediate report to be presented [a PICO White Paper on Coastal Module of GOOS has been submitted titled "Building a Global System of Systems for the Coastal Ocean: *A Strategic Action Plan for Implementing the Coastal Module of GOOS"*]. An internal draft Implementation Plan should be ready by January 2010, with a finished report before the GSSC-XIII in 2010. PICO continues to develop linkages with other programmes: GEO, GODAE OceanVIEW, GEF, LME, the GOOS Regional Alliances and the GRA Council. The coastal programmes have a large number of institutions and people working on coastal oceanography, it is difficult to maintain connections to all. The GRAs provide a very important service to GOOS and to PICO by providing local and regional connectivity to the community. PICO has had fair success interfacing with the GEO through the Coastal Zone Community of Practice. The complete draft will be circulated to the appropriate parties in March/April 2010 for community review, with final plan for initial priority Phenomena of Interest to be completed by the end of 2010, and then submitted to GSSC in early 2011.

Outcomes from GRF-IV and GRC

3.2.13 GRF-IV was held in Guayaquil, in November 2008; all twelve of the GOOS Regional Alliances participated. Discussions covered the role of the GRAs in furthering the goals of coastal GOOS, the governance of the GRAs by the UNESCO/IOC and GOOS Programme Office, interactions of GRAs with Large Marine Ecosystem programmes and other programmes. Reports summarizing the achievements of the individual GRAs were presented. A wide variety of systems are moving successfully ahead across the globe under GRA programmes. However, the presentations revealed a discontinuity and lack of communication between GRAs. The GOOS Regional Council was discussed and formed by six of the GRAs (joined by two more in January 2009, and another May 2009) under the co-chairmanship of MedGOOS and EuroGOOS.

GOOS Interaction with JCOMM

3.2.14 During the I-GOOS-IX session, in June 2009, I-GOOS members agreed with the assessment of the JCOMM co-president of JCOMM's role as an implementation mechanism for global GOOS and as the in situ marine component of the WMO Global Observing System, bridging between meteorology and oceanography toward the operational oceanography. JCOMM has been making efforts to address priorities defined by the UNESCO/IOC High Level Objectives and WMO Expected Results, through activities and new initiatives under each Programme Area (Observations, Data Management, and Services). The members appreciated the role that JCOMM would play representing the needs of GOOS within the WMO Integrated Global Observing System, WIGOS.

3.2.15 JCOMM serves the UNESCO/IOC by coordinating implementation of observing systems within the GOOS Regional Alliances and Polar observatories. Several Member States expressed concerns that local and regional scale issues should be strengthened by more direct involvement in the JCOMM by the GOOS Regional Alliances. It was recommended that each GRA designate a JCOMM rapporteur to ensure each region would implement UNESCO/IOC policy principles and JCOMM data standards / guidelines in observation of essential ocean variables and data dissemination.

3.2.16 The GSSC-XII, in February 2009, addressed issues concerning the future role of the GODAE OceanView within GOOS. A GSSC working group evaluated the implications of GODAE OceanView involvement with GSSC and concluded that close cooperation with the JCOMM Expert Team on Operational Oceanographic Forecasting Systems (ETOOFS) was necessary. The JCOMM/ETOOFS and the GODAE OceanView complement each other for development of ocean modelling and forecast capabilities. The objectives of JCOMM/ETOOFS focus on support and coordination for agencies and systems delivering operational ocean forecasting and related services. The objectives of GODAE OceanView focus on the scientific challenges associated with development of operational oceanography and coordination with the research community. The ocean observing systems cannot afford separate, or duplicate, efforts. The ET/OOFS has a clear job to do which cannot be separated from science and development. GOV should keep separate autonomy to enable it to conduct its R&D as determined by its members, but understanding that reaching maturity in the intergovernmental system requires a "group discipline". A draft record of understanding is being agreed upon between the two groups whereby the GOV and JCOMM/ETOOFS will interact together to advise the JCOMM/MAN and the GSSC. It was advised that JCOMM-III should consider the inclusion of the GOV in new JCOMM structure.

Sustained Arctic Observing Network (SAON)

3.2.17 Following the success of the IPY the need to find a method to sustain the observation base put in place by the research programmes has led to the formation of the SAON Initiating Group. The group has concluded that the present Arctic observing sites do not adequately cover the Arctic region and the value of the observations could be enhanced by better coordination. The SAON Initiating Group (SAON-IG) was formed by the Arctic Council and other programmes to

carry this work forward. Through workshops and other activities the SAON-IG is soliciting input from relevant people and agencies in the Arctic and non-Arctic countries. The SAON-IG prepared a report delivered to the Arctic Council Ministerial Meeting, April 2009, outlining next steps: an inventory of existing networks and programmes; development of long-term data management systems; encourage commitments for sustained coordination and funding of observations and establish an organization to continue the work of SAON-IG or AOF.

Southern Ocean Observing System (SOOS)

3.2.18 At the Forty-first Session of the UNESCO/IOC Executive Council (Paris, June 2008) several UNESCO/IOC Member States recommended that UNESCO/IOC should play a major role in the Antarctic Treaty Consultative Meeting, particularly in the development of a Southern Ocean Observing System, under GOOS. The UNESCO/IOC Assembly, at its twenty-fifth session (June 2009) decided to sustain multilaterally supported ocean observing systems in the Arctic and Southern Oceans as regional contributions to GOOS [see item 3.4 below].

3.3 World Climate Research Programme (WRCP)

3.3.1 The WCRP Website at http://wcrp.wmo.int contains updated information on WCRP current activities. Websites of the WCRP projects CLIVAR (http://www.clivar.org), CliC (CliC.npolar.no), GEWEX (http://www.gewex.org) and SOLAS (http://www.solas-int.org) provide updated information on their activities of relevance to JCOMM.

3.3.2 In 2005 the WCRP announced its Strategic Framework 2005-2015 “Coordinated Observation and Prediction of the Earth System” (COPES), which focussed the programme’s activities on facilitating analysis and prediction of Earth’s climate system variability and change for use in an increasing range of practical applications of direct relevance, benefit and value to society. With this renewed focus, the two original objectives of WCRP remain to determine the extent to which climate can be predicted, and to determine the extent of human influence on climate. The document summarizing the COPES Framework is downloadable from http://wcrp.wmo.int/pdf/WCRP_strategImple_LowRes.pdf.

3.3.3 WCRP continues to inform the UNFCCC process, which is particularly important for the development of the post-Kyoto regime. WCRP also made great strides in transferring the scientific information and knowledge about the Earth’s climate system for policy decisions through the IPCC, the UNFCCC Conference of Parties and its Subsidiary Body on Scientific and Technological Advice (SBSTA). The major part of the scientific and technical contributions used in the Working Group I volume of the IPCC Fourth Assessment Report (AR4) was provided, to a large extent, by WCRP affiliated scientists.

3.3.4 In 2008 and 2009, ISCU, WMO, UNESCO/IOC and the International Group of Funding Agencies for Global Change Research (IGFA) sponsored an independent review of WCRP. They also sponsored similar reviews of the IGBP and the Earth System Science Partnership (ESSP). Full text of the Review team is now available on the ISCU website (http://www.icsu.org). The Review recommended that the WCRP should:

- Immediately focus the 2005 WCRP Strategic Framework to better capture the WCRP role in providing the science that underpins research on climate predictability, adaptation, and mitigation, thus strengthening the links with key end-user groups;

- Rapidly implement its focused Strategic Framework, paying special attention to societal needs while maintaining its science-driven approach;

- Introduce clear priorities into WCRP as a whole, collaborating with other Global Environmental Change programmes to take into account urgent science required for IPCC and other societal demands;

- Lead the initiative on Earth system modelling, in collaboration with IGBP and other Programmes, utilizing the full richness of relevant disciplines, and explicitly addressing scientific problems that lie at the interfaces with these disciplines;

- Consolidate and strengthen its focus as a user and promoter of observations as well as its support of the components of the Global Climate Observing System;

- Set specific strategy and goals for building its scientific capacity in diversity of age and gender and for participation of developing country scientists in planning and research;

- Build its resource capacity by enhancing support for coordination and advocacy for research and infrastructure needs. This will necessitate expanding its funding sources outside traditional targets and working through IGFA;

- Expand its strategic outreach activities to target greater visibility and better uptake and utilization of WCRP outputs by the climate research community, the policy world and private sector, and more broadly to the general public;

- In partnership with other global environmental change programmes, develop a framework for future joint research operation, with the initial focus on the elements identified in the Review.

3.3.5 Even before the draft Review and recommendations were made available to WCRP, the Programme had started work on its implementation plan for the interim period (up to 2013–2015, with a focus on completing the tasks formulated in its Strategic Framework COPES) and a forward-looking strategy beyond that period based on an assessment of the needs in science for the two time horizons. The Implementation Plan 2010-2015 was published in September 2009. The electronic version of the Plan can be found at http://wcrp.wmo.int/documents/WCRP_IP.pdf.

3.3.6 Almost all WCRP projects are involved in research of relevance for JCOMM. CLIVAR provides the focus within WCRP for understanding the role of the ocean in climate, helps to promote, plan and coordinate implementation of observing systems, promotes reanalysis of existing ocean data, and develops ocean modules of global climate models. CliC contributes to these activities on cryospheric and polar aspects. GEWEX does so in the areas of surface flux research and facilitates regional climate studies. As a co-sponsor of the Ocean Observations Panel for Climate (OOPC), WCRP strives to ensure high-quality and long-term ocean observations for climate research and prediction. WCRP, together with the IGBP, Scientific Committee on Oceanic Research (SCOR) and the international Commission on Atmospheric Chemistry and Global Pollution (CACGP) is a co-sponsor of the Surface Ocean – Lower Atmosphere Study Project that develops the science of biogeochemical interactions between the ocean and atmosphere. The WCRP Observation and Assimilation Panel, the WCRP Modelling Panel and Working Group on Coupled Modelling (WGCM) activities make significant contributions to ocean research, observations, modelling and analysis.

