

EXECUTIVE COUNCIL WORKING GROUP ON CLIMATE
AND RELATED WEATHER, WATER AND
ENVIRONMENTAL MATTERS
Third Session

Item 4

Original: ENGLISH

GENEVA, 27 March 2010

IMPLEMENTATION OF THE GFCS

REFERENCES:

Res. 22 (EC-LIX)
Res. 29 (Cg-VIII), Res. 12 (Cg-XI), Res. 7 (Cg-XII), Res. 8 (Cg-XV)
Reports of EC-AGCE, V, 2004, VII, 2006 and VIII, 2007
EC-WG-CWE-2, Doc. 5

ACTION PROPOSED:

It is recommended that the EC Working Group consider future structure and function of WCP as proposed in this document and make suggestion to EC-LXII.

CONTENT OF THE DOCUMENT:

APPENDICES:

- Appendix 1: Draft text for inclusion in the general summary of the report of the EC-WG on Climate and Related Weather, Water and Environmental Matters
- Appendix 2: Discussion Paper on Reorganization of World Climate Programme
- Appendix 3: Review of World Climate Programme and the Climate Agenda

IMPLEMENTATION OF THE GFCS

4.1 World Climate Program and Climate Agenda

The World Climate Program (WCP) was established in 1979 (*Res. 29, Cg-8*) which evolved into an interagency collaborative program encompassing the UN System as well as other interested international bodies. Resolution 12 (*Cg-XI*) in 1991 decided that the World Climate Programme should be reconstituted to provide an inter-agency interdisciplinary framework to address the full range of climate and climate change issues. The Climate Agenda emerged as an integrating framework from the operation of climate coordinating mechanism established in the form of a Coordinating Committee for the WCP established by *Cg-XI* in 1991 and an Inter-governmental meeting on the WCP convened in 1993. The Climate Agenda was endorsed by *Cg-XII*.

4.2 Need for a review

Concerned with the effectiveness of the integrating framework established by it for climate activities, *Cg-XV* desired that steps should be taken to review and coordinate activities within *The Climate Agenda* and to monitor its implementation, identification of priorities and coordinating mechanism (Resolution 8, *Cg-XV*). The EC LX had concluded that WMO should retain WCP as the overarching framework for all its climate activities. The Council had also desired that there was need for major refocusing of its activities under WCP. Subsequently, the EC WG-CWE after its meeting in February 2009, in its report to the EC-LXI recommended that the Climate Agenda would finally be retired and replaced by the (then proposed) Global Framework for Climate Services. However, it suggested deferring final decision on the future of the WCP and the Climate Agenda until after the WCC3. It had suggested that after the outcomes of WCC-3 had become known, the Executive Council (EC-LXII in 2010) could then take a final view and forward the proposal to *Cg-XVI* for its consideration and approval in 2011.

4.3 The Proposal

EC WG-CWE in its last meeting in February 2009 had considered 'Review of WCP and Climate Agenda' prepared by the Secretariat. The Group noted that the WCP was enormously successful, since its operation triggered global attention on climate issues. The Group further noted that the Global Framework for Climate Services would particularly require a refocusing of the WCP components of WCDMP and WCASP.

Considering the above, a discussion paper on "Reorganization of World Climate Programme" has been prepared (see Appendix 2), proposing the new structure of World Climate Programme and is now open for e-discussions.

WORLD METEOROLOGICAL ORGANIZATION

CLIMATE AND WATER DEPARTMENT

Discussion Paper on Reorganization of World Climate Programme

(Version 1 Dated 1.03.2010)

1. Introduction

1.1 World Climate Program

1. The World Climate Program (WCP) was established in 1979 (*Res. 29, Cg-8*) which evolved into an interagency collaborative program encompassing the UN System as well as other interested international bodies. Resolution 12 (*Cg-XI*) in 1991 decided that the World Climate Programme should be reconstituted to provide an inter-agency interdisciplinary framework to address the full range of climate and climate change issues. WCP plays a fundamental role in the provision of authoritative assessments of climate science and climate impacts, in the further development of climate applications and services, in improving systematic observations of climate and climate monitoring, and in climate system research.

1.2 The Climate Agenda

2. The Climate Agenda emerged as an integrating framework from the operation of climate coordinating mechanism established in the form of a Coordinating Committee for the WCP established by *Cg-XI* in 1991 and an Inter-governmental meeting on the WCP convened in 1993. The Climate Agenda was endorsed by *Cg-XII*.

1.3 Need for a review

3. Concerned with the effectiveness of the integrating framework established by it for climate activities, *Cg-XV* desired that steps should be taken to review and coordinate activities within *The Climate Agenda* and to monitor its implementation, identification of priorities and coordinating mechanism (*Resolution 8, Cg-XV*).

4. The EC LX had concluded that WMO should retain WCP as the overarching framework for all its climate activities. The Council had also desired that there was need for major refocusing of its activities under WCP. Subsequently, the EC WG-CWE after its meeting in February 2009, in its report to the ECLXI recommended that the Climate Agenda would finally be retired and replaced by the (then proposed) Global Framework for Climate Services. However, it suggested deferring final decision on the future of the WCP and the Climate Agenda until after the WCC3. It suggested that after the outcomes of WCC-3 had become known, the Executive Council (EC-LXII in 2010) could then take a final view and forward the proposal to *Cg-XVI* for its consideration and approval in 2011.

2. Background Information

5. A comprehensive background on the subject was provided in the note "Review of World Climate Programme and Climate Agenda" submitted to EC-WG-CWE in February 2009 which is placed as Appendix 3 for ready reference. The following paragraphs provide the additional considerations for taking a decision.

2.1 The new paradigm presented by GFCS

6. The World Climate Conference-3 (WCC-3), decided to establish a Global Framework for Climate Services to strengthen the production, availability, delivery and application of science based climate prediction and services. The Framework is conceived as an integrating set of international arrangements which will be built upon the established global climate observation and research programmes as well as operational structures and proposed to have five major components: (i) Observations; (ii) Climate research, modelling and prediction; (iii) a Climate Services Information System; (iv) a Climate User Interface Programme; and (v) Capacity Building. Many of these elements (systems, programmes, projects, institutions etc.) are either in place or are in the process of being established.

2.2 Decisions of Congress on various programmes during last six years

7. While reviewing the WCP, it is important that the decisions of Congress, establishing various Programmes within WMO, after the endorsement of the Climate Agenda are kept in view. The two new major programmes/initiatives approved by Congress that have direct relevance to WCP are the Disaster Risk Reduction (DRR) Programme and the WMO Integrated Global Observing System (WIGOS).

8. Cg-XIV established the DRR Programme in 2003 to strengthen and integrate disaster risk reduction processes related to meteorological, hydrological and climate services through this crosscutting Programme, WMO is developing an organization-wide coordinating framework to achieve these objectives at the international, regional and national levels.

9. Cg-XV approved the WMO Integrated Global Observing System (WIGOS) as a concept for a comprehensive, coordinated and sustainable system of observing systems. WIGOS is based on all WMO Programmes' observational requirements, including climate. It provides a single focus for the operational and management functions of all WMO observing systems as well as a framework and mechanism for interactions with WMO co-sponsored observing systems enabling integration, cooperation and coordination taking into account the multiplicity of perspectives and observing domains covered by WIGOS. Through the WMO Information System (WIS), it will ensure availability of required data, metadata and products according to identified requirements.

2.3 Review of WCRP by its sponsors

10. A review of the World Climate Research Programme (WCRP) was carried out by a Review Panel appointed by its co-sponsors - the International Council for Science (ICSU), World Meteorological Organization (WMO), and the Intergovernmental Oceanographic Commission (IOC) of UNESCO—and the International Group of Funding Agencies for Global Change Research (IGFA) in 2008. The report of the WCRP Review Panel recognizes the many important achievements of this international scientific research programme, and concluded that WCRP can play a significant role in helping society meet the challenges of global climate change. It recommended that to meet these challenges WCRP must focus its Projects and connect with partners and users in strategic ways, and that it would need new resources to do so.

2.4 Climate Knowledge base: the UN System delivering as one on Climate

11. WMO and UNESCO jointly are the coordinators of the Climate Knowledge base under UN System 'Delivering as One'. This new UN system wide coherent approach on climate change activities, which has brought new level of coordination among UN agencies with WCC3 as one of the outcomes of this approach, provides the opportunity to WMO and the NMSs to show that WMO is naturally structured to support climate knowledge with other agencies and sectoral organizations to work with them on the application of climate information and services in the various impact and adaptation sectors.

2.5 Earlier decisions of EC-WG-CWE on review and aligning WCP

12. EC WG-CWE in its last meeting in February 2009 had considered 'Review of WCP and Climate Agenda' prepared by the Secretariat (Appendix). The Group had recalled the historical significance of the WCP as well as the Climate Agenda and noted that WMO was the only leading Organization which implemented them at a time when no other major Organization had developed a strong interest in climate related issues. It noted that the WCP was enormously successful, since its operation triggered global attention on climate issues.

13. The Group noted that WCP fostered the effective application of climate knowledge and information for the benefit of society and the provision of climate services and as such the Group further noted that expected the Global Framework for Climate Services would particularly require a refocusing of the WCP components of WCDMP and WCASP. The Group had left open the way for UNEP to reconstitute the WCIRP as part of the new WCP, if so desired.

3. Present Components

14. World Climate Programme has four main objectives as articulated in the 6th Long Term Plan:

- (a) To improve the understanding of climate processes for determining the predictability of climate, including its variability and change, identifying the extent of human influence on climate and developing the capability for climate prediction;
- (b) To facilitate the effective collection and management of climate data and the monitoring of the global climate system, including the detection and assessment of climate variability and changes;
- (c) To foster the effective application of climate knowledge and information for the benefit of society and the provision of climate services, including the prediction of significant climate variations, both natural variations and those resulting from human activity; and
- (d) To assess the impacts of climate variability and changes that could markedly affect ecosystems, economic or social activities and advise governments thereon, and contribute to the development of a range of social and economic response strategies that could be used by governments and the community.

15. The present (2010) World Climate Programme has following four components:

- i) World Climate Research Programme (WCRP);
- ii) World Climate Data and Monitoring Programme (WCDMP);
- iii) World Climate Applications and Services Programme (WCASP); and
- iv) World Climate Impact assessment and Response Strategies Programme (WCIRP)

16. These, along with their SWOT analysis as briefly outlined in Annexes to the Appendix 3 "Review of WCP and Climate Agenda" (Reproduced from EC-WG-CWE-2 Doc. 5).

