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RELATIONSHIP WITH OTHER PROGRAMMES AND BODIES

PROGRAMMES AND BODIES OF WMO AND UNESCO/IOC

BACKGROUND MATERIAL

SUMMARY

Reference: **JCOMM-III/Doc. 13.1**

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Appendix:

- Background Material

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].

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