3.3.7 With the successful development of Argo and other observational techniques, WCRP works towards engaging the predictive potential of the ocean in the tasks of extending the predictive skill of seasonal forecasting systems and determining climate predictability at decadal time scales. WCRP is a sponsor of OceanObs'09 organized by UNESCO/IOC and European Space Agency (ESA). Chairpersons of the OOPC and CLIVAR Global Synthesis and Observations Panel are co-chairpersons of the Conference, which is extremely important for WCRP.

3.3.8 The WCRP core project on Climate Variability and Predictability (CLIVAR) is the main focus in WCRP for studies of climate variability. Its mission is to observe, simulate and predict the Earth's climate system, with a focus on ocean-atmosphere interactions enabling better understanding of climate variability, predictability and change to the benefit of society and the

environment in which we live. Examples of CLIVAR recent accomplishments related to the oceanography and marine meteorology:

- Collaborative intercomparison and assessment of global ocean synthesis (reanalysis) products aimed at determining their quality and potential for ocean initialization in climate prediction;
- Ongoing implementation of an integrated Indian Ocean Observing System in collaboration with IOC and Indian Ocean GOOS;
- Tropical Atlantic Climate Experiment (2006-2011) to improve regional climate prediction;
- Support to and coordination of programmes to monitor the Meridional Overturning Circulation (MOC) in the Atlantic;
- Input to design the Arctic and Southern Ocean Observing Systems, in collaboration with several partners, as a part of the International Polar Year 2007-2008 and its legacy;
- Coordination of key international climate process studies in the Pacific;
- Developing the tropical moored buoy arrays to provide key observations for seasonal predictions;
- Completion of Version 1 and design of Version 2 of Coordinated Ocean-ice Reference Experiments (CORE-II) to further develop ocean components of global climate models and initiation of a CLIVAR Repository for Evaluating Ocean Simulations (REOS) to support evaluation of ocean simulations by bringing together datasets, analyses/syntheses, tools, papers, and commentaries;
- Assisting the Intergovernmental Oceanographic Commission (IOC) of UNESCO to provide guidelines for the future global deep ocean hydrography and carbon network;
- Coordination of climate model scenario experiments for IPCC. Key inputs on changes in climate extremes to IPCC AR4;
- Model intercomparison activities aimed at improving seasonal predictions and ocean model performance;
- Coordination of field studies to help improve parameterization schemes for atmosphere and ocean climate models and their interactions;
- Advocacy for real time data and high quality delayed mode observational data for operations and research;
- Organizing and sponsoring training workshops on seasonal prediction in Africa, climate impacts on ocean ecosystems, climate data and extremes and ENSO.

3.3.9 The Joint CCl/CLIVAR/JCOMM Expert Team (ET) on Climate Change Detection and Indices (ETCCDI) has had two sessions since the JCOMM-II. The ETCCDI work plan was developed at its 2006 meeting. The ET will review climate indices and finalize indices for assessment in the AR5 from the WCRP CMIP5 experiment. ETCCDI anticipates availability of high frequency (daily data) from the WCRP CMIP5 experiment, which will facilitate the calculation of indices. In 2009, this active and successful ET prepared for publication “Guidelines on Analysis of extremes in a changing climate in support of informed decisions for adaptation”. The current mode

of ETCCDI operation involves research on and development of indices, implementation of standard software, application in standardized workshops, and synthesis into regional and global products. ETCCDI would like to focus now on how it can better serve the needs of the developing world in respect of climate information to support adaptation activities.

3.3.10 The mission of the WCRP/SCAR/IASC Climate and Cryosphere (CliC) project is to understand and represent in models the role of the cryosphere in Earth's climate system and to assess and quantify the impacts that climate variability and change have on components of the cryosphere and its overall stability, and the consequences of these impacts for the climate system. Examples of CliC accomplishments related to the oceans:

- Developing the IGOS Theme on Cryosphere (IGOS-Cryo) in partnership with SCAR, and achieving the broad consensus on the planned development of cryospheric observations for years to come. In May 2007, the Fifteenth WMO Congress approved Canada's proposal to create a Global Cryospheric Watch based on the IGOS-Cryo recommendations. These activities will lead to better observations of marine cryosphere including all forms of sea ice and ice shelves;

- Coordinating strong input from the climate research community to the scientific programme of IPY 2007-2008. This included a concept of polar satellite snapshot aimed at obtaining unprecedented coverage of both polar regions including Arctic and Southern Ocean with observations from space;

- Drawing the attention of the world's scientific community to the role of the cryosphere in the climate system, such as developing a chapter on Snow, Ice and Frozen Ground for the IPCC Assessment Report 4 (2007). The report highlights the contribution of melted water to recent sea-level change.

3.3.11 The Surface Ocean – Lower Atmosphere Study (SOLAS of IGBP, SCOR, WCRP and CACGP) held its second open science meeting in Xiamen, China in March 2007 and its third summer school for 2007 (see http://www.solas-int.org/). Its third Open Science Conference will be held in Barcelona, in November 2009. Over 300 participants are expected to present their findings on biogeochemical and physical feedbacks between the ocean and the atmosphere. The fourth SOLAS summer school was held in Cargèse, Corsica, in August 2009.

3.3.12 The main goals of WCRP in the International Polar Year 2007-2008 (IPY) were to address existing gaps in the knowledge of polar processes, develop understanding of the role of polar regions in Earth's climate system and an ability to better predict global climate. Many of the IPY project leaders and participants are members of WCRP projects and groups. The following WCRP contributions to IPY scientific achievements are related to the oceans:

- Establishing a basis for an Arctic Ocean Observing System and sustaining Arctic observing networks (through the International Arctic Science Committee and its Arctic Ocean Sciences Board);

- Establishing an Arctic hydrological cycle observing system to advance polar hydrology and enable global studies of ocean freshwater balance;

- Promoting a sustained survey of the Southern Ocean forming the foundation of the Southern Ocean Observing System (SOOS, with SCAR and SCOR);

- Proposing for the first time a satellite snapshot of the polar regions by major space agencies, especially with the Synthetic Aperture Radars and reconstructing snapshots of the polar cryosphere and polar oceans, atmosphere, including stratosphere and mesosphere, as a benchmark for an integrated 'atmosphere-cryosphere-ocean' study;

- Strengthening interoperable data exchange and information archival;

- Coordination of the IPY cluster on the Climate of Antarctica and the Southern Ocean.

3.3.13 Together with SCOR and GLOBEC WCRP was a co-sponsor of the International Symposium “Effects of Climate Change on the World's Oceans” (Gijón, Spain, May 2008) organized by UNESCO/IOC, PICES, and ICES. The Met-Ocean Committee of the International Association of Oil and Gas Producers (OGP), the JCOMM and WCRP Workshop on Climate Change and the Offshore Industry (Geneva, Switzerland, May 2008) organized a very successful workshop, attended by approximately 60 participants that opened the dialogue on climate change between specialists from oil companies and environmental research organizations. The following areas for future research towards the adaptation of the offshore industry services to climate change were identified: understanding of the performance of climate models at various resolutions, time scales and in various regions; advanced regional downscaling methodologies; standards for (meta-)data; non-stationary extreme value analysis techniques for key metocean parameters such as wind speeds, wave heights, sea-level, sea-ice coverage, and explicit inclusion of uncertainty in extreme value analyses.

3.3.14 For all numerical climate predictions on time scales from several months to years and out to decades, there is a need to represent the initial observed state of the atmosphere and oceans. Three completed WCRP experiments, namely the Tropical Ocean Global Atmosphere (TOGA), the World Ocean Circulation Experiment (WOCE), and the Arctic Climate System Study (ACSYS) enabled better observations and understanding of the ocean, its circulation and interactions with the atmosphere.

3.3.15 In partnership with the WMO Atmospheric Research and Environment Programme, IGBP and relevant Partners, WCRP is working on development of the future seamless forecasting system for weather, hydrology, ocean and climate, and for the variety of environmental parameters. Observing and predicting capabilities created by WCRP and partners are the pillars for the development of the future Global Framework for Climate Services (GFCS), which will link science-based climate predictions and information with climate-risk management and adaptation to climate variability and change throughout the world.

3.3.16 With respect to ocean science and observations, the outcomes of the WCC-3 and OceanObs’09 will serve to guide WCRP in how to best focus its activities to ensure that international coordination of research on all aspects of ocean physics that are vital for climate and visa versa is facilitated. Main areas, modalities, and priorities of the WCRP cooperation with JCOMM will be strongly shaped by the scientific requirements posed by the emerging GFCS and will strongly depend on the recommendations of OceanObs’09.

3.4 International Polar Year (IPY) 2007-2008

3.4.1 The implementation of IPY was successfully carried out in 2007-2008 in the framework of 160 scientific projects under overall supervision of WMO/ICSU Joint Committee (JC) for IPY. The first preliminary results of IPY implementation were discussed at the IPY Open Science Conference (St. Petersburg, Russia, 8-11 July 2008). The conference titled “Polar Research – Arctic and Antarctic Perspectives in the International Polar Year” was the largest polar science meeting yet held, with over 1200 participants. The next IPY Science Conference is planned to be held in Oslo, Norway from 8 to 12 June 2010. The preliminary results of IPY were partially given in a Statement “The State of Polar Research” publicly submitted to WMO and ICSU Executive Heads by IPY JC on 25 February 2009. The success of IPY had inspired many nations to continue IPY projects beyond the IPY “official” period and an official closure of IPY is therefore planned at the IPY Oslo Science Conference in 2010.