4. The Proposed Components of refocused World Climate Programme

4.1 The Climate Agenda and the GFCS

17. The GFCS will essentially include all the elements of the Climate Agenda, but provide a new mechanism for bringing together not only the contributions from various relevant WMO programmes but also enhancing interaction with traditional as well as new climate partners, within and outside the UN System.

18. Further, the GFCS coordination mechanism is expected to actively involve various UN Agencies. The High Level Taskforce setup to develop a work plan for the implementation of the

GFCS, is actively considering the possibility of an inter-agency/ inter-governmental mechanism for the coordination among various UN and other partners, which are expected to be much broader than those that participated in the WCP.

4.2 The Proposed Components of refocused World Climate Programme

19. In the past WCIRP has been lead by UNEP and it has been difficult to keep track of the progress under the programme. Efforts in rejuvenating this programme have not been very successful, and WMO constituent bodies had little say in its functioning. The proposed restructuring of WCP provides an opportunity to address such gaps and refocus WCP largely as a WMO “driven” Programme but continuing to pursue the participation of other agencies. As such, it is proposed to drop WCIRP as a component of WCP.

20. Most of the WMO Programmes are having considerable inputs to GFCS, therefore while defining the WCP components for the future, it is important to distinguish between WCP and GFCS. WCP should be seen as only one of the WMO Programs (unarguably the most important) among many others contributing to the GFCS. The Table 1 provides a mapping of these proposed elements of the new WCP with the components of GFCS. In order to provide clarity, the Table also shows the main WMO Programmes that would be supporting various GFCS Components. Incidentally, the implementation of GFCS will not only achieve Expected Result¹ 3 and will also support achievement of ER 1 and ER 2 while it will use the outcomes of ER 5 and ER 6 for its success through partnerships created under ER 7.

21. In view of the above the new refocused World Climate Programme is proposed to consist of:

- (i) World Climate Research Programme (WCRP)
- (ii) Climate Data and Analysis Programme (CDAP)
- (iii) Climate Monitoring and Prediction Programme (CMPP)
- (iv) Climate System Operation and Infrastructure Programme (CSOP)
- (v) Climate Adaptation and Risk Management Programme (CARP)
- (vi) Climate Knowledge and Partnership Programme (CKPP)

22. Complete list of WMO Programmes whose contribution will be equally crucial in various components of GFCS are listed in Table 3. Brief description of each of the components, which will be working in close coordination, is described in the following paragraphs. It may be mentioned that all of them will have to work under a well established quality management framework and support capacity building in their respective area of activities.

- i) World Climate Research Programme (WCRP)*

23. WCRP, a co-sponsored Programme is and would continue to be an essential component of WCP. Through its research, it would continue to provide the underpinning to the operational services developed under the other components of WCP.

- ii) Climate Data and Analysis Programme (CDAP)*

24. WMO Congress has made decisions in the recent past (CG-XV) to establish a WMO Integrated Global Observation System (WIGOS) that serves across various programmes, including the co-sponsored GCOS. While observations are an essential element of GFCS, due to the above stated reasons the reorganized WCP does not include the Observations as part of WCP.

¹ Please see Table 2 for list of Expected Results

Table 1. Mapping of GFCS Components, various WMO programmes contributing to these components and the proposed components of WCP

WMO Programmes	GFCS Components	Proposed WCP components
WIGOS	Observations	Climate Data and Analysis (CDAP)
GCOS		
WMO Space Programme		
World Weather Research Programme/ Thorpex	Climate research, modeling and prediction	World Climate Research Programme (WCRP)
GDPFS	Climate Services Information System	Climate Monitoring and Prediction (CMPP)
		Climate System Operations and Infrastructure (CSOP)
HWRP	Climate Users Interface Programme	Climate Adaptations and Risk Management (CARP)
AgMP		
DRRP		
PWSP		
ETR	Capacity Building	Climate Knowledge and Partnership (CKPP)
VCP, Regional Program		CDAP, WCRP, CMPP, CSOP, CARP

25. Climate Data and Analysis Programme (CDAP) will serve to coordinate global efforts related to management of climate data including their quality control and analysis. The programme will include the development and the use of high quality and robust climate data sets for climate research, monitoring and prediction of the climate system; setting up appropriate internationally agreed mechanisms to ensure high quality globally compatible climate data management systems; fostering data rescue and developing data base systems based on best practices and international standards; development of metadata; promote the use of inter-operable climate data management systems; development of climate data oriented services; facilitation and development of integrated data sets based on data collected from various observing networks/platforms, including in-situ, spaced base, remote sensing and marine data, as well as model-based and girded data.

26. CDAP will also facilitate developing sound and robust methodologies and tools for assessing climate variability and climate change; promote the use of international commonly agreed definitions and standards for climate extremes and indices and fostering the development of national, regional and global databases, including for extreme climate events. Implementation of the above will also require contribution to development and review of capacity building strategy for developing and least developed countries in all aspects of climate data, in particular on data rescue, and Climate Analysis including climate indices.

iii) Climate Monitoring and Prediction Programme (CMPP)

27. The Climate Monitoring and Prediction Programme (CMPP) will include facilitation of operational global and regional climate monitoring and prediction services including climate assessments (WMO Statement on the Status of the Global Climate) and updates (El Niño Update, Global Seasonal Climate Updates); definition and further development of standardized global and regional monitoring and prediction products; facilitation of the development of tools for climate monitoring and prediction; transformation of integrated climate monitoring and prediction products into societal services (e.g. Climate Watch systems); introduction of stringent Quality Management principles into the production of the above core product sets; development of guidance material on climate monitoring and prediction methodologies; initiation of relevant projects and demo cases including scaling up options.

28. Research-operations linkages need to be sustained to expedite the implementation of research advances in operational climate services and to ensure ongoing improvement to the operational practices and outcomes. The programme will work to facilitate the transition of WCRP research outcomes into operational products.

29. The programme will also facilitate maintaining linkages and collaboration with user communities and assist in Capacity Building, focusing primarily on the uptake and use of the above core set of products and guidance on communicating monitoring and prediction products and services including aspects of uncertainties and probabilities.

iv) Climate System Operations and Infrastructure Programme (CSOP)

30. For an effective delivery of climate information, it is essential to put in place appropriate institutional mechanisms to generate, exchange and disseminate quality information at global, regional and national levels on an operational basis. In order to set up and operationally provide climate information, products and services, and to ensure their quality, countries will require guidance on the requirements and best practices for generating climate information and products.

31. The Climate System Operations and infrastructure Programme (CSOP) would support development and coordination with the network of global, regional and national institutions that develop and provide the climate information. Accordingly, networks of global, regional and national entities, including Global Producing Centres of Long Range Forecasts (GPCs), Global Data Centres (GDCs), Regional Climate Centres (RCCs) and NCCs, would serve as key CSOP elements. CSOP would also foster regional and global networking of climate service providers as well as users, through sustainable mechanisms such as Regional Climate Outlook Forums (RCOFs).

32. The programme will support the development and implementation, globally, of National Climate Services (NCSs), as an effective mechanism to undertake and/or coordinate climate information and prediction services at the national level; help develop National Climate Services framework; support identification of core products for climate services at the national level taking into account the user needs and National Climate Outlook Forums.

v) Climate Adaptation and Risk Management Programme (CARP)

33. Decisions in different economic sectors for planning, operations, risk management and adaptation to cope with both climate change and variability (on a range of relevant time and space scales) would be improved by a higher level of climate knowledge, and by access to and use of actionable information and products, tailored to meet user needs.

34. The main thrusts of the Climate Adaptation and Risk Management Programme will be interaction with users in various sectors for: collection and analysis of information on user requirements for climate and applied climate information; development and provision of climate information and user-targeted products in a manner that facilitates their effective use in the longer-term climate adaptation strategies and Climate Risk Management in key socio-economic sectors; quantification of the social and economic benefits of climate information and products in various sectors, in collaboration with the concerned sectoral agencies; provide technical inputs for developing communication strategies and tools for various sectors and develop methods for sector specific climate indices and inputs for climate risk assessment.

35. The Programme will support in enhancing capacity at the regional and national levels to produce and disseminate information and products targeted to user needs in support of climate adaptation and risk management. The Programme will support development of sectoral outlooks (e.g., hydrological outlooks, malaria outlooks) based on Regional Climate Outlook Forums.

36. The Programme, will focus on development of climate applications for Health, Energy, Tourism, Building Industry etc through strategic partnerships on technical matters with other UN organizations. It will coordinate with DRRP, HWRP and AgMP for adaptations in Disaster, Water and Agriculture sectors respectively.

vi) *Climate Knowledge and Partnership Programme (CKPP)*

37. Delivery of climate knowledge to decision and policy making processes requires coordination and partnership. Presently, maintaining links with climate partners along with coordination of activities with the UNFCCC and contribution to articles 4 and 9 of the convention are being undertaken within a division called "Climate Coordination Activities", outside the WCP. Further, WMO and UNESCO jointly take the lead on United Nations system coordination in the area of "Science, assessment, monitoring and early warning (knowledge base)" as a key cross-cutting area within the United Nations system.

38. The Programme will liaise with UNFCCC and will help development of 'UN Climate Knowledge Portal' including a WMO-UNESCO portal for 'Climate Knowledge' incorporating knowledge from interdisciplinary areas, particularly in adaptation in all relevant sectors for adaptation in close coordination with all UN partner agencies. The Programme will help capture and disseminate knowledge in diverse socio-economic settings. Although partnerships will be developed under all the above components, the CKPP will provide coordination within the UN System and other relevant agencies, particularly on institutional arrangements and identification of roles and responsibilities and provide support to develop the required partnerships. The Programme through enabling participation of NMSs in Climate Policy deliberations and will coordinate the capacity building activities, with support from all the other programmes.

5. Coordination Mechanism

39. A two-tiered mechanism for the coordination of cross-cutting technical activities among various WMO Programmes and Technical Commissions supporting WCP is proposed. The first tier is a set of inter-commission technical groups addressing specific issues, and set up by the Commission of Climatology or any other Technical Commission as and when required. The second tier mechanism is proposed as a more senior group to oversee and coordinate these activities. This issue was recently discussed during the PTC 2010 The PTC suggested that this oversight and coordination function could be more effectively and efficiently achieved by setting up an Inter-commission Group on GFCS (ICG-GFCS). This Group, in addition to the Presidents of the Technical Commissions would also include Chairs of the JSC of WCRP and GCOS.