3.4.2 Among the scientific and observational advances of IPY there are several which are closely related to JCOMM activities:

- Satellite and conventional observations during IPY have discovered that the summer minimum extent of Arctic perennial sea ice had decreased by roughly one million square kilometres to its minimum extent since satellite records began. In addition, the North Pole region was covered only in relatively thin first-year ice in mid-winter for the first time in the observational record. IPY expeditions recorded an unprecedented rate of ice drift across the Arctic basin, providing compelling evidence of changes in the Arctic ice–ocean–atmosphere system;

- New evidence of the global warming rate has come from some IPY projects. Data from robotic ocean-profiling floats, instrumented marine mammals and IPY research vessels confirmed that the Southern Ocean, particularly the southern flank of the Antarctic Circumpolar Current, has warmed more rapidly than the global ocean average. In addition, the dense bottom water formed near Antarctica has freshened in some locations and warmed in others. The freshening is consistent with increased melt from the Antarctic ice shelves and ice sheet. These changes are signs that global warming is affecting the Antarctic in ways not previously suspected;

- In the North Atlantic it has been shown that subtle changes in ocean conditions and in the fluxes of heat and momentum between the atmosphere and the ocean can play a strong role in the eventual strength and trajectories of major storms. Observations and modelling by IPY researchers have revealed that these storm systems represent the major atmospheric inputs of heat and moisture to the Arctic. This knowledge will improve forecasting the paths and intensities of storms;

- Surface-based observational networks in polar oceans were extended by establishment or modernization of tide-gauge stations as well as by the intensive deployment of drifting and moored buoys;

- New integrated observing systems in Arctic and Southern Oceans were developed based on the wide use of modern technologies such as gliders, ice-tethered profilers, marine animals equipped with sensors and Argo floats;

- Due to the coordinated approach undertaken by the Space Agencies during IPY an impressive array of new satellite data and products was created.

3.4.3 Based on these achievements the IPY observing legacy initiatives, such as Sustaining Arctic Observing Networks (http://www.arcticobserving.org) including Arctic Ocean Observing System, Global Cryosphere Watch, Southern Ocean Observing System and Polar Satellite Constellation were proposed and can be developed to reinforce regional observing systems in both polar regions as valuable contributions to existing global observing systems. The WMO Executive Council established the Panel on Polar Observations, Research and Services, at its sixtieth session (June 2008), as one of the mechanisms to secure IPY observing system legacy.

3.4.4 The WMO Executive Council, at its sixty-first session (June 2009), noted that the idea of an International Polar Decade expressed at its previous session had been discussed and met positively at several international forums, including the Arctic Council Ministerial Meeting (Tromso, Norway, April, 2009). The Council requested its Panel to consider modalities and plans for the Decade, focusing on decadal needs and issues of long-term character based on lessons learned during IPY, and to make recommendations to its sixty-second session.

3.4.5 One of the challenges of IPY at present is data exchange and preservation. IPY Subcommittee on Data has been contacting individual nations with specific data management requests and timelines. As the result, some federation of the portals was beginning and interoperability arrangements were also being developed. The WMO Information System (WIS) is seeing as a central mechanism to assist with data sharing and interoperability. In addition, the

Committee on Data for Science and Technology (CODATA), an international scientific organization concerned with the collection, management, access to and exploitation of quantitative data in science and technology, made a project proposal entitled “The Polar Information Commons (PIC): Establishing the Framework for Long-term Stewardship of Polar Data and Information”. This project aims to establish a sustainable long-term framework for the preservation and access of polar data, building on recent "commons" approaches developed in other scientific fields and entraining new stakeholders and participants into polar data management.

3.4.6 The UNESCO/IOC Assembly, at its twenty-fifth session (June 2009) decided to: (i) sustain multilaterally supported ocean observing systems in the Arctic and Southern Oceans as regional contributions to GOOS, implemented through JCOMM, with data exchange and long-term stewardship of the data by IODE of UNESCO/IOC; and (ii) support the Arctic Council’s call for a follow-on International Polar Decade [see item 3.2 above].

_____

BACKGROUND MATERIAL

UN system agencies

1. In 1999, the General Assembly decided to establish the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea (the Consultative Process) in order to facilitate the annual review by the General Assembly, in an effective and constructive manner, of developments in ocean affairs and the law of the sea by considering the report of the UN Secretary-General on oceans and the law of the sea and by suggesting particular issues to be considered by it, with an emphasis on identifying areas where coordination and cooperation at the intergovernmental and inter-agency levels should be enhanced (resolution 54/33). The tenth meeting of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea (UNICPOLOS) was held at United Nations Headquarters in New York from 17 to 19 June 2009. In its deliberations on the report of the Secretary-General on oceans and the law of the sea, the Consultative Process at its tenth meeting focused its discussions on the *implementation of the outcomes of the Consultative Process, including a review of its achievements and shortcomings in its first nine meetings*. A full report of the meeting is available at: http://www.un.org/Depts/los/consultative_process/consultative_process.htm#2009.

2. UNESCO/IOC held a Technical Briefing on: "UNCLOS and the Outer Limits of the Continental Shelf" for providing awareness-raising for policy-makers and members of the Delegations of the Member States to UNESCO on 18 April 2008. UNESCO/IOC also has been providing advice on this issue to Delegations of UNESCO and IOC Member States that have requested it, in close cooperation with UNEP. Several African Member States have benefited from these activities.

3. The XLI UNESCO/IOC Executive Council adopted the *Guidelines for the Implementation of Resolution XX-6 of the UNESCO/IOC Assembly Regarding the Deployment of Profiling Floats in the High Seas within the Framework of the Argo Programme* through EC Resolution 4 (EC-XLI), as result of the discussions held at the VIII meeting of IOC/ABE-LOS.

4. UNESCO/IOC and WMO participate in UN-Oceans, a coordination mechanism for all agencies within the UN System active in marine and ocean affairs. The First Inter-Agency Meeting of UN-Oceans (Paris, January 2005) established the UN-Oceans Task-Force on marine biodiversity in areas beyond national jurisdiction for coordinating information input to the General Assembly, the Convention on Biological Diversity (CBD), and other international processes dealing with biodiversity in marine areas beyond national jurisdiction. A website was developed to address the issue of marine biodiversity beyond areas of national jurisdiction, as follows: http://www.un.org/Depts/los/biodiversityworkinggroup/marine_biodiversity.htm. The fifth meeting of UN-Oceans (Paris, May 2007) established the Task Force on Marine Protected Areas and Other Area-based Management Tools, on which UNESCO/IOC plays a leading role. The main purpose of the Task Force was to strengthen collaboration and coordination among UN organizations dealing with marine protected areas, especially to promote the accomplishment of the targets set by the World Summit on Sustainable Development (WSSD). As a contribution to the achievement of the goals of the Convention on Biological Diversity (CBD), the UNESCO/IOC has recently published the report *Global Open Oceans and Deep Seabed (GGODS) – Biogeographic Classification* (IOC/2009/TS/84), produced with the collaboration of Australia, Canada, Germany, Mexico and IUCN. This publication is available on the Website and can be downloaded from http://unesdoc.unesco.org/ulis/.

5. Given the alarming signals of degradation in the world's oceans at the World Summit on Sustainable Development (WSSD), the international community decided to maintain the Oceans under permanent review by "*establishing by 2004 a regular process under the United Nations for global reporting and assessment of the state of the marine environment, including socio-economic aspects, both current and foreseeable, building on existing regional assessments*" (JPOI,

paragraph 36.b.). The UN General Assembly through Resolution 60/30, requested in 2005 UNESCO/IOC and UNEP to lead the start-up phase of the *Regular Process* by conducting an Assessment of Assessments (AoA), to be completed within two years. A Group of Experts has been working since March 2007 on the AoA report, which provides a framework and options for a Regular Process as they relate to three aspects: the assessment products that can be delivered during the first four years; the institutional arrangements for a Regular Process as well as the means for financing it. The AoA report is available on the Website and can be downloaded from http://www.unga-regular-process.org/. The AoA report has been finalized and was submitted to the Secretary-General of the UN for consideration by the *ad hoc* Working Group of the Whole, established by the UN General Assembly in November 2008 through UNGA Resolution 63/111. Additionally, an interactive on-line database on assessments and activities on the marine environment has been developed (www.unep-wcmc.org/GRAMED).

6. In keeping with GESAMP's mission "to provide authoritative, independent, interdisciplinary scientific advice to organizations and Governments to support the protection and sustainable use of the marine environment", five GESAMP Working Groups are currently active, as follows:

(a) WG 1 (Evaluation of the hazards of harmful substances carried by ships) with IMO as the lead agency;

(b) WG 34 (Review of proposals for approval of ballast water management systems that make use of 'active substances') with IMO as the lead agency;

(c) WG 37 (Expanded scientific review of mercury and its compounds and threats to the marine environment) with UNIDO as the lead agency;

(d) WG 38 (Atmospheric input of chemicals to the ocean) with WMO as the lead agency; and

(e) WG 39 (Global trends in pollution of coastal ecosystems: retrospective ecosystem assessment) with IAEA-MEL as the lead agency.

Detailed information is available at http://s244621454.onlinehome.fr/. GESAMP is also actively contributing to the start-up phase of the UN Regular Process (AoA). The GESAMP Working Group on Atmospheric Input of Chemicals to the Ocean was established to enhance interaction of the marine community with atmospheric programmes in order to assess needs for the development of new model and measurement products for improving our understanding of the impacts of the atmospheric deposition of nitrogen, phosphorus and dust (iron) to the ocean. WMO leads this group assessment and established a Trust Fund for financial contributions of GESAMP partners to support this assessment.