6. Way Forward

40. Before a final decision is taken, the new structure will be discussed with all the current partners in WCP.

41. Various WMO Programmes, as indicated in the Table above will have to be appropriately re-visited to include the special activities related to climate services, if not already included.

Table 2. Expected Results as per the Draft WMO Strategic Plan 2011-2015

		5 Strategic Thrusts	8 Expected Results
WMO Strategic Plan 2012-2015	3 Global Societal Needs	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 callused by weather, climate and water and related environmental elements
	1. Improved protection of life and property (related to the impacts of hazardous weather, climate, water and other environmental events and increased safety of transport on land, at sea, and in the air)	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 interoperable Earth-and space-based systems for weather, climate and hydrological observations, as well as related environmental observations, based on world standards set by WMO
			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
	2. 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)	Strengthening Capacity-building	6. Enhanced capabilities of NMHSs, in particular in developing and least developed countries, to fulfill their mandates
3. Sustainable use of natural resources and improved environmental quality	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 United Nations system, relevant international conventions and national strategies	
	Strengthening Good Governance	8. An effective and efficient Organization	

Table 3 Mapping of WMO Programmes to the GFCS Components

Programme	Observations	Climate research, modeling and prediction	Climate Services Information System	Climate User Interface Programme	Capacity Building
WCP					
WCASP		X	XXXXX	XX	XX
WCDMP	XXXX		XX		XX
WCRP	X	XXXXX	XX		X
GCOS	XXXXX	X			X
WWW Programme					
GOS/ WIGOS	XXXXX				X
GDPFS		X	XX	X	X
WWWDM/GTS/WIS			XX		X
WWWSSA					X
IMOP	X				X
TCP			X	XX	X
ERA			X	X	
AREP					
GAW	XX		X		X
WWRP/Thorpex		XXX	XX		X
Applications of Meteorology Programme:					
PWSP			X	XXXX	X
AgMP			X	XXXX	X
AeMP				X	X
MMOP	XXX		XX	X	X
HWRP	X			XXXX	X
ETR Programme			X	X	XXXX
TCP				X	
VCP					XXXX
P-LDCs					XX
Regional Programme			X	X	X
DRR Programme			X	XXX	X
WMO Space Programme	X		X		X

CLIMATE AND WATER DEPARTMENT

Review of World Climate Programme and the Climate Agenda (As Reproduced from EC-WG-CWE-2/ Doc. 5)

CONTENTS

Preamble

1. **Background**
 - History of development of climate activities
 - Role of WMO, IPCC, UNFCCC and the UN system
 - New challenges and need for a new strategy
2. **Mapping of climate related international programmes**
 - 2.1 World Climate Program
 - 2.2 Climate Agenda
 - 2.3 Other relevant programmes contributing to climate activities
3. **Coordination mechanisms for climate related programmes**
 - 3.1 Coordination committee for WCP
 - 3.2 Climate Agenda and Inter-agency Committee for Climate Agenda
 - 3.3 UN Framework Convention on Climate Change (UNFCCC)
 - 3.4 Current United Nations climate change coordination
 - 3.5 WMO internal coordination of climate related activities
4. **Framework for enhanced national climate products and services**
 - 4.1 Rationale for a demand driven approach
 - 4.2 Requirements of a user-focused approach
5. **Proposed WMO initiatives for provision of climate products and services**
 - 5.1 Initiative to provide climate services
 - 5.2 Integrated climate research
6. **Conclusions and recommendations**
 - 6.1 Conclusions
 - 6.2 Recommendations

Figures

Figure 1: Core areas of WCP and development and delivery mechanism for climate information products and services for various climate sensitive sectors.

Figure 2: Climate information value chain

ANNEXES

- I World Climate Data and Monitoring Program
- II World Climate Applications and Services Programme
- III World Climate Research Program (WCRP)
- IV World Climate Impacts Assessment and Response Strategies Programme (WCIRP)
- V Global Climate Observing System
- VI WMO Programmes contributing to climate activities
- VII Acronyms

Review of World Climate Programme and the Climate Agenda (For consideration of EC WG-CWE)

Preamble

The World Climate Program (WCP) was established in 1979 as an interagency collaborative program encompassing the UN System as well as other interested international bodies (*Res. 29, Cg-VIII*). WCP plays a fundamental role in the provision of authoritative assessments of climate science and climate impacts, in the further development of climate applications and services, in improving systematic observations of climate and climate monitoring, and in climate system research. WCP and its associated activities make an effective contribution to the work of the Intergovernmental Panel on Climate Change (IPCC), the United Nations Framework Convention on Climate Change (UNFCCC), Agenda 21 as well as the United Nations Commission on Sustainable Development. Subsequently, the *Climate Agenda* developed by the international organizations supporting WCP was endorsed by the World Meteorological Congress in 1995 (*Res. 7, Cg-XII*), which was intended to serve as an integrating framework for effective and efficient integration and management of the international climate-related programmes.

Following the implementation of the WCP, the establishment of subsequent climate related activities such as IPCC and the UNFCCC have transitioned “climate” from a topic of scientific interest into the concerns of public policy. With the Fourth Assessment Report of IPCC, (AR4) and the award of 2007 Nobel Peace Prize to the IPCC, there is a distinct surge in the number of Intergovernmental organisations including the UN Agencies that are actively engaged in meeting the challenges of increasing climate variability and climate change. With proactive encouragement from the UN, a new mechanism has emerged to coordinate collaborative efforts among the UN agencies.

Concerned with the effectiveness of the integrating framework established by it for climate activities, Cg-XV desired that steps should be taken to review and coordinate activities within *The Climate Agenda* and to monitor its implementation, identification of priorities and coordinating mechanism (Resolution 8, Cg-XV).

This Note has been prepared to serve as the starting paper for discussion on the subject. It is proposed to be placed before the EC-Working Group on Climate and related Weather, Water and Environment Matters (ECWG-CWE). It is hoped that it will provide inputs for the strategic reorientation of the Climate Agenda and the WCP. Specifically, Section 1 provides some background, in section 2 the existing climate and other related programmes are described and various climate coordination mechanisms are outlined in Section 3. An Analysis of the existing gaps in providing user-driven climate information is provided in Section 4, and Section 5 provides key elements on the new WMO initiative to support adaptation decisions to climate variability and climate change. Finally, a set of recommendations are provided in Section 6.

1. Background

1.1 History of development of climate activities

During the 1960s and 1970s, a series of highly publicised climatic and environmental events with disastrous consequences demonstrated the fragility of world food production and trade systems and their dependence on the earth's climate system. In response, WMO, UNEP, FAO, UNESCO and WHO convened in 1979, The First World Climate Conference (FWCC) to assess the state of knowledge of climate and to consider the effects of climate variability and change on human society. The First World Climate Conference followed a series of UN convened conferences during the 1970s: the United Nations Conference on Environment, Stockholm, 1972 which resulted in the establishment of UNEP, the UN World Food Conference Rome, 1974, which recognized the central role of climate in world food production, UN World Water Conference in Mar Del Plata, Argentina, 1976, UN Conference on Desertification, UN Economic and Social Council (ECOSOC), Resolution endorsing the WMO initiation of a World Climate Programme, that drew attention to the global condition, each identifying climate impacts as a central concern (*ref. Proceedings of the First World Climate Conference (FWCC), 1979*). The First World Climate Conference led to the establishment of the World Climate Programme and its research component, the WMO/ICSU/IOC-UNESCO sponsored World Climate Research Programme.

The Second World Climate Conference (SWCC) cosponsored by the WMO, UNEP, UNESCO and its IOC, FAO and ICSU was convened in Geneva in 1990 with the objectives to review the work of the first decade of the WCP, the First Assessment Report of the IPCC, and the development of an International Geosphere-Biosphere Programme (IGBP). The Conference Statement of SWCC noted that additional international observational and research efforts would be necessary to strengthen the knowledge-base of climate processes and human interactions (*P. 497, Proceedings of the Second World Climate Conference (SWCC), 1990*). It endorsed four streams of international activities:

- The Future Structure of the WCP,
- Special Needs of the Developing Countries to build up their capabilities,
- Cooperation in International Research through the WCRP, IGBP and other related international programmes
- Coordinated International Activities and Policy Development through global measurement and research efforts, assessment functions of IPCC and development of a Convention on Climate Change

1.2 Role of WMO, IPCC, UNFCCC and the UN system

In 1988, WMO and UNEP established the Intergovernmental Panel on Climate Change (IPCC) with the goals to (i) assess available scientific information on climate change; (ii) assess the environmental and socio-economic impacts of climate change; and (iii) formulate response strategies. United Nations General Assembly through a resolution in 1988 entitled "Protection of global climate for present and future generations of mankind" endorsed this action (*Res. 43/53 UNGA, 1988*).

IPCC has been successful in reaching its main goals as awareness building and providing the objective scientific and technical information as sound scientific basis for the climate negotiations. The IPCC produces key scientific material that is of the highest relevance to policymaking and is very important for the international climate agenda in the coming years. One of the most important principles of the IPCC, perhaps the reason for its success, is to be policy relevant but not policy prescriptive. Other important factors are scientific integrity, objectivity, openness and transparency, achieved through a rigorous review process for all IPCC reports and an adoption and approval process that is open to all member governments.

Following the First Assessment Report of IPCC and the Ministerial declaration of the SWCC, UN General Assembly formed an Intergovernmental Negotiating Committee (INC) which later established INC/FCCC (*ref. History of Global Climate Change Regime, chapter 2*). The Fourth Assessment Report of the IPCC and the subsequent award **the Nobel Peace Prize** "for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change", has had a major impact in creating public awareness on various aspects of climate change. The Bali Action Plan (*ref. Decision 1/CP.13*) in 2007 has identified the need for enhanced action on adaptation by Parties to the Convention.

1.3 New challenges and the need for a new strategy

The four assessment reports prepared by IPCC have concluded that climate issues reach far beyond atmospheric and oceanic sciences, affecting every aspect of life on the planet, which are pivotal in determining the future environmental and economic well-being of the human race. There is a clear scientific consensus that, if the increase in atmospheric greenhouse gas concentrations was not limited, the predicted climate change would place stresses on natural and social systems unprecedented in the past 10,000 years.

The awarding of Nobel Peace Prize to IPCC is an acknowledgement of the threats to stability and human security inherent in the impacts of increasing climate variability and changing climate and, therefore, the need for developing an effective rationale for timely and adequate action to avoid such threats in the future. The Fourth Assessment Report (AR-4) of IPCC has put the issue beyond doubt and has laid emphasis on the important role the scientific knowledge plays in shaping public policy and guiding global affairs for the sustainable development of human society.

2. Mapping of Current Climate related International Programmes

2.1 World Climate Programme

FWCC (1979) declaration called for the urgent development of a common strategy for a greater understanding of the climate system and a rational use of climate information. It urged that governments to give their strongest support to a proposed World Climate Programme. Consequently, the Eighth Congress of the World Meteorological Organization (WMO), in 1979, established the World Climate Programme (WCP) as an authoritative international scientific programme with goals to improve understanding of the climate system and to apply that understanding for the benefit of societies coping with climate variability and change (*Res. 29, Cg-VIII*).

The four main objectives adopted for the WCP were to:

- Determine the physical basis of the climate system that would allow increasingly skilful climate forecasts;
- Develop evermore useful applications of climate information benefiting economic efficiency, the human health of communities, food production and the prudent use of water resources;
- Determine socio-economic impacts and national vulnerabilities to climate variations and change; and
- Develop and maintain an essential global observing system fully capable of supporting the other three objectives.

WCP was established as an interagency, interdisciplinary effort, with WMO, ICSU and United Nations Environment Programme (UNEP) initially as the co-sponsors. It comprised of four components:

- 1) The World Climate Data Programme (WCDP)
- 2) The World Climate Applications Programme (WCAP)

3) The World Climate Impacts Programme (WCIP)

4) The World Climate Research programme (WCRP)

Leadership of the individual components was assigned to agencies according to their primary mandates. WMO took lead responsibility for WCDP and WCAP and UNEP for WCIP. WCRP was co-sponsored by the WMO and ICSU until 1993, when Intergovernmental Oceanographic Commission (IOC) of UNESCO also joined the sponsorship. After the SWCC in 1991, WMO Congress reoriented the four components and renamed the components, specifically, World Climate Data and Monitoring Programme (WCDMP), World Climate Applications and Services Programme (WCASP), World Climate Impact Assessment and Response Strategies Program (WCIRP) and the World Climate Research Programme (WCRP). A Coordination Committee for WCP (CCWCP) was also established (*Res. 12, Cg-XI*).

The contributions of the WCP through these four components can be primarily framed under following core areas,

1) Climate observations, monitoring and data management

2) Operational climate information, prediction and analysis systems including user liaison, and

3) Impact assessment and response systems

4) Climate research, modelling and tools

Specific objectives, activities and coordination mechanisms under each of the components are briefly described in Annex I to V. WCP, along with WMO's co-sponsored programmes; the Intergovernmental Panel on Climate Change (IPCC) and the Global Climate Observing System (GCOS), constitute the framework for WMO's climate activities.

2.2 Climate Agenda

A Coordinating Committee for the WCP (CCWCP) was established by Cg XI (*Res. 12, Cg-XI*) (1991) with the objective to provide overall coordination between the four components of the programme and maintain an effective communication with other related international climate activities.

WMO, on behalf of the seven sponsoring organizations, convened an Inter-Governmental Meeting on the World Climate Programme (IGM-WCP) in April 1993. The Meeting recognized the importance of the WCP for the socio-economic development of nations, and its contribution to the work of the IPCC and the development of the UNFCCC. The IGM-WCP proposed new thrusts to the WCP and its associated activities and called upon the Executive Boards/Councils of the international organisations concerned to prepare an integrated proposal for their climate-related activities.

The operation of climate coordinating bodies resulted in the preparation of the inter-agency document '*The Climate Agenda - International Climate Related programmes, A Proposal for an Integrating Framework*'. The agenda consisted of four thrust areas, which closely reflected the four components of the WCP. They included:

1) New frontiers in climate science and prediction and human influence on climate whose focused programmes included: WCRP, IGBP, IHDP;

2) Climate services for sustainable development whose focused programmes included: WCASP;

3) Studies of climate impact assessments and response strategies to reduce vulnerability whose focused programmes included: WCIRP, IHDP

4) Dedicated observations of the climate system: whose dedicated programmes included GCOS

The Climate Agenda was formally endorsed by WMO through Resolution 7 of the Twelfth World Meteorological Congress (*Res. 7, Cg-XII*). This resolution also extended an invitation to WHO to join as a sponsor of the Climate Agenda, which was accepted in 1997.

2.3 Relevant WMO Programmes contributing to climate activities

A number of WMO programmes (See Annex VI) contribute in the following areas that are closely related to climate activities:

Observations, Monitoring, and Data Management

Research, Modelling and Tools

Operational Forecasting and Analysis Systems

Data exchange and recovery and Data Rescue

Assessment

Beyond the Climate Agenda, WMO has continued its applications programmes, capacity building and educational activities to enhance utilisation of climate information for sector-specific decisions. These are *Agriculture, Water Resource Management and Disaster Risk Reduction (DRR)*. Effective utilisation of climate information in sector-specific climate risk management on both policy and business decision-making fronts remain underdeveloped. As such, the effectiveness of these initiatives may have been limited by lack of clear priorities and inconsistency in the sector-specific activities.

3. Coordination mechanisms for climate related programmes

3.1 Coordination Committee for WCP

A Coordinating Committee for the WCP (CCWCP) was established by Cg XI (*Res. 12, Cg-XI*) (1991) with the objective to provide overall coordination between the four components of the program and maintain an effective communication with other related international climate activities. The membership and Terms of Reference of the CCWCP was drafted and approved by EC-XLIII in the same year. The WMO Secretary-General, in consultation with the Executive Heads of UNEP, UNESCO and its IOC, FAO and ICSU finalised the establishment of the committee. The first session of the CCWCP, held in May 1992 provided the initial mechanism that began inter agency climate coordination activities.

Since the Intergovernmental Meeting in 1993, only the WCRP has undergone a formal 'review' process. The first review was undertaken in August 1997, and more recently, by ICSU, the International Group of Funding Agencies for Global Change Research (IGFA), and – in the case of WCRP – the World Meteorological Organisation (WMO) and the Intergovernmental Oceanographic Commission (IOC) in 2007–09. The goal of the reviews was to evaluate the extent to which the international programmes add value to their respective areas of research and to the national programmes that contribute to them.

The IGM-WCP proposed new thrusts to the WCP and its associated activities and called upon the Executive Boards/Councils of the international organisations concerned to prepare an integrated proposal for their climate-related activities. The CCWCP served this role until 1997 when the Inter Agency Committee for the Climate Agenda (IACCA) was formed as the official interagency coordinating body for the Climate Agenda.

In order to capitalize upon past and ongoing successes, IGM-WCP recommended that a reformulated CCWCP, thereafter referred to as the Interagency Climate Coordination Agenda (IACCA), take overall responsibility for monitoring implementation of the Climate Agenda. Following this, Resolution of 7 (Cg-XII) endorsed 'The *Climate Agenda - International Climate Related programmes, A Proposal for an Integrating Framework*' and establishment of Interagency Climate Coordination Agenda (IACCA).

3.2 Climate Agenda and Inter-Agency Committee for the Climate Agenda (IACCA)

The Executive Heads of the sponsoring organisations at the IGM-WCP meeting gave their approval for the establishment of an Inter-Agency Committee on the Climate Agenda (IACCA) to oversee the development of the Climate Agenda and agreed on its terms of reference and membership as proposed by the CCWCP. The responsibilities of IACCA included, in particular:

Review

- introducing output-oriented evaluation methodologies;
- coordinating the review of projects on the basis of these methodologies;
- highlighting areas of synergy between programmes and outlining mechanisms by which these could be exploited.

Resources

- identifying priority areas, and their resource requirements, within the Agenda;
- pursuing the development and implementation of a methodology for assessing the resources required to implement international climate-related programmes;
- seeking commitments of resources from both national and international organisations and governments in order to implement the Climate Agenda.

Reporting

- reporting to the governing bodies of the organisations involved in the Climate Agenda, as required;
- providing information to other organisations, as appropriate.

WMO provided interim secretarial support to the functions for IACCA through WCP staff and budget. The Secretary General of WMO convened three meetings of IACCA, the first was held in April 1997, the second in April 1998 and the third in March 1999. (*Ref. Final Reports of the 1st, 2nd and 3rd meetings of IACCA*). Notwithstanding the true endorsement of the sponsoring agencies, IACCA has not met since 1999. All three IACCA meetings were chaired by the representative from Canada, Dr McBean who was personally a motivating character in the Committee. After the third meeting he stepped down as Chairman. The Committee observed that a future Chair should have been selected from the user community and possess both a sound understanding of the UN system and international climate activities. There was never a decision on the next Chair for IACCA.

3.2.1 Views of Congress

While the Cg-XIII commended the work of IACCA (*Para. 3.2.1, Final Abridged Report of Cg-XIII*) and its successful performance during its three sessions, Cg-XIV (*Para. 3.2.1.6, Final Abridged Report of Cg-XIV*) expressed its concern that Climate Agenda and its coordinating method through IACCA had lost momentum but was not able to reach consensus. It reviewed various mechanisms for inter-agency coordination and agreed that further investigation required to fully understand why IACCA had not functioned as envisaged. (*Para. 3.2.1.9, Final Abridged Report of Cg- XIV*).

3.2.2 Review by Executive Council

In 2001, Executive Council at its fifty-fourth session (*para. 4.1.1.8*) again recalled that the IACCA was meant to be a mechanism that had been set in place to improve coordination between the major stakeholders supporting international climate related programmes. Considering that IACCA had been dormant for several years, the Council agreed that rather than attempting to revive it at that stage, requested the Secretary General to consider new advisory mechanisms as part of evaluation process. EC-LVIII also requested the Secretariat to study, through an independent consultant, the role, mandate and international climate governance process in climate coordination activities.

3.2.3 Views of the EC Advisory Group on Climate and Environment (EC-AGCE)

ECAGCE-III (2002) contended that although IACCA has not fulfilled its original purpose the original role intended for the IACCA remained valid and recommended that, it may be appropriate to reconstitute IACCA with a more focused mandate, revised terms of reference and a new title. ECAGCE-IV (2003) also considered that the Climate Agenda, which was formulated as a framework, has not completely met the expectations of the scientific community or those of the agencies. It also opined that it is still necessary to formalise the methods of interagency coordination but at the same time it was important to understand why IACCA did not function as envisioned before beginning a new process. It also opined that partnerships are necessary and can prove beneficial, however WMO needs to ensure that when a partnership or new relationship with another agency is being formed that the implications of this are clearly understood, both financially and scientifically, and most importantly that there is a clear benefit to WMO and its Members. (*ref. Final Reports of EC-AGCE, III, 2002 and IV, 2003*).