7. Both the UNESCO/IOC and the WMO have contributed to the development of the UN Atlas of the Oceans (www.oceansatlas.org), an Internet portal providing information relevant to the sustainable development of the oceans. This portal is designed for policy-makers who need to become familiar with ocean issues and for scientists, students and resource managers who need access to databases and approaches to sustainability. The Atlas was developed 10 years ago and was launched online in June 2002. The website contains important and useful information such as maps, images and data. At the moment there are 10,000 registered members, a number that continues growing as well as the general use of the Atlas (on average the Atlas received ~100,000 monthly visits in 2008). Plans for the future include continuing developing and strengthening partnerships, obtaining a wider collaboration, adding new partners, updating content and functionality and ensuring equitable use. The seventh meeting of the UN-Oceans (Paris, April 2009) discussed how partners could best support continued growth and development of the UN Atlas – through regular content updating, a thorough review of the original topic tree and enlarged partnership. The meeting suggested that the Atlas could be used to as a key instrument

to promote UN-Oceans activities and communication messages (such as the upcoming and first celebration of UN World Oceans Day). Other suggestions include: (1) a calendar that could be created to publish UN-Oceans members' events/activities; and (2) a collaborative workspace that could be established to better coordinate the group's actions.

8. Ocean fertilization is an emerging issue that Parties to the London Convention and Protocol are addressing with the final objective to provide in 2009 a transparent and legal base for legitimate research activities and in which the Secretariats of the UNESCO/IOC and the Convention on Biological Diversity (CBD) are helping with scientific and technical assistance. A Technical Working Group was established by the London Convention/London Protocol (LC/LP) non-binding Resolution (LC-LP.1 (2008)) on the regulation of ocean fertilization, with the purpose of developing an assessment framework on ocean fertilization and a document summarizing the state of knowledge on ocean fertilization. The UNESCO/IOC has been contributing to these initiatives by revising the "UNESCO/IOC–SCOR Watching Brief on Ocean Fertilization" in order to provide a scientific summary for policy-makers on ocean fertilization, in collaboration with SOLAS, the global research programme Surface Ocean–Lower Atmosphere Study sponsored by IGBP, WCRP and SCOR. Additionally, the UNESCO/IOC, through the *UNESCO/IOC–SCOR International Ocean Carbon Coordination Project* (IOCCP), also cooperated with the Secretariat of the Convention on Biological Diversity (CBD) in compiling and synthesizing available scientific information on potential impacts of direct human-induced ocean fertilization on marine biodiversity, in collaboration with the UN Environment Programme-World Conservation Monitoring Centre (UNEP-WCMC) and the IMO. The IOCCP has also assisted the CBD Secretariat in identifying scientists capable to critically peer-review the scientific synthesis of the impacts of fertilization experiments on marine biodiversity, before they are submitted to the forthcoming 14th meeting of the CBD Subsidiary Body on Scientific, Technical and Technological Advice, scheduled for May 2010. The full report is available at http://www.cbd.int/marine/doc/scientific-synthesis-marine-peerreview-en.doc.

9. WMO has been very active in implementing the International Convention for the Safety Of Life At Sea (SOLAS) in collaboration with the International Maritime Organization (IMO). In particular, a revised version of the MSC Circ. 1017 "Participation *in the WMO Voluntary Observing Ships' (VOS) Scheme*" (June 2001), was submitted to the Eighty-fifth Session of the IMO Maritime Safety Committee (MSC) (London, November-December 2008). The MSC revoked MSC/Circ. 1017 and issued MSC.1/Circ.1293 in December 2008, on which ship owners and masters concerns with regard to VOS data exchange were addressed. On this matter, the WMO Executive Council, at its fifty-ninth session (June 2007), adopted Resolution 27 (EC-LIX) – ship owners and masters' concerns with regard to VOS data exchange, which recommends continuing the trial masking schemes in successive years, unless decided otherwise by the WMO Executive Council, while pending the universal acceptance and implementation of a more suitable solution and the CBS migration to table driven codes. Full report of the WMO-IMO High-level Consultative meeting (Geneva, February 2007) is available at ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/Publications-Other/WMO-IMO-Cons-Final-Report.pdf.

Non-UN system organizations and programmes

10. In addition to the joint activities with other UN-System agencies, both WMO and UNESCO/IOC also collaborated extensively on marine issues with international organizations and programmes outside the system, both governmental and non-governmental, such as ICSU, IOI, IHO, ICES, PICES, POGO, EMSA, etc. Specific activities developed in collaboration with these organizations and programmes are addressed under the relevant agenda items.

Group of Earth Observations (GEO)

11. The Group of Earth Observations (GEO) was established by the first Earth Observation Summit (EOS I) in July 2003. A second EOS Summit was held in Japan in April 2004. The third

GEO Summit took place in Brussels in February 2005, where GEO was formally established and a ten-year GEO Implementation Plan adopted.

12. Since then, considerable progress has been made towards the development of a comprehensive, coordinated and sustained Global Earth Observation System of Systems (GEOSS), focused on nine beneficiary areas, responding to socio-economic needs (the so-called GEO Societal Benefit Areas or SBAs). Both the WMO and the UNESCO/IOC are directly involved in GEO and in the GEOSS process as Participating Organizations. The permanent GEO Secretariat is hosted by WMO in Geneva.

13. At its second session, the JCOMM agreed that the Commission should continue interacting with GEO in progressing the GEOSS Implementation Plan and its work plan. From the GEO Implementation Plan, which described a series of two-year, six-year and ten-year targets, successive GEO Work Plans dated 2005-2006 and 2007-2009 have been derived. An updated GEO Work Plan for 2009-2011 was released in January 2009 and is available on the GEO Website (www.earthobservations.org) under documents. The GEO Work Plans involved the WMO and the UNESCO/IOC, including JCOMM, in the implementation of several of the work packages dealing with ocean observation.

14. For example the GEO Implementation Plan lists the need to "support JCOMM to coordinate the implementation of and prepare regulatory and guidance information for an operational *in situ* ocean observing system" as a two-year target related to the Climate SBA. Related GEO Tasks included the CL-06-04 (GEOSS IPY Contribution), CL-06-06 (Global Ocean Observation System), US-06-02 (Pilot Communities of Practice), and CL-06-05 (GEOSS IPY Contribution).

15. The role of JCOMM and the importance of the ocean were highlighted in a series of high-level documents released in November 2007 on the occasion of the GEO-4 Plenary and the 4th GEO Ministerial Summit held in Cape Town, South Africa.

16. Among those documents, there was a book on "GEO Early Achievements", which emphasised such specific elements of the ocean observing system as the ARGO network of profiling floats or the Global High Resolution Sea Surface Temperature (GHRSST) Project. The book also described ocean-related aspects of interest to several SBAs, including Disasters (GEO Coastal Zone Community of Practice; the German-Indonesian Tsunami Early Warning System), Climate (EuroCryoClim; Improving projections of sea level rise and variability; Ocean Surface Topography Constellation; the Cryosphere Observing System – Legacy of the IPY), Ecosystems (Arctic Observing Network; Census of Marine Life; Continuous Plankton Recorder survey; European Marine Services MERSEA; Large-Marine Ecosystems Indicators of Climate Change; Indian National Centre for Ocean Information – INCOIS) and Agriculture (ChloroGIN – Building a Chlorophyll Ocean Global Integrated Network).

17. Another high-level document was a book entitled "The Full Picture", with a preface by the President of South Africa, an introduction by Prof. José Achache, the GEO Secretariat Director, statements by the Minister of Science & Technology of South Africa, and the four GEO co-Chairs (Administrator of the China Meteorological Administration, European Commissioner for Science and Research, DG of Department of Science & Technology, South Africa, NOAA Administrator). The book content included national and regional reports, a detailed account of the GEOSS Components, including: ARGO; The blue Planet; Why the world needs a GOOS; New Marine Observations around Africa; European Marine Core Service, and descriptions of the expected Societal Benefit Areas of GEOSS, such as sea level rise and vulnerable coastal populations, applications of remote sensing in fisheries and aquaculture, satellite-based fishery service in India, and the green ocean – observations of marine biodiversity.

18. The advent of GEO has provided a number of benefits to the ocean observing community, through its high visibility, political awareness, enhanced coordination (e.g. with the

Committee on Earth Observation Satellites) and corresponding improved effectiveness and potential savings. GEO has also allowed new achievements (e.g. GEONETCast, Data Sharing Principles) of global significance. It has helped engage new players into observations and identify new opportunities.

19. The key issues facing GEO leading up to the next Ministerial Summit in 2010 are: data sharing principles; interoperability arrangements; and, governance and sustained financing as GEO transits from a developmental to operational phase for a System of Systems. The next Plenary will be held in Washington in November 2009. Further progress can be expected for the future, which will require the sustained contribution of WMO and UNESCO/IOC, including JCOMM and the ocean observation community in GEO.

CEOS

20. The Committee on Earth Observation Satellites was created in 1984. It comprises 25 members (space agencies operating EO satellites) and 20 Associates (including WMO and UNESCO/IOC) mostly representing user organizations. CEOS was instrumental in promoting the establishment in 1998 of the IGOS (Integrated Global Observing Strategy) Partnership and in proposing the "Theme" approach. The first Theme report published in 2001 was devoted to the Ocean. IGOS Themes were further transferred in 2008 into GEO (see above) when the IGOS Partnership was terminated.

21. In 2006, CEOS developed the concept of "Virtual Constellations", as a way to improve coordination among ongoing and future satellite missions in view of better fulfilling user requirements and needs. Four-prototype constellation projects were initiated, one of them being devoted to ocean surface topography. In 2008, CEOS accepted two additional constellation projects for further consideration, both of them being devoted to ocean surface variables, namely surface wind vectors and ocean colour.

22. In the fall of 2008, JCOMM, including the Expert Team on Operational Ocean Forecasting Systems (ET-OOFS), took part in the initiatives aimed at securing the continuity of satellite systems for ocean observation. Concern was expressed about decisions relative to Jason-3 as part of the high-altimetry satellite series initiated by the US-French Topex/Poseidon satellite mission launched in August 1992 and continued with the US-French Jason-1 satellite launched in December 2001 and the USA-Europe Jason-2/OSTM satellite launched in June 2008. Concern was also expressed about the inclusion in the second segment of the European Space Agency's Sentinel series of a second flight model, named Sentinel 3-B, of an ocean-dedicated satellite. Both systems are deemed essential to provide sustained and comprehensive observations of ocean surface temperature, winds, waves, topography and spectral reflectance of paramount importance for marine meteorology and ocean monitoring and forecasting.

23. Positive signs were received late in 2008, with the European decision of the second segment of the Sentinel programme including Sentinel 3-B, though with a delayed launch date, and early in 2009, with the inclusion of a Jason-3 budget request in the NOAA FY-2010 budget released by the President of the US for submission to the Congress, while the Jason-3 programme proposal is progressing in the European side.

24. The Surface Vector Wind Constellation Team has analysed the situation as regards the routine usage of satellite-derived surface vector wind (SVW) and significant wave height (SWH) products by those developing countries with responsibility for operational high-seas forecasts under the Global Maritime Distress and Safety System (GMDSS), with a view to broaden it. It appears that there is a low operational use of those parameters, which have been observed and distributed on the GTS for more than ten years. A detailed analysis of the reasons behind this situation and of the ways to overcome them has been performed by CEOS. Issues of data accessibility, training and capacity building, and data policy and timeliness are involved.

Industry and commerce

25. Both the WMO and the UNESCO/IOC have been working for many years with some organizations representing industrial and commercial marine-related activities and companies, including those involved with commercial shipping, the offshore oil and gas industry, equipment manufacturers and vendors, and providers of marine telecommunications systems (e.g. the International Chamber of Shipping (ICS), the International Association of Oil and Gas Producers (OGP) and CLS/Service Argos). These organizations often represent at the same time both major users of marine data and services, and potential sources of data and collaborators in marine monitoring and research.

26. JCOMM-II recommended the establishment of an *ad hoc* task team to enhance interactions with the private sector. The discussion during the session had focused on the importance both of being able to better understand the requirements of industry for met-ocean data and products, and also to engage industry more directly in the work of JCOMM and GOOS (Global Ocean Observing System). The *ad hoc* team, sponsored jointly by GOOS, met in March 2006 in Paris, France. It made a number of recommendations to enhance JCOMM/GOOS/Industry interactions. Subsequently, it was decided by the Management Committee that this task team should be merged with a parallel industry coordination mechanism established by the GOOS Scientific Steering Committee, which now includes experts representing JCOMM.

27. The WMO Executive Council, at its sixty-first session (EC-LXI, June 2009), addressed:

(a) Options for WMO to stimulate establishment of global or regionalized international representation bodies of the private sector service providers to better facilitate coordination between that sector and WMO;

(b) Approaches to address problematic issues connected with complementary and competitive cooperation between NMHSs and private sector service providers;

(c) Policy and guidelines for an ethical framework for engagement with corporate sponsors and donors, taking into account pertinent recommendations of the WMO Audit Committee; and,

(d) A mechanism involving the technical commissions concerned and the regional associations for developing guidelines for use by NMHSs on best practice models of partnership in furthering cooperation with the private sector, and in particular private sector service providers.

Detailed information is given in the *Abridged Final Report with Resolutions of the Sixty-first Session of the WMO Executive Council* (WMO-No. 1042), under the agenda item 4.2, available at http://www.wmo.int/pages/governance/ec/ec_docs_en.html.

_____

BACKGROUND INFORMATION ON THE WMO STRATEGIC PLAN AND THE UNESCO/IOC MEDIUM-TERM STRATEGY

WMO Strategic Plan

1. WMO has formally adopted, with Resolution 31 (Cg-XIV), the Results-based Management approach that it had been implementing for several years before. The Result-based Management concept is a key instrument for ensuring effective management oversight, based on the performance measurement and reporting system. It consists of four major building blocks, namely, the WMO Strategic Plan (SP), the WMO Operating Plan, the Results-based Budget and a WMO Monitoring and Evaluation System. The WMO Strategic Plan, which is available at http://www.wmo.int/pages/about/spla_en.html, addresses the activities and operation of the whole of WMO, its Members and their NMHSs, as well as the Secretariat. The Strategic Plan supersedes and replaces, since 2008, the previous approach through Long-term Plans.

2. The WMO Strategic Plan for the period 2008-2011 outlines the strategic initiatives that WMO Members are using to deliver more accurate, timely, useful and cost-effective weather, climate, water and environmental (including ocean and air quality) information and services to meet national and global needs. It focuses on strategic initiatives that increase utility, effectiveness and efficiency in the production and delivery of weather, climate, hydrological and environmental services. Successful use of the Plan will contribute to the following desired societal outcomes:

- Increased protection of life, livelihood and property;
- Improved health and well-being of citizens;
- Greater safety on land, at sea and in the air;
- Sustained economic growth in both developed and developing countries; and
- Protection of other natural resources and improved environmental quality.

3. The desired social outcomes are addressed by the following three **Top Level Objectives**:

I. Produce more accurate, timely and reliable forecasts and warnings of weather, climate, water, and related environmental elements;

II. Improve the delivery of weather, climate, water, and related information and services to the public, governments and other users; and

III. Provide scientific and technical expertise and advice in support of policy and decision-making and implementation of the agreed international development goals and multilateral agreements.

4. These long-term objectives are achieved through a series of initiatives, which emphasize five **Strategic Thrusts**:

- Science and technology development and implementation to monitor and observe the environment, to forecast and warn of significant weather, water and climate conditions, and to understand the Earth system;
- Service delivery to ensure that society can realize the full benefit of the weather, water and climate information and services that WMO Members produce;

- Capacity-building to sustain and improve the ability of all Members, with a particular focus on developing and least developed countries, to provide essential environmental services to their societies;

- Partnership to work with international agencies, other organizations, academia, the media and the private sector to improve the range and quality of critical environmental information and services; and

- Efficient management and good governance to ensure environmental information and services are affordable.

5. Taken together, the top level objectives and strategic thrusts are structured into results or outcomes, which are referred to as Expected Results that WMO expects to achieve during 2008-2011. These eleven Expected Results related to five strategic thrusts are shown in the table below.

Strategic thrusts	**Expected results**
Science and technology development and implementation	1. Enhanced capabilities of Members to produce better weather forecasts and warnings
	2. Enhanced capabilities of Members to provide better climate predictions and assessments
	3. Enhanced capabilities of Members to provide better hydrological forecasts and assessments
	4. Integration of WMO observing systems
	5. Development and implementation of the new WMO Information System
Service delivery	6. Enhanced capabilities of Members in multi-hazard early warning and disaster prevention and preparedness
	7. Enhanced capabilities of Members to provide and use weather, climate, water and environmental applications and services
Partnership	8. Broader use of weather, climate and water outputs for decision-making and implementation by Members and partner organizations
Capacity-building	9. Enhanced capabilities of NMHSs in developing countries, particularly least developed countries, to fulfill their mandates
Efficient management and good governance	10. Effective and efficient functioning of constituent bodies
	11. Effective and efficient management performance and oversight of the Organization

6. The WMO Executive Council, at its sixtieth session (Geneva, June 2008) endorsed the schedule for delivering the draft WMO Strategic Plan 2012-2015 by the end of 2008; the draft WMO Operating Plan by the end of 2009; and the proposal for the Results-based Budget 2012-2015 by the end of 2010. It requested the technical commissions and regional associations to ensure that their future operating plans (goals, deliverables, performance indicators and implementation timelines) would be fully harmonized with the next WMO Strategic Plan, in particular as regards relevant Strategic Thrusts and Expected Results. At the same time, they should be actively involved in the strategic planning cycle lead by the WG on Strategic and Operational Planning. Additionally, the Council emphasized the importance of focusing on outcomes in monitoring and evaluation (M&E) process. It stressed the need to refine the Deliverables and associated performance indicators to ensure that the M&E System would be based on appropriate and measurable performance metrics. It also agreed to:

(a) Reflect more appropriately the current plans developed by the constituent bodies in the Deliverables that the corresponding Departments had formulated in the SOP (2008-2011); and by refining the deliverables, performance targets and timeliness to better distinguish the roles of the Members from those of the Secretariat;

(b) Request the constituent bodies to review and, as appropriate, improve the formulation of the Deliverables and the measurability of the performance indicators in the SOP (2008-2011) because well formulated deliverables are critical for achieving measurable and recognizably important outcomes.

7. The WMO Executive Council, at its sixty-first session (Geneva, June 2009), addressed the WMO Strategic Plan (SP) for the period 2012-2015 and agreed on the following:

(a) To base the strategic direction of the Organization on a set of Global Societal Needs (GSN), as given in Table 1.

Table 1: Global Societal Needs

- Improved protection of life, and property (related to impacts of hazardous weather, climate, water and other environmental events and increased safety of transport on land, at sea and in the air)
- Poverty alleviation, sustained livelihoods and economic growth (in connection with the Millennium Development Goals) including improved health and social well-being of citizens (related to weather, climate, water and environmental events and influence)
- Sustainable use of natural resources and improved environmental quality

(b) That the framework of the next SP should consist of the five Strategic Thrusts (ST) and eight organization-wide Expected Results (ER), as given in Table 2.