ECAGCE-V (2004) recognized that there is need for collaboration with other key international agencies, but that prioritization should occur based on proactive evaluation of other agencies climate related activities, identification of joint objectives, identification of potential partners, mechanisms for on-going formal collaborations. The group recognized that this could occur on a bilateral or a multilateral basis depending on the interest and situation. The group stated that WMO needs to clearly articulate its capabilities and potential contributions to the objectives of their partners. Similar views were expressed during the ECAGCE-VII (2006) which had also set up an ad-hoc group to review the climate activities and suggest a strategic vision. ECAGCE-VIII (2007) recommended to Cg-XV that the development of climate agenda be reviewed (*ref. Final Reports of EC-AGCE, V, 2004, VII, 2006 and VIII, 2007*).

3.3 The UN Framework Convention on Climate Change (UNFCCC)

The IPCC First Assessment Report was accepted at the Second World Climate Conference. In December 1990, the UN General Assembly assumed responsibility for treaty negotiations and established an intergovernmental negotiating committee. The objective of the Convention is stabilization of greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous interference with the climate system. The Convention came into force on 21 March 1994. It is the highest-level political and diplomatic response by the international community to the scientific evidence of increasing concentrations of greenhouse gases in the atmosphere. The Conference of the Parties (COP) is the supreme body of the UNFCCC and is assisted by two subsidiary bodies, one for Scientific and Technological Advice (SBSTA) and the other for implementation (SBI).

3.4 Current United Nations Climate Change Coordination

The United Nations conducts programmatic work at the headquarters level through the Secretariat of the Chief Executive Board's (CEB) High-level Committee on Programmes (HLCP). The HLCP is connected to UN system activities at the country level through the UN Development Group, now also a pillar of the CEB, and the individual UN Country Teams. In addition to the indicative examples of UN system activities provided under each earlier, a system-wide inventory of UN activities on climate change is being developed on-line both as an information resource and a planning tool (accessible through www.un.org/climatechange).

In the past, UN agencies have suffered from a lack of cooperation between organizations due to competition for funding, mission creep and outdated business practices. System wide reform efforts known as ONE UN are currently underway. It is within these reform efforts that the HLCP has proposed a new mechanism for climate coordination efforts. With this in mind the HLCP after some deliberation created a coordination framework which has identified five focus areas of climate change coordination. These include:

- 1) Adaptation: HLCP collectively
- 2) Reducing Emissions from Deforestation (REDD): FAO, UNDP, UNEP;
- 3) Technology Transfer: UNIDO, UNDESA;
- 4) Finance for Mitigation and Adaptation: World Bank, UNDP;
- 5) Capacity Building: UNDP, UNEP;

These five focus areas are supported by a number of cross cutting issues, including:

- 1) Climate knowledge: science, assessment monitoring and early warning,, WMO and UNESCO are the conveners,
- 2) Support of global, regional, and national action implemented by UNDP, UNDESA, and UN regional commissions;
- 3) Public awareness implemented by UNEP, and the UN communication group 10;
- 4) Climate Neutral UN implemented by UNEP.

In addition, the UN wide coordination framework has identified twelve relevant sectors, including Energy (UN Energy), Agriculture (FAO), Fresh water (UN-Water), Oceans (UN-Oceans), Health (WHO), Forestry (FAO), Transport (IMO, ICAO, UPU), Disaster Risk Reduction (ISDR, WMO), Human settlements (UNHABITAT), Education (UNESCO), Industry (WIPO), Green UN (EMG/UNEP) and the agencies that are charged to coordinate the activities of all UN agencies in these areas (given in brackets). (*ref. UNSG letter, 30 May 2008*).

The five focus areas, the four convening programmes, and the eleven sectors combine to form the present climate coordination mechanism to assist Members in developing their capacities and strategies for mitigating and adapting to climate changes.

3.5 WMO Internal coordination of Climate related Programmes

Considering involvement of a number of WMO programmes in the climate activities, two mechanisms have been put in place. First coordination mechanism at the program level in the form of "Coordination Committee for Climate Activities" has been established by the Secretary General. This Committee reports back to the Comité de Direction and the SG periodically. The oversight to WCDMP and WCASP is provided by the Management Group of the Commission for Climatology (CCI) while the Joint Scientific Committee (JSC) with members selected by the co-sponsoring organisations (WMO, ICSU, IOC-UNESCO) oversees the WCRP. The implementation of GCOS is coordinated through advice and guidance from a joint Steering Committee to the GCOS sponsors (WMO, IOC, UNEP and (ICSU) and the various bodies responsible for its component observing systems'.

To oversee this coordination, the Executive Council (*para.s 3.20-3.24 EC-LI*) appointed an EC Advisory Group on Climate and Environment in 1999. Later on the Executive Council (*Res. 22, EC-LIX*) re-established it as a Working Group on Climate and related Weather, Water and Environmental matters where the Chairs of the WCRP/JSC and GCOS Steering Committee plus the Presidents of Commissions of CHy, CAS and CCI, Chairman of IPCC and representative of GEO participate as ex-officio members. The Congress and Executive Council provide the overall direction to these programmes.

4. Framework for Enhanced National Climate Products and Services

4.1 Rationale for a demand-driven approach in the current context

Enhanced action on adaptation through international cooperation, risk management, risk reduction strategies and building resilience has been recognized by The Bali Action Plan adopted at the COP-13 (2007) as essential to meet the growing challenges of climate variability and change. There is evidence that demand for climate information (data, monitoring products, climate watch products, forecasts, analysis, scenarios, etc.) is growing among various decision makers from the

international to local level and involving both the public and private sectors.² Central to the development of sector-specific climate information is the recognition that the needs of the user community are as diverse and complex as the climate system itself.³ Development of effective and relevant climate products and services for decision-making would require a detailed understanding of the needs and requirements of the target users. There is need for integration of relevant scientific and technical climate information in decision-support analysis and tools. This would enable the decision-making process for climate risk management to shift from a “reactive” to a “proactive” approach.

However, managing risks associated with climate variability and change is a very complex process. Decision makers from policy level to individual level need objective, and reliable source of information about the causes variations and changes in the climate system including their causal mechanism, potential environmental and socio-economic consequences and the adaptation and mitigation options to respond to them. It requires adaptation decisions at various levels – from national to local governments, private sector and individual; in every economic sector; and at various temporal and spatial scales. As such, the climate information, one of the basic ingredients required for making decision, needs to be easily accessible, in a user friendly format, made available at various levels – global to local, and at various time scales.

In the past, the climate information has been generated based on the capacity of the scientific expertise and for other climate related studies. As such, the information content, and other product attributes such as formats, delivery mechanisms, among other issues do not necessarily meet the needs and requirements of sectoral users. Climate information is now required by expert from different sectors who may need the climate information with a different perspective and in a more user-friendly format. The information needs to be made readily available to all and in a timely manner and in a form that facilitates correct interpretation including aspects of uncertainty. The climate information providers would need to understand the requirements of different users and provide the information in a format that is easy to incorporate in their decision-making process. This requires closer interaction of climate scientists with experts from other sectors and disciplines, not only to generate tailored information but also to assist in its interpretation.

Efforts have been made in the past to understand the user needs through conferences and other interactions. The conference “Living with Climate Variability and Change: Understanding the uncertainties and managing the risks (LWCVC)” was organised in July 2006, Espoo, Finland, which came out with an ‘Espoo Statement’ highlighting that the process of effective climate-related risk management works better if it is driven by the needs and requirements expressed by relevant decision sectors. Another conference on the similar lines was organised in Madrid in March 2008 and an action plan formulated where implementation is being pursued by different WMO programmes.

4.2 Requirements of a user-focused approach

WMO has provided technical leadership in the area of climate through many initiatives in the past. Historically, the main climate activities of most/many NMSs have been focused on the provision of basic climate records and statistics for planning/design and related purposes to a wide range of

² Climate in different ways impacts most economic sectors, such as energy, agriculture and food, water, human health, tourism, Finance, transportation, and natural resources.

³ The users would require a variety of different types of climate information on a wide range of temporal (weeks to decades) and spatial (local to global) scales, because decision-making occurs on all these scales.

national/local government, business and private sector users The Climate activities of WMO (Secretariat and the NMHS) fall within five specific but interrelated themes:

- (1) Climate observing, monitoring, data management, data rescue and data exchange
- (2) Climate research, modelling and tools
- (3) Operational climate forecasting and analysis systems
- (4) Climate applications and user liaison
- (5) Capacity building, education and training services spanning various aspects of above areas

Figure 2 illustrates a simple schematic of the “Climate Information Value-Chain” from development of basic scientific and technical climate information (data, research and predictions) to development of climate-related products and services to improve climate sensitive decisions (decision outcomes). The y-axis shows the progression from basic information to value-added over the counter to highly customized climate products and services that are utilised in decision-making, and the x-axis indicates the increasing recognition for climate information as it is transformed from basic scientific and technical information to inputs into decision support models.

The schematic indicates three different spaces and their linkages (Space A, B, and C). Space A covers activities related to scientific and technical infrastructure and development of basic climate information in fundamental technical areas of Data, Research and Prediction. Space B involves policy and business decision-makers in climate sensitive sectors, who make decisions in the real-world contexts on international to local levels. Effective utilisation of reliable climate information in decision support tools covered by Space C could lead to the development of more “proactive” strategies for climate risk management, sector planning and adaptation measures.

To ensure improved decision outcomes in Space B, there is a strong need for filling in the gap between the scientific and technical climate information (Space A) and the decision-makers (Space B). As spaces A, B, and C are further developed and expanded and linkages between Spaces A, B and C are strengthened (shown with dotted lines), climate information would be more systematically, and effectively utilized in national development and climate policies and business decision-making in climate sensitive sectors. This would enable the decision-making to shift from a “reactive” to a more “proactive” response resulting in improved outcomes.