Table 2: Strategic Thrusts and Organization-wide Expected Results

STRATEGIC THRUSTS	ORGANIZATION-WIDE EXPECTED RESULTS
I. Improving Service Quality and Service Delivery	1. Enhanced capabilities of Members to deliver and improve access to high quality weather, climate and water and related environmental predictions, information and services in response to users' needs and to enable their use in decision-making by all relevant societal sectors
	2. Enhanced capabilities of Members to reduce risks and potential impacts of hazards caused by weather, climate and water and related environmental elements
II. Advancing Scientific Research and Application as well as Development and Implementation of Technology	3. Enhanced capabilities of NMHSs to produce better weather, climate, and water and related environmental information, predictions and warnings to support in particular climate impact and adaptation strategies
	4. Enhanced capabilities of Members to access, develop, implement and use integrated and inter-operable Earth- and space-based systems for weather, climate and hydrological observations, based on world standards set by WMO, as well as related environmental observations
	5. Enhanced capabilities of Members to contribute to and draw benefits from the global research capacity for weather, climate, water and environment science and technology development

STRATEGIC THRUSTS	ORGANIZATION-WIDE EXPECTED RESULTS
III. Strengthening Capacity Building	6. Enhanced capabilities of NMHSs, in particular in developing and least developed countries, to fulfil their mandates
IV. Building and Enhancing Partnerships and Cooperation	7. New and strengthened partnerships and cooperation activities to improve NMHSs' performance in delivering services and to increase the value of the contributions of WMO within the UN System, relevant international conventions and national strategies
V. Strengthening Good Governance	8. An effective and efficient Organization

(c) To involve regional associations and technical commissions in the development of Expected Results and Key Performance Indicators, Key Outcomes and a manageable number of related performance measurement parameters and to ensure that those are based on Members' needs and adequately reflect the programme areas of the Organization. Such involvement would also facilitate the establishment of baselines and realistic target setting.

UNESCO/IOC Medium-term Strategy 2008-2014

8. The UNESCO/IOC Medium-Term Strategy 2008–2013 (available at http://ioc-unesco.org/index.php?option=com_oe &task=viewDocumentRecord&docID=1640) will address the following High-Level Objectives:

High-Level Objective 1 - Prevention and reduction of the impacts of natural hazards

Recognizing the UNESCO/IOC's role, for over four decades, of coordinating the Pacific Tsunami Warning System, the United Nations has mandated the UNESCO/IOC as the lead agency for coordinating the planning and implementation of tsunami early warning and mitigation systems. Following the rapid progress in installing the Indian Ocean Tsunami Early Warning and Mitigation System, the UNESCO/IOC has expanded its action to other regions (north-eastern Atlantic and Mediterranean; Caribbean) and is contributing to develop a global system for addressing multiple marine hazards, thus supporting the overall objective of contributing to disaster preparedness, mitigation and recovery.

Action	Expected Results
1a. Promote integrated and sustained monitoring and warning systems for coastal and oceanic natural hazards, in close coordination with other relevant intergovernmental organizations where appropriate, using enhanced coastal and ocean networks, including education and training activities.	Establishment of initial/core regional and national capabilities for tsunamis and other related coastal hazards warning and mitigation systems.
1b. Educate communities at risk with respect to natural hazards impact prevention, preparedness and mitigation measures.	Plans developed for risk assessment and hazard mitigation integrated into coastal planning and management at the national level.

High-Level Objective 2 - Mitigation of the impacts and adaptation to climate change and variability

UNESCO/IOC will continue its role as an intergovernmental advocate, coordinator, and partner in international scientific research to improve the understanding of the Earth System, by contributing to improve prediction of climate and its effects on marine ecosystems and resources through sustained ocean observation and process studies at regional and global scales and by contributing to the development of science applications to mitigate the effects of climate change, including sea-level rise.

Action	Expected Results
2a. Increase the understanding of the ocean's role in climate variability and climate change.	Participation of the Ocean Sciences research community promoted and catalyzed, and their cutting-edge results integrated into international Climate Research.
2b. Contribute to the better prediction of climate through ocean observations and process studies, at regional and global scales.	Provide the intergovernmental coordination and promote the international cooperation required to sustain the two modules of the Global Ocean Observing System.
	Scientific and expert guidance for global and coastal observations and services ensured.
	Support for regional cooperation in ocean observations and services provided.
	International cooperation in observations and research of the ocean's role in the global carbon cycle facilitated.
2c. Increase the understanding of the impacts of climate change and variability on marine ecosystems and their living resources.	Organize the participation of the Ocean Sciences research community to address the impacts of climate change on marine ecosystems and their living marine resources at the global and regional level. Integration of their cutting-edge results into mitigation strategies and interventions at the national and regional level. Cooperation to improve understanding of coral bleaching and regularly assess the status of coral reefs of the world facilitated.
	International cooperation required to improve understanding of ocean acidification and its impacts on marine ecosystems sustained and enhanced.
	International cooperation to improve the scientific understanding of climate impacts on fisheries and other living marine resources continued and facilitated.

High-Level Objective 3 - Safeguarding the health of ocean ecosystems

UNESCO/IOC will leverage science and capacity to monitor and safeguard the health of ocean ecosystems and services, by addressing the conservation and sustainable management of coastal resources and marine biodiversity. In this regard, UNESCO/IOC will continue harmonizing its capacity-development activities according to long-term capacity-development principles that improve the ability of Member States to apply sound scientific methods for sustainable management of their resources.

Action	Expected Results
3a. Actively contribute to the "Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including socio-economic aspects".	First phase of the Regular Process completed.
3b. Further develop the research and monitoring required for prevention of marine environment degradation, and the maintenance of biodiversity and the sustainable use of marine habitats.	Through the sponsorship of GEOHAB, capacity to predict and mitigate harmful algal events improved.
3c. Identify and develop the capacity-building necessary for maintenance of healthy oceans ecosystems focusing on the regional needs.	Initiate integrated cooperative regional frameworks focusing on regional capacity-building and regional collaboration (GOOS GRA's, IODE ODIN's)
	Assess institutional capacities in eastern, western and central Africa and Latin America to conduct marine scientific research.
	Enroll a selected number of UNESCO Chairs to promote educational aspects within pilot projects in developing regions.
	Engage young scholars in science done at sea through Training-Through-Research (TTR) grants.

High-Level Objective 4 - Management procedures and policies leading to the sustainability of coastal and ocean environment and resources

UNESCO/IOC will assist Member States, at their request, in the management of their marine and coastal environment, focusing on regional needs and building national capabilities, by translating research results into management approaches and wise practices, through spatial and other planning approaches demonstrated through pilot projects in target regions, by providing the necessary training and assistance to implement them and by strengthening UNESCO/IOC Regional Subsidiary Bodies to fully ensure the regional implementation of the UNESCO/IOC Medium-Term Strategy 2008–2013.

Action	Expected Results
4a. Enhance regional cooperation and involvement of the Member States through capacity-building and transfer of technology and measures to strengthen the capabilities of the IOC Regional Subsidiary Bodies and IOC decentralized offices.	Member States will be assisted in implementing Parts XIII and XIV of UNCLOS. Assistance provided to developing countries to make timely submissions for the extension of their continental shelf (deadline 13 May 2009), alerting all Member States to this by the end of 2007 and responding to all requests within 3 months.
	Assistance to developing countries to make timely submissions for the extensions of the continental shelf provided.
4b. Facilitate science related to ocean and coastal resource management.	Science-based applications and policies to adapt to climate and coastal change developed.
	Approaches to link freshwater management with coastal management developed.
4c. Enhance development and implementation of decision-support tools that improve integrated ocean and coastal management.	ICAM indicators framework in selected regions applied through pilot projects.
	Marine and coastal spatial planning methodologies developed.

BACKGROUND MATERIAL

1. The JCOMM Strategy, endorsed by JCOMM-II (Halifax, September 2005), included, *inter alia*, a requirement for a periodic review of the Commission:

> ***"6.4 External Review***
>
> *[…]. The parent bodies must ensure that JCOMM is periodically reviewed by an external group of experts every 8 years and the findings reported to every alternate Session, to ensure that JCOMM is best aligned to the requirements identified by its parent bodies and its clients."*

2. The conduct of this review during the current intersessional period was specifically requested by JCOMM-II. The Management Committee, at its fifth session (Geneva, October 2006), gave implicit endorsement for the preparation and conduct of the review, to be presented at JCOMM-III.

3. The sixth session of the Management Committee (Paris, December 2007) agreed that the review, in conjunction with the Implementation Plan (IP), had to fulfil a number of purposes, including:

(i) Assess how well JCOMM is addressing high level strategic objectives and expected results as expressed in the various planning documents of both WMO and UNESCO/IOC since the establishment of the Commission;

(ii) Assess how well JCOMM has fulfilled, over the past 8-10 years, the expectations of WMO and UNESCO/IOC for the Commission when it was established;

(iii) Analyse to what degree JCOMM delivers benefits to Members/Member States, and is cost-effective in its operations;

(iv) Based on the findings under (i) to (iii) above, provide recommendations on how JCOMM can improve benefits to its Members/Member States, as well as its cost-effectiveness, including modifications to its working structure, if appropriate.

4. In order to properly address these objectives, the Management Committee agreed that the review should be "external" (i.e. not directly by JCOMM officers, members, Secretariat, etc.), but conducted by experts with some knowledge and experience of the history (and pre-history) of JCOMM, and of its present workings. It was the view of some Committee members that the review team should include, or be comprised of, experts who could assess technical progress made by JCOMM.

5. With these considerations in mind, the Management Committee agreed on draft terms of reference for the review, together with a timeline for its conduct and reporting to JCOMM-III, as well as suggestions for composition of the review team. The Committee further provided some additional guidelines for the conduct of the review, in the form of a series of questions related to the operation of JCOMM, including its external relations with both users and other relevant bodies and organizations.