WMO (through its programmes and the activities of the NMHS) has built scientific and technical capabilities and infrastructure in areas of Data, Research and Prediction that occupy Space A. WMO has also taken limited initiatives for improved utilisation of climate information by decision-makers (e.g., linking Spaces A and C). Historically, WMO has provided strong scientific and technical leadership in this space. However, over the last two decades, there has been rapid increase in the agencies generating and disseminating various aspects of climate information, both within and outside WMO coordinated activities. While the scientific and technical climate activities of WMO have grown, there is need for improved coordination and management of all such activities and development of strategic partnerships with the new players to strengthen WMO’s technical presence and contributions in the expanding Space A (shown with dotted lines). WMO has also taken some initiatives for improved utilisation of climate information by decision-makers (e.g., linking Spaces A and C) (*ref. Paper: WMO Leadership in Climate, 2004* http://www.wmo.int/pages/prog/wcp/cca/documents/climate_leadership.pdf)

5. Proposed WMO initiatives for provision of climate products and services

The core technical capacities to deliver and support climate products and services at national levels has to be facilitated through strengthened international and regional cooperation engaging GPCs and RCCs, and other relevant entities and mechanisms to support core technical capacities

that would enable NMHS serve their mandate. Specifically, the regional and international cooperation should support core capacities linked to:

- Observations, Monitoring and Data Management
- Climate diagnostics
- Climate Research, Modelling and Tools
- Operational Climate Forecasting and Prediction Systems and Climate Scenario Development

With this in view, EC LX (2008), (*ref. 3.2.6- General Summary, EC-LX*), has initiated two pronged action by approving in principle development of a WMO Initiative to Support Adaptation to Climate Variability and Change and establishing a Research Task Team to facilitate production of sector specific products through applied research. These are discussed in limited details in the following paragraphs.

5.1 Initiative to provide climate services

The mission of the WMO Initiative to Support Adaptation to Climate Variability and Change is:

To strengthen coordination and enhance the provision of user-oriented climate information, products, advisories and services and to thereby support national and regional climate risk assessment, climate adaptation planning and implementation practices for sustainable development.

The main objectives of the initiative are to:

- Support the scientific foundation for development of strategies for adaptation to climate variability and change;
- Make available adequate data products and other relevant climate information for developing adaptation strategies in different sectors at regional and national levels and help integrating them into national development agenda;
- Facilitate use of climate information for mainstreaming climate risk management into decision-making;
- Enhance the national capacities in the provision of user-oriented climate information, products, advisories and services for climate adaptation planning and implementation; and
- Help develop regional capacities for operational implementation of the above.

Climate observations form an essential element of this initiative and form its foundation. Improving the quality and quantity of climate observations needed for adaptation to climate variability and change is a central element of the mission of the GCOS. Climate prediction on global and regional scale and long-term projections through the research initiative, which is being advanced by WCRP, form the second element of the foundation. Based on this twin foundation, a framework consisting of a network of regional institutions with effective linkages to global institutions would be built to provide the climate data, prediction and services in user-friendly formats. The initiative will also focus on building capacities at the regional and national level and facilitating interaction with the users.

Given that climate processes operate on a wide range of space-time scales, for an effective delivery of climate products and services, it is essential to put in place appropriate mechanisms to generate, exchange and disseminate information at global, regional and national levels. WMO has designated Global Producing Centres (GPCs) for long range forecasts, and is in advanced stages of designating Regional Climate Centres (RCCs), which are designed to provide crucial real-time inputs to NMHSs to generate climate information to meet their national needs. Considering that there are multiple sources of climate information that need to be consolidated to

assist decision making, WMO has helped establish regional climate outlook forums (RCOFs) in several parts of the world with an overarching responsibility to produce and disseminate a regional assessment of the state of the regional climate for the upcoming season. Built into the RCOF process is a regional networking of the climate service providers and user-sector representatives. The GPC-RCC-RCOF-NMHS model can thus become an effective climate information channel representing Space A, but it needs to be further consolidated and evolved into a sustainable operational framework.

Another good example are Climate Watch systems which enable continuous and timely climate-related risk assessment and management to avoid damages to humans, their livestock and livelihoods, instead of crisis management that usually occurs as a 'clean up' operation after the climate anomaly has set in. The establishment of national and regional Climate Watch systems in all countries will heighten awareness and improve preparedness for adverse climatic conditions – and reduce socioeconomic vulnerability to climate hazards by alerting the user community well in advance.

The initiative, based on a demand-driven approach, will facilitate the development of climate services at the national level. The initiative will therefore support WMO's efforts and that of the relevant partner to enhance capacity at international, regional, national, sectoral and local levels to identify and understand impacts, vulnerability and adaptation. It will essentially be a framework built upon WMO's existing strengths to provide climate information and services and pool the resources and strength of various related programmes. Such a framework is built upon:

- Understanding of the requirements of climate sensitive sectors for climate products and services and detailed in the following sections
- Operational climate products and service development
- Coordination to ensure access to core capacities as Input to Climate Product and Service Development and technical cooperation at various levels
- Effective products and service delivery mechanisms
- Feedback Mechanisms from user community for Improvement of different Stages of the Climate Product Development Cycle
- Linkages to National Development and Climate Policies

The new framework will require strengthening international and regional cooperation. Many agencies have an interest in adaptation to climate variability and change. This initiative will complement and integrate contributions of WMO with those of other agencies and therefore will reinforce existing, and establish new partnerships with other relevant international and regional agencies, both UN and non-UN, for providing access to various user sectors; implementing the initiative; and financing various activities.

5.2 Integrated Climate Research

Climate impacts both the natural and human systems. These systems are influenced by climate variability and human-induced climate change on different temporal and spatial scales. The ability of human management systems to respond to the adverse impacts of climate is determined by access to resources, availability of relevant information and technology, capabilities to utilise the information, and the ability to formulate and implement effective response strategies.

Development of reliable science-based adaptation and mitigation strategies will only be possible if regional climate predictions and the delivery of this information to the users could be taken to next higher level. However, at this point of time, the ability of science to provide robust estimates of the risk to society, at the regional and local level is constrained by limitations in computer power and scientific understanding. It is both necessary and possible to revolutionize regional climate prediction: *necessary* because of the challenges posed by the changing climate, and *possible* by building on the past accomplishments of prediction of weather and climate.

There is a need for strengthening of international, regional and national cooperation for interdisciplinary research and activities to, (i) develop improved methodologies for the assessment of climate impacts on natural and human systems, (ii) characterize and model climate risk on time and space scales relevant to decision making, (iii) develop other relevant information such as better understanding of the linkages between climatic regimes with severity and frequency of extreme events, and (iv) provide capacity building and training in data gathering, monitoring and assessments, especially in and for developing countries. This requires a new level of commitment to strengthening climate research to support operational development of climate information for sectoral decision-making.

In order to address this issue, there is also an urgent need to build a global scientific workforce that can provide the intellectual power required to address the scientific challenges of predicting climate change and assessing its impacts with the level of confidence required by the decision makers. Neither the necessary scientific expertise nor the computational capability is available in any single nation. A comprehensive international effort is essential. Advances in climate prediction will require close collaboration between the weather and climate prediction research communities.

To address this important issue the EC-LX established a Research Task Team to propose a strategy focusing on strengthening prediction research and related scientific assessments in support of enhanced climate, weather, water and environmental services in the next decade.

6. Conclusions and Recommendations

6.1 Conclusions

6.1.1 WCP and Climate Agenda

The four components of WCP were; the World Climate Data and Monitoring Programme, the World Climate Applications and Services Programme, the World Climate Research Programme, and the World Climate Impacts and Response Programme.

While the first three components progressed reasonably well, the same cannot be said for the fourth component. WCRP, although under-resourced, has served an important role in the progress of climate science and has contributed substantially to improving operational climate predictions and to the four IPCC assessments. WCDMP and WCASP equally under-resourced, and mostly funded through the regular budget of WMO, were successful in initiating a number of projects and activities. These activities and elements such as CLIPS, RCOFs, GPCs, RCCs, have built the basic elements on which a framework for delivering the climate predictions and climate services can be built. However, these activities have remained largely disconnected and disjointed are still unsustainable and as such need to be put on firm grounds. The progress on the fourth component WCIRP has been uncertain and at best in the form of an array of isolated activities.

The Climate Agenda was designed as a comprehensive scientific approach to address the issues that were relevant at the time of its establishment. It primarily addressed improvement of coordination among the technical components of climate information generation. The activities under the Climate Agenda did not gain momentum due to the fact that the planning and initial implementation phase focused more on organisational coordination rather than:

- 1) developing of joint objectives and their benefits to the involved organisations,
- 2) identifying and prioritising joint issues,
- 3) developing of a detailed implementation plan for inter-agency collaborations, and
- 4) establishing institutional mechanisms that could sustain inter-agency collaboration.

- 5) It is also believed that the Climate Agenda failed to gain momentum for one major reason; because the WMO Secretariat did not/was not able to commit the resources to working with the other agencies, servicing IACCA and leading/inspiring the development of National Climate Programmes and National Climate Agendas in Member Countries;
(ref. Report of IACCA third meeting and *Paper: WMO Leadership in Climate, 2004*).

6.1.2 Coordination

The mechanism for coordination and collaboration between the first three components WCASP, WCDMP and WCRP has been effective but only to a certain degree. The three components have also been able to keep a good liaison with climate related elements outside the Climate Agenda although there is scope for its improvement. WCIRP has been functioning without any interaction with the other three components. WCIRP interaction with other activities and organisations such as UNFCCC or IPCC has almost been absent. The Inter-Agency Committee on the Climate Agenda (IACCA) has not met since early 1999. There are a number of reasons for the failure of IACCA as a coordinating mechanism for Climate Agenda:

- 1) *Limited manpower and financial resources:* The designed coordination mechanism under Climate Agenda needed a dedicated secretariat of 2 professionals and 2 support staff including provision of funds for meetings, publications and external studies, (totally around US\$ 5 Million per annum).
- 2) *Lack of linkages to highest governmental levels:* Emerging UN Convention on Climate Change provided much higher platform for decision makers in the governments to engage. IACCA was conceived as dealing only with scientific issues. As a result, IACCA could not emerge as a forceful platform as was originally expected. It did not make structural connect with the UNFCCC. On the other hand, IACCA's mandate did not respond to the needs of governments, industry and society.
- 3) *Lack of interest among sponsors in centralized implementation of the Climate Agenda:* IACCA intended to bring major observation, space, and international finance agencies as well as UN bodies together for implementation of the Climate Agenda. Nevertheless, this was practically limited to independent managing and governing bodies of WCRP and GCOS which benefit from multiple agency ownership of programmes and projects. They also benefit from relatively reliable Trust Funds.
- 4) *Shift of world interest from Commission for Sustainable Development (CSD) to UN conventions on environmental issues including UNFCCC:* Although the Climate Agenda had received support from the CSD and governing bodies of the participating agencies, IACCA failed to develop a message/document that could be used by other bodies such as UNFCCC, UNCCD and UNCBD. As a result, GCOS, IPCC, etc. report unilaterally to COP sessions.

However, at various occasions the Advisory Group of the EC on climate issues has opined that, notwithstanding the current and somewhat unclear picture with respect to high level international coordinating mechanisms and structures on climate and environmental matters, the original role intended for the IACCA remained valid.

6.2 Recommendations

In moving forward, WMO has ample opportunities to provide leadership in the areas of its core strength, by carefully formulating and implementing its response to the climate challenges expected in the 21st century. An effective response will encompass not only strengthening of its core technical and scientific climate capabilities and improving coordination of these activities, but also activities to develop strong linkages to sector-specific policy and business decision-makers at international, regional and national levels. Thus, the Climate Agenda could continue to serve as the basic framework for the WMO climate activities.

Based on the above analysis EC WG-CWE may like to consider the following options for recommending to the EC:

Alternative A

- 1) The Climate Agenda should be revised and updated by the responsible organizations in light of the changed circumstances, and responsibilities of these organizations should be clearly defined.
- 2) WCP should be strengthened by filling in the existing gaps duly incorporating the new WMO climate services initiative.
- 3) The existing dormant coordination mechanism of the IACCA should be revived and aligned with the HLCP coordination mechanism.

A coordination mechanism at the UN-Secretary General level shall be established.

Alternative B

- 1) The Climate Agenda should be formally retired, as having been overrun by the new developments.
- 2) WCP should be re-drawn as a WMO program duly incorporating the new WMO climate services initiative (with support from other agencies).
- 3) WMO partnership in co-sponsored programmes should be re-visited in order to strengthen these programmes.
- 4) WMO should seek a high-level Inter-agency meeting to discuss with other concerned organizations the new WMO Global Framework for Climate Services (perhaps under the umbrella of the HLCP) with the aim of improving collaboration.

In case Alternative B is adopted, the mechanism for coordination would form part of the Draft Proposal that would be developed in line with the decisions of EC LX.

6.3 Views from the members

Views of Dr John Zillman, Chair of the GCOS Steering Committee, on the Recommendations:

- (a) The WCP and Climate Agenda terminology should be retained. Both are very powerful concepts, they belong unambiguously to WMO and, if properly re-formulated and strongly but sensitively interpreted and implemented, the WCP and Climate Agenda can help ensure that the world will be well served by climate science and information and that WMO (and the NMSs of its Members) continue to be seen as key players on the overall international and national 'climate' scene;
- (b) WMO should grasp the opportunity provided by the WMO-UNESCO mandate to convene and facilitate the 'Climate Knowledge' element of the UN System Coordinated Action on Climate Change to engage its former WCP/Climate Agenda co-sponsors in the reformulation and reconstitution of GCOS, the WCRP and the WCDMP/WCASP (and parts of the original WCIRP) as, or in support of, a World Climate Service System; and
- (c) The WCC-3 Ministerial Declaration process should be used to provide the political endorsement and guidance to WMO and its partner agencies to proceed with the reconstitution and institutionalisation of the GCOS/WCP/Climate Agenda service provision framework to meet the global need for climate science and services in support of the policy and political processes of the UNFCCC and the counterpart activities at the national level in all countries.

Views of Dr Pierre Bessemoulin, President Commission for Climatology on the Recommendations:

I am very much in favour of Alternative B, probably needing an improved cooperation between WCP and WCRP, which has to be fully described, including participation of representatives of both programmes in respective CCI MG and WCRP JSC, and a mechanism for transferring research results and tools to operational applications.

Views of Dr Bruce Stewart, President, Commission for Hydrology on the Recommendations:

There is need to address following questions:

1. Have WCP and Climate Agenda been successful in addressing, to some extent, the need/issues? (the paper suggests yes for WCP and much less so for the Climate Agenda)
2. Are those needs/issues still relevant?
3. Have the needs/issues been appropriately defined? (for all perspectives, not just the climate community)? (I believe the needs/issues must be more user identified and driven)
4. If there remains a need/issues, is Climate Agenda the best mechanism to address it?
5. What are other mechanisms and what are their strengths and weaknesses?

If we accept that either WCP or the Climate Agenda is still the best method/process to address the issues then we need to look at three options:

- (a) Do nothing - what happens if we just let things go on as they are - not a good option I know, but one we have to consider.
- (b) Make changes to either WCP or the Climate Agenda that will enable it to meet the needs/issues - these changes will have to be shown to have the potential to turn things around.
- (c) Scrap it and put something else in its place that will meet the needs.

At the end of the day, it is essential that we have a real and identified need, supported by the users of climate information for the continuation of a program. Give the current situation with respect to climate etc., this should be readily and easily identified. However, if we don't improve our users' interfaces and get their input we will not succeed. We have to listen to and learn from their needs, influence the method for addressing these needs and set programmes etc in place that will add value to the climate information we develop through improving the management of climate related resources.

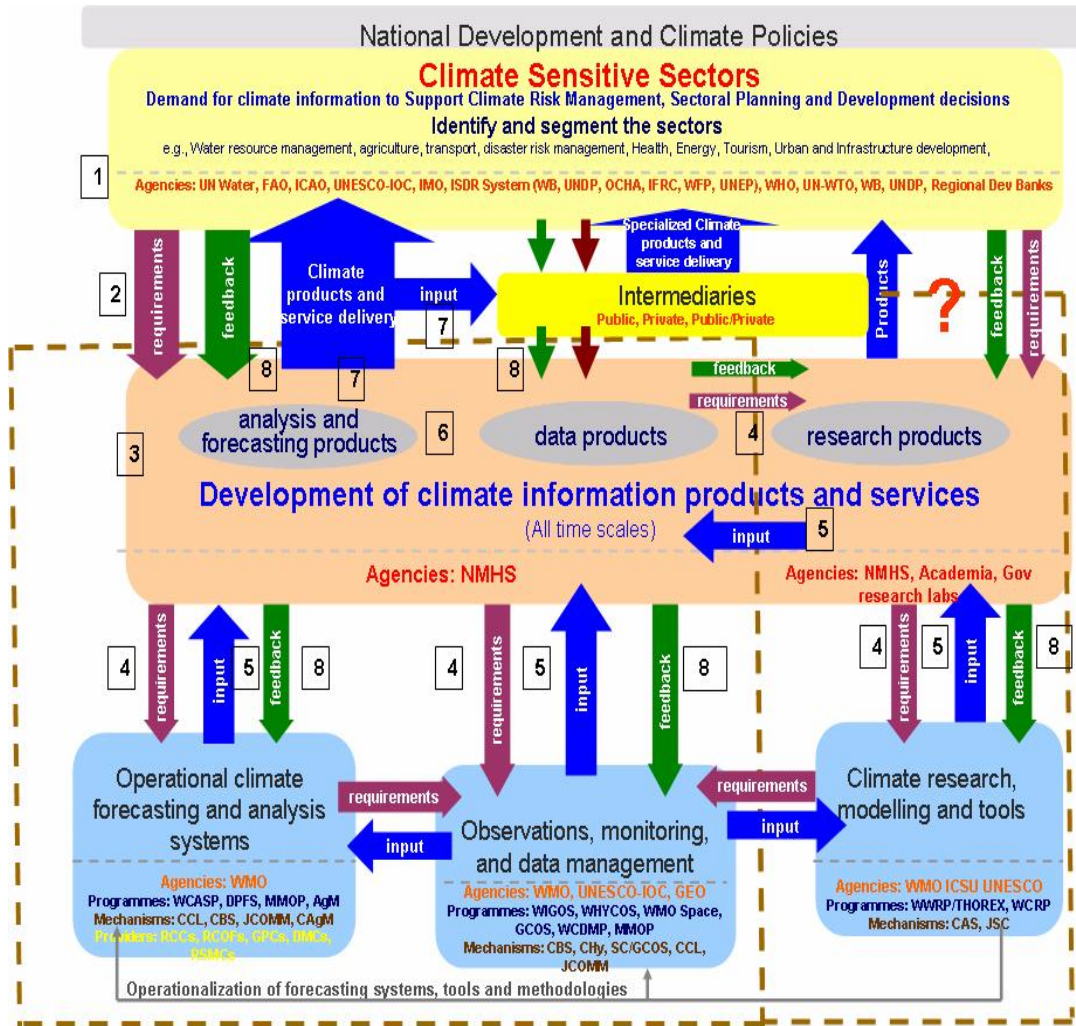


Figure 1: Core areas of WCP and development and delivery mechanism for climate information products and services for various climate sensitive sectors.

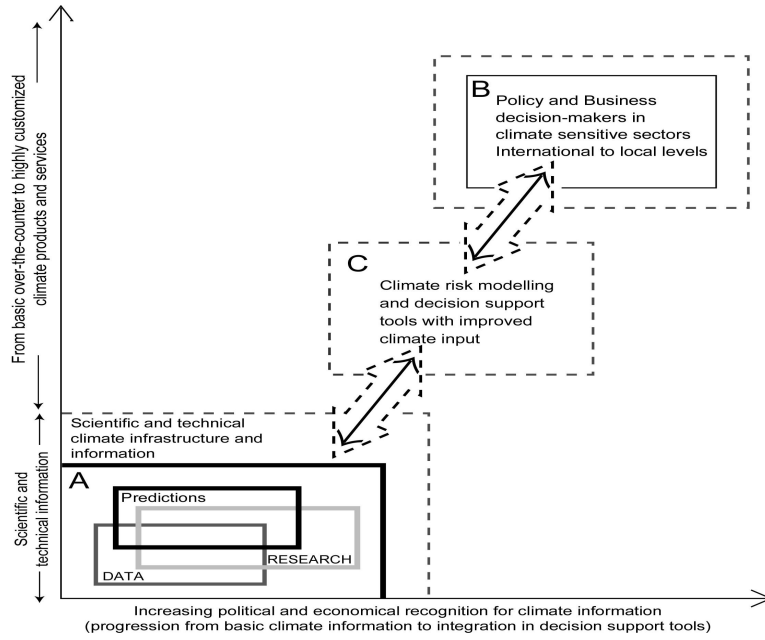


Figure 2 Climate information value chain

World Climate Data and Monitoring Program

Rationale

Adequate climate monitoring requires homogeneity, continuity and adequate coverage of climate data at various spatial and temporal scales. The increased concern about climate variability and change and the induced negative impacts of extreme climate events has put more pressure on NMHSs to provide improved climate services. NMHSs and data archiving centres need to increase their efforts in making available climate data with the maximum accuracy and minimum time delay; within the borders of individual countries as well as among nations.