6. The seventh session of the Management Committee (Melbourne, December 2008) was informed that both WMO and UNESCO/IOC Executive Councils supported the proposed review of JCOMM, considering it timely at this stage in the Joint Commission's lifetime. They had noted that: (i) the review process should reside in, and be carried out by, the Governing Bodies of the two co-sponsoring organizations of JCOMM, and not by JCOMM itself; (ii) the review should reflect the views of UNESCO/IOC Member States and WMO Members; and (iii) that carrying out such a

review would require extrabudgetary support. The Committee was also informed that UNESCO/IOC had mobilized some extrabudgetary funds from US NOAA to provide support to the former NOAA Administrator Dr D. James Baker to undertake a broad review of UNESCO/IOC-WMO interactions, including JCOMM, and that a joint circular letter would be issued to Members/Member States informing them about the review process and seeking additional funds. The Committee noted that the WMO and UNESCO/IOC Secretariats had agreed on the Terms of Reference for Dr Baker's consultancy contract. However, these ToR were broader than those required for a full review of JCOMM, as requested by both MAN-VI, and the WMO and UNESCO/IOC Executive Councils. The Management Committee had therefore strongly recommended that, should Members/Member States provide additional funds in response to the circular letter, that these should be used to undertake this full review. In the event, no such additional funding was provided, so that the only review available to JCOMM-III would be that to be done by Dr Baker.

7. The review was undertaken by Dr Baker in the first half of 2009, and the final report delivered to the UNESCO/IOC and WMO Secretariats in early June 2009. This report, *Planning and Implementation for GOOS – A Consultant Study for WMO and UNESCO/IOC,* is available at http://www.jcomm.info/GOOS. The existence of the review report was made known to the sixty-first session of the WMO Executive Council (Geneva, June 2009) and the 25th session of the UNESCO/IOC Assembly (Paris, June 2009), and placed on the WMO and UNESCO/IOC Websites, with Members/Member States invited to provide comments as appropriate.

8. The recommendations of the study are presented in summary form in Appendix B to this information document. Many of them make specific reference to JCOMM, and most of the remainder are of at least indirect relevance. The Commission is invited to provide advice on the outcomes of the review and recommendations as they relate to JCOMM, and in particular to advise and instruct the Management Committee on any follow-up.

_____

EXTRACT OF THE CONSULTANT STUDY ON THE PLANNING AND IMPLEMENTATION FOR GOOS

28 May 2009

Recommendations:

Recommendation 2.1: UNESCO/IOC and its partners should complete the development of and implement a business plan for the operations and delivery of services of GOOS as a whole (coastal and global).

Recommendation 2.2.1: The business plan for GOOS implementation should have an emphasis on the "user pull," drawing examples from successful country and regional implementation such as the US IOOS, European Commission's GMES Marine Services, and Australia's IMOS.

Recommendation 2.2.2: The business plan should clearly identify products and services to be delivered, drawing heavily on the experience and capability of existing UNESCO/IOC services such as GLOSS in JCOMM's Observations Programme Area and JCOMM's Services Programme Area. An important input for building products and services will come from development and support of GODAE OceanView.

Recommendation 2.2.4: The Business Plan should show how UNESCO/IOC and WMO JCOMM plan to broaden their activities in capacity building, and to partner with marine groups deeply involved in capacity building.

Recommendation 2.2.5: UNESCO/IOC and WMO should continue to ensure the free and open exchange of ocean and related data through IODE of UNESCO/IOC and national centres. This is a particularly high priority for coastal GOOS. The strong efforts of GEO to ensure a free and open data policy for satellite information can help UNESCO/IOC and WMO in providing data for GOOS.

Recommendation 2.2.6: The Business Plan should include a clear explanation of the roles and responsibilities of the intergovernmental groups with direct responsibility for both management and outreach: I-GOOS (or a new group as recommended), JCOMM, and GSSC.

Recommendation 2.2.7: The Business Plan should incorporate the ways in which GOOS will contribute to providing the data needed for the issues raised by the Secretary-General in his March 2009 Law of the Sea report to the UN.

Recommendation 2.2.8: The Business Plan should include identification of the roles of SCOR, POGO, the marine component of GEO/GEOSS and other related groups to ensure their full engagement in GOOS implementation.

Recommendation 2.3: Completion of the Business Plan should be the direct responsibility of the GOOS Project Office, working in conjunction with JCOMM and the GRAs. Other sponsoring bodies ICSU and UNEP should be invited to participate. Input should be solicited from POGO, GEO, the private sector, other ocean-related parts of the UN family, regional organizations and appropriate Member States, of both developed and developing countries.

Recommendation 3.1: UNESCO/IOC and WMO must continue and enhance their support of sustained ocean observations. UNESCO/IOC needs to work with UNESCO to make the case for GOOS, make its membership more aware and responsive to GOOS needs, and to enhance capacity building.

Recommendation 3.2: At this point and with the current structure, I-GOOS is a failed experiment. I-GOOS should be dissolved and replaced with a body that could truly help make UNESCO/IOC Member States aware of its role in implementing both coastal and global GOOS. The new body

should seek Member State representatives who represent relevant national agencies or otherwise play a significant role in coastal or global observations and to the extent possible, can make binding funding commitments. The new body needs to be responsible for GOOS (both open ocean and coastal components) and its implementation in these domains and able to take up advice from OOPC, PICO etc.

Recommendation 3.3: JCOMM is playing a key role in the implementation of GOOS and the proposed restructuring needs support by both UNESCO/IOC and WMO. JCOMM could take on the responsibility for coordinating the Global Coastal Network (GCN). JCOMM should examine its roles and responsibilities for GOOS particularly with an eye towards identifying its role in implementing coastal GOOS, and help make both UNESCO/IOC Member States and WMO Members aware of its role in implementing GOOS overall.

Recommendation 3.4: In recent years, GSSC has lacked direction and focus. Members are not clear about their roles and responsibilities, whereas the GSSC Panels are active and effective. GSSC should be dissolved in its current form and reformed based on the Panels. One possible arrangement would be a joint body made up of the two panels with a governing tripartite executive committee: the current Chair representing outreach, the Chair of PICO, and the Chair of OOPC. To save funds, a single 3-4 day joint annual meeting that includes PICO and OOPC should be convened, and the Executive Committee could meet during the joint meeting.

Recommendation 3.5: UNESCO/IOC through the GPO should lead the effort to strengthen and clarify the relations between UNESCO/IOC, I-GOOS, JCOMM, POGO and the marine component of GEO/GEOSS, as well as UNCLOS, IMO, the Small Island States, and other organizations so that coastal ocean GOOS and open ocean GOOS are made more visible to the public and decision-makers.

Recommendation 4.1: UNESCO/IOC and WMO JCOMM management of GOOS should be streamlined, starting with a careful consideration of what meetings and reports are really required, and a review of recommendations that have been made in the past and whether these are being followed up. UNESCO/IOC and WMO JCOMM need to do a regular review of their priorities as new ideas and techniques arise, and should consider reallocating internal resources to meet planning and coordination needs.

Recommendation 4.2: Following the successful move of IODE of UNESCO/IOC and the establishment of the regional GOOS offices, UNESCO/IOC should carefully explore moving other central functions from Paris to countries willing to commit resources and help to leverage funds.

Recommendation 4.3: UNESCO/IOC and WMO JCOMM should make every effort to find additional support for planning and coordination in order to ensure day-to-day attention to these critical issues.

Recommendation 4.4.1: UNESCO/IOC GPO and WMO JCOMM should be active and entrepreneurial in seeking outside funding from the private sector, foundations, and regional governmental groups and consider other ways of doing business, such as contracting with outside organizations, if this reduces costs.

Recommendation 4.4.2: UNESCO/IOC should task I-GOOS to develop a process for helping developing countries develop sustainable coastal plans for possible funding from the developed world.

Recommendation 4.4.3: UNESCO/IOC and WMO JCOMM should use the business plan to help increase support from Member States for the operations of GOOS and delivery of services.

Recommendation 5: The UNESCO/IOC Secretariat should consider convening a series of strategic coordination meetings that would involve existing bodies and new institutions to help GOOS meet

the many issues that have been discussed above. Such institutions and bodies include I-GOOS (or the new body recommended), JCOMM, other parts of the UN family, GEO, POGO, SCOR, IMO, IHO, and the private sector. These meetings could form the basis for consideration of a larger regular “Oceans Davos” conference to bring together all the constituencies of the ocean community.

_____

BACKGROUND MATERIAL

1. The JCOMM Programme Area Coordination Groups, other subsidiary and reporting bodies have prepared a draft proposal for their future work plans, which is available at http://www.jcomm.info/JCOMM_WP.

2. The Management Committee prepared a draft JCOMM Operating Plan, including planned programme implementation, for the periods 2010-2013, taking into account the WMO and UNESCO/IOC strategic planning processes and their respective Expected Results and Actions. The full document is available at http://www.jcomm.info/JCOMM_OP.

_____

STATUS OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS ADOPTED BY THE COMMISSION PRIOR TO ITS THIRD SESSION AND SUGGESTED ACTIONS

1. Resolutions of JCOMM

Resolution No.	Title of the Resolution	Suggested action			Comments and action proposed
		To be kept in force	To be replaced	Not to be kept in force	
1 (JCOMM-II)	Management Committee of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology		X		To be replaced by a new one (JCOMM-III/Doc. 14.4)
2 (JCOMM-II)	Services Programme Area		X		To be replaced by a new one (JCOMM-III/Doc. 14.4)
3 (JCOMM-II)	Observations Programme Area		X		To be replaced by a new one (JCOMM-III/Doc. 14.4)
4 (JCOMM-II)	Data Management Programme Area		X		To be replaced by a new one (JCOMM-III/Doc. 14.4)
5 (JCOMM-II)	Capacity Building			X	
6 (JCOMM-II)	Satellite Data			X	
7 (JCOMM-II)	Review of previous resolutions and recommendations of JCOMM (including CMM and IGOSS) and of relevant resolutions of the governing bodies of WMO and UNESCO/IOC		X		To be replaced by a new one (JCOMM-III/Doc. 14.3)

2. Recommendations of JCOMM (including the WMO Commission for Marine Meteorology (CMM) and the IOC-WMO Committee for the Integrated Global Ocean Services System (IGOSS))

Recommendation No.	Title of the Recommendation	Suggested action			Comments and action proposed
		To be kept in force	To be replaced	Not to be kept in force	
2 (JWC-IGOSS-V)	Real-time distribution and archiving of oceanographic data	X			
1 (CMM-XI)	Marine meteorological services monitoring programme	X			
12 (CMM-XI)	Use of Beaufort equivalent scale for wind force	X			
4 (CMM-XII)	Wave forecast verification scheme	X			
6 (CMM-XII)	Data buoys in support of meteorological and oceanographic operations and research	X			
1 (JCOMM-I)	Ocean Data Acquisition System (ODAS) Metadata Format	X			Work underway (see JCOMM-III/Doc. 7)
2 (JCOMM-I)	Resources for Ship-based Observations	X			

3 (JCOMM-I)	International Seakeepers Society	X			Seakeepers has informed WMO that it is undergoing financial problems because of the international financial crisis, and would probably get out of funding by June 2009. Solutions are being sought, including proposing governmental agencies to take over operational funding, but WMO is not aware of any practical solution at the moment
4 (JCOMM-I)	Vandalism of Ocean Data Buoys	X			
5 (JCOMM-I)	The Global Sea-level Observing System (GLOSS)	X			
12 (JCOMM-I)	Working Arrangements between WMO and the International Mobile Satellite Organization (IMSO)	X			Discussions underway between WMO and IMSO
1 (JCOMM-II)	Guide to Storm Surge Forecasting			X	
2 (JCOMM-II)	The development of operational oceanographic products and services under JCOMM			X	
3 (JCOMM-II)	Consumables for ship-based observations	X			
4 (JCOMM-II)	New terms of reference for JCOMMOPS		X		To be replaced by a new one (JCOMM-III/Doc. 6.4)
5 (JCOMM-II)	UNESCO/IOC Project Office for IODE	X			
6 (JCOMM-II)	JCOMM Data Management Strategy			X	
7 (JCOMM-II)	Complementary guidelines for NAVTEX broadcast			X	
8 (JCOMM-II)	Guidelines for sea ice charts			X	
9 (JCOMM-II)	Modifications to the International Maritime Meteorological Tape (IMMT) format and Minimum Quality Control Standards (MQCS)		X		To be replaced by a new one (JCOMM-III/Doc. 12)
10 (JCOMM-II)	Marine Pollution Emergency Response Support System (MPERSS)			X	
11 (JCOMM-II)	Modifications to the *International List of Selected, Supplementary and Auxiliary Ships* (WMO-No. 47)			X	
12 (JCOMM-II)	JCOMM support for marine multi-hazard warning systems, including tsunamis	X			
13 (JCOMM-II)	The Global Earth Observation System of Systems	X			
14 (JCOMM-II)	Revision of resolutions of the WMO and UNESCO/IOC governing bodies based on previous recommendations of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (including the WMO Commission for Marine Meteorology and the Joint IOC-WMO Committee for the Integrated Global Ocean Services System)		X		To be replaced by a new one (JCOMM-III/Doc. 14.3)

_____

STATUS OF PREVIOUS RESOLUTIONS OF THE GOVERNING BODIES OF WMO AND UNESCO/IOC CONCERNING THE COMMISSION AND SUGGESTED ACTIONS

Resolution No.	Title of the Recommendation	Suggested action			Comments and action proposed
		To be kept in force	To be replaced	Not to be kept in force	
15 (WMO EC-XXI)	WMO participation in cooperative investigation of the oceans	X			
12 (WMO EC-XXV)	Use of ocean weather ships and buoys for research purposes	X			
3 (WMO EC-XLVIII)	The Joint IOC/WMO/CPPS Working Group on the instigation of El Niño		X		The Terms of Reference for the Joint IOC/WMO/CPPS Working Group on the instigation of El Niño is being reviewed by the WMO Executive Council Working Group on Climate, and related Weather, Water and Environment matters
6 (WMO EC-LVIII)	Report of the second session of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology			X	
27 (WMO EC-LIX)	Ship owners and masters' concerns with regard to VOS data exchange	X			
UNESCO/IOC EC-XXXIX.2	Report of the second session of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology			X	

_____

ABSTRACTS OF SCIENTIFIC LECTURES

SOCIO-ECONOMIC BENEFITS OF MET-OCEAN INFORMATION AND SERVICES

Professor John Zillman

The foundations of international cooperation in meteorology and oceanography owe much to the need for, and benefits from, marine meteorological and oceanographic services that had already become evident from the pioneering work of Humboldt, Maury, von Neumayer and others in the mid nineteenth century and which were subsequently codified and institutionalized through the International Convention on Safety of Life at Sea (SOLAS). The past 150 years have demonstrated the enormous existing, and even greater potential, social, economic and environmental benefits from the effective application of marine services to the safety and efficiency of marine transport and off-shore operations, disaster risk reduction and mitigation, marine resource development, environmental stewardship, coastal zone management, tourism, marine sports and recreation and a wide range of other human priorities and pursuits. Met-ocean services provide a particularly powerful demonstration of the benefits of widespread availability and use of economic public goods with the theory of global public goods providing compelling guidance as to the optimum national funding and internationally cooperative institutional arrangements for their provision and application. The WMO-IOC partnership under JCOMM, through which a wide range of marine research and operational agencies of individual nations work together to support the agreed international ocean observation, data management and service provision arrangements provides the essential global framework for future delivery of even greater socio-economic benefits, shared widely across nations and across the increasingly broad range of users of marine meteorological and oceanographic information, products and services. This lecture will provide a broad overview of the history, rationale, theory, practice, achievements and still unrealized opportunities for national and international benefit from recent advances in meteorological and oceanographic science, technology and policy for the provision of met-ocean information and services.

_____

SOCIO-ECONOMIC BENEFITS OF MET-OCEAN INFORMATION AND SERVICES IN AFRICA

Dr Malika Bel Hassen-Abid

Africa, like other parts of the world, is subjected to marine related hazards. Several events might frequently occur like inundations, coastal flooding and storm surge. The coastal zones are the most affected by these disasters and constitute therefore the most vulnerable areas. Africa is also experiencing a steady migration of population to the coastal areas in search of improved livelihoods and economic opportunities. Integrated management of marine and coastal resources, as well as reduction of the risks of ocean related hazards, based on sound scientific knowledge, are essential and contribute to poverty alleviation and sustainable development in Africa. Access to reliable and up-to-date Met-ocean data is crucial for this process.

The shortage of oceanographic and meteorological data and information has been, and continues to be, a major constraint to sustainable development in coastal and marine areas in Africa in recent years. An increasing number of initiatives, supported by national governments and international partners, to address coastal and marine management in an integrated manner has been launched in recent years to fill information gaps needed to improve management decision making and prevent against natural hazards. Most of these initiatives were conducted in the framework of Large Marine Ecosystems programmes (LMEs).

The accessibility to Met-ocean data has been another constraint to the use of data by a wider community. This is due to the combined effect of several factors, such as the scattering of data in various institutions, the wide variety of data formats and metadata formats that are prevalent and the limited information and communication technology infrastructure in the African countries. To overcome this problem the UNESCO/IOC-IODE programme has launched an innovative strategic approach called the ODIN (Ocean Data and Information Network) which was used in Africa from 1997. This strategy aims at strengthening a pan African network of National Oceanographic Data Centres (NODCs), as a sustained mechanism for the implementation of best practices in managing marine data and information for the benefit of the marine and coastal management.

_____

OCCASION OF THE 50th ANNIVERSARY OF UNESCO/IOC

Dr Geoffrey L. Holland

In 2010, the Intergovernmental Oceanographic Commission (IOC) of UNESCO will be celebrating its fiftieth anniversary as a UN Specialized Agency dealing with Ocean Science and Services. This presentation is a personal look at the evolution of that organization from its original mandate, to provide intergovernmental support and direction to multinational ocean research expeditions, into a broader and more proactive role in the provision of operational ocean information and products. In particular, the development of the interagency cooperation between the UNESCO/IOC and the WMO is explored. Although the obvious relationship and mutual dependence of meteorological and oceanographic sciences in the understanding of ocean/atmospheric processes has dictated close involvement between the UNESCO/IOC and the WMO from the beginning, the path from the early years to the establishment of the Joint Technical Commission for Oceanography and Marine Meteorology has not always been smooth.

_____

MARINE METEOROLOGICAL ACTIVITIES AT THE DIRECTION OF NATIONAL METEOROLOGY

Mr Hassan Bouksim

Morocco, with its 3 500 km of coastline and its access to both the Atlantic and the Mediterranean, is a maritime country. Many economic activities are carried out at sea and in coastal regions and are closely linked to meteorological conditions and the marine environment. Thus, the maritime navigation, fishing, port operations and shoreline management sectors need specialized meteorological assistance for the planning and management of their operations.

The talk will be an opportunity to take stock of the maritime meteorology activities at the National Meteorological Administration of Morocco (NMA). There will be a discussion on the organization of these activities, the resources available and activities related to forecasting and meteorological assistance intended for users in the maritime sector. An emphasis will also be placed on efforts being undertaken by the NMA to improve the quality of this assistance, to strengthen the observation network and to develop forecasting models. Finally, the talk will touch on cooperation and partnership aspects involving organizations at both the national and international levels.

_____