While on one hand progress in technology for collecting (in-situ and space based), managing, processing and analysing climate data including relevant metadata present an opportunity, it also presents various challenges such as the state of climate data availability, exchange and archival, puts climate monitoring in a situation where it continuously needs an effective world-wide collaboration to update strategies.

Terms of Reference

The World Climate Data and Monitoring Program (WCDMP) provides the international collaboration framework for exchanging, managing and exploiting climate data in various climate monitoring activities and applications. Under WCDMP framework, climate experts and partner institutions, design projects and carry out activities ranging from, providing NMHSs with standards and requirements for climate observations (based on the GCOS monitoring principles), formulate guidelines and organising seminars and training workshops to developing climate monitoring information systems and products.

The long-term objectives of WCDMP are:

- (a) To support the development of observation networks to meet the needs of specific applications, including the use of traditional in situ surface and upper-air observations, satellite systems and new observing technologies;
- (b) To complete the implementation of a climate watch system to inform Members on pending significant climate anomalies;
- (c) To coordinate the provision of monitoring of climate anomalies, regular assessments and authoritative statements on the interpretation and applicability of instrumental and proxy data for the study of climate variability, the detection of climate change, and the validation of climate models and forecasts;
- (d) To develop awareness of the inter-annual variability of the global climate system and to facilitate the generation, interpretation and dissemination of this information in global and regional scale climate fluctuations;
- (e) To facilitate the development and implementation of methods to enable the rescue, preservation and management of climate data by WMO Members, especially developing countries and those in transition, and to promote the international exchange of climate data and related products;
- (f) To coordinate the preparation and distribution of global and regional data sets, including metadata, as required for both research and the development of climate information and prediction services;
- (g) To coordinate the development and implementation of advanced climate database management systems, with the provision for capacity-building and technology transfer.

Activities

WCDMP faces several challenges in addition to restrictions put on climate data by some Members. These include availability of climate data due to declining climate observing networks, quality of data and its homogeneity, transitioning of networks from manual to automatic mode, rescuing old climate records which are at risk of degradation and lost, compliance to the changing technologies in media storage for the archiving systems, and security of data through back-up and providing safe archiving sites in case of conflict or natural disasters, etc. To meet these challenges WCDMP carries out following activities:

Development of standards and requirements for climate observations: This involves the development of guidelines on climate networks, their requirements, their change management, their cost-effectiveness, special needs in developing countries for implementing automatic weather stations, etc.

Data rescue and data management systems: It carries out Data Rescue (DARE) including design and implementation of modern Climate Data Management Systems (CDMSs). Data Rescue has been extended to records other than paper forms and now, it is including records stored in obsolete electronic media such as old magnetic tapes and discs. WMO-DARE activity is supported mainly by Members through VCP or bilateral agreements. MEDARE is an initiative for Data Rescue in the Mediterranean basin that brings together scientists from universities, research centres and other international climate-related institutions and projects together with experts and climatologists from the NMHSs. The long-term goal of the project is to develop a comprehensive high quality instrumental climate dataset for the Greater Mediterranean Region (GMR) with a focus on the Essential Climate Variables (ECV) of the Global Climate Observing System (GCOS). CLIMSOF-WIS Demonstration project aims at improving climate data discovery through the WMO Information System (WIS) by putting in place the software/hardware interface for historical climate data and metadata exchange through the WIS. Emphasis in these projects has been made on developing countries and least developed countries.

Authoritative assessment of the annual state of the climate: WCDMP provided international coordination for the provision of authoritative assessment of the annual state of the climate by issuing Climate Monitoring Bulletin, Climate System Monitoring Review, and annual WMO Statement on the Status of the Global Climate. WCDMP facilitates and promotes the set up of dedicated websites and portal to inform on climate anomalies and weather-climate extremes with emphasis on global and regional scale.

Capacity development: It supports and promotes the organisation of international and regional conferences, seminars and workshops on using climate data, including reanalysis data to advance knowledge in monitoring the climate system at various time-space scales. Focus is made on climate change detection and implementing climate watch systems

Governance and coordination with other components of WCP

WCDMP is guided through the Commission for Climatology (CCI) and provided the oversight by the Executive Council and the WMO Congress. Budgetary provisions are made for the manning the activities under the program. Extra budgetary resources are also solicited for its activities. It coordinates with CLIVAR/WCRP and JCOMM in the international efforts and collaboration in climate change detection and indices through the Expert Team on Climate Change Detection and Indices (ETCCDI), which provides the scientific leadership for these efforts. The techniques and software developed by ETCCDI are made freely available for download through its web site. The output of ETCCDI contributes ultimately to the IPCC assessment reports and in informing policy and decision makers.

It contributes to the WMO efforts at regional level for the implementation of various aspect of the World Climate Programme, including the support to the development of Regional Basic Climate

Network (RBCN), the implementation of the Regional Climate Centres. In collaboration with the Regional Associations working groups on climate related matters and the regional climate institutions in all WMO regions, including in Africa: ACMAD, ICPAC, and DMC; in south America: CIIFEN, and CPPS; and in Asia: Beijing and Tokyo Climate Centres, and with several other institutions and universities.

WCDMP has established a strong linkage with the WMO Information System (WIS) project office to benefit from the WMO standards in exchanging climate data and meta-data. It contributes to the World Weather Watch and GCOS on climate observations. WCDMP is also actively involved with GCOS directly by two ex-officio CCI members at the GCOS Atmospheric Observations Panel for Climate (AOPC), this allows WCDMP to consider GCOS plan and projects in climate observations that have impacts on climate data management and climate monitoring.

Strengths

- 1) The WCDMP has regular resources and man power to undertake its activities.
- 2) There is an effective oversight and coordination mechanism to link the activities of the program with other entities involved in climate area.
- 3) There is an excellent experience built in the field of data rescue and data management and building capacity in the countries.
- 4) WCDMP work is based on standards, norms and practices common to all Members. These are included in WMO technical regulations, Guides and guidelines. This gives WCDMP, in a quick and a widely applicable manner, the possibility to make the needed updates as science and technology evolve
- 5) Existence of climate data Infrastructure at global, regional and national levels providing the programme with the required data services and climate monitoring products.

Weaknesses

1. There is lack of financial resources to undertake the work in all the countries.
2. The climate observation shrinking networks in the countries, particularly the developing countries affect the quality of climate monitoring activities
3. Lack of resources with the NMHSs puts pressure on them to raise resources to support their activities by selling the services and products. This comes in the way of free exchange of climate data.

Opportunities

- 1) Growing awareness of the potential impacts of climate variability and climate change on the development process and the poverty alleviation efforts, particularly among the policy makers presents an opportunity to address this issue.
- 2) The fast development of new observing systems in particular remote sensing, ground and space based ones provide an advanced climate data source
- 3) The implementation of WIGOS and WIS will provide greater opportunity to Members to become more active in implementing WCDMP at regional and national levels.
- 4) Implementation of RCCs will allow conducting tasks that some NMHSs are not able to conduct alone, especially in developing countries.

ANNEX II**World Climate Applications and Services Programme****Rationale**

Both natural and man-made systems are critically influenced by climate variability and change. Variability over time and space, while being an integral part of the climate system, can lead to quite anomalous situations – some windows of opportunity and some risks. As a major natural resource, the climate needs to be constantly explored for opportunities that can help meet the growing demands of societies within the context of the achievement of sustainable development. As a hazard posing immense risk to infrastructure and life, climate anomalies and trends need to be monitored and predicted to devise effective risk management strategies. Climate information and services therefore leverage the opportunities, helping us to seize them when they offer themselves, and also risk management strategies to cope with climatic hazards. In this context, climate information includes prediction, and services include products, communication and use. Usability of the products is of prime importance in defining climate services.

Terms of Reference

WCASP fosters the effective application of climate knowledge and information for the benefit of society and the provision of climate services, including the prediction of significant climate variations both natural and as a result of human activity. The purpose of WCASP is to assist WMO Members and relevant international organizations in furthering the applications to maintain public safety, health and welfare, to alleviate poverty and to promote sustainable development. The main long-term objectives of WCASP are:

- (a) To help Members develop climate services with special emphasis placed on services for national sustainable development and for devising methods of adapting to, and mitigating, the adverse impacts of climate and its variations;
- (b) To promote awareness of the potential benefits of climate services in human endeavour, with particular emphasis on alleviating poverty and maintaining public safety and welfare;
- (c) To encourage the development and use of practical methods and techniques for applying climate information, including climate prediction products.

Activities

WCASP is implemented through:

- (a) CLIPS (Climate Information and Prediction Services) project including conducting training seminars and workshops, and international conferences;
- (b) Assistance to Members in building their capacity to interact with various sectoral users and to promote the application of cost/benefit analyses related to climate services in various sectors, including the organization of training workshops and seminars, and the provision of specialized guidance material;
- (c) Support to NMHSs through meetings of experts and sharing expertise in the application of climate information in sectors such as food production, water resources management, human health, energy, tourism, and urban and building development;
- (d) Development, coordination and assistance to the Regional Climate Centres (RCCs) within each of the Regions;
- (e) Promotion of Regional Outlook Forums (RCOFs) as an effective mechanism for the WMO, NMHSs and partners for consensus building, capacity building and end-user liaison at the regional level, particularly in developing countries.

At the global level, an important activity of WCASP is to coordinate consensus updates on El Niño and La Niña, which are known to influence climatic patterns around the world at seasonal to inter-annual time scales.

CLIPS

WCASP, through the implementation of the CLIPS project assists Members, taking advantage of advances in the climate science and associated technologies for developing enhanced services. The CLIPS project has the overarching vision

'to utilize climate information and predictions of the near future (monthly, seasonal and interannual conditions) in order to provide the best possible information on future conditions that guide economic and social decisions to reduce risk and improve economic vitality and the quality of life'

The CLIPS project has the following objectives:

- 1 To provide an international framework necessary to enhance and promote economic, environmental and social benefits from climate information and predictions.
- 2 To facilitate the development and strengthening of a global network of regional/national climate centres, including communications and training; these centres to act as a focus for the provision of climate information and prediction services.
- 3 To demonstrate the value and ultimate socio-economic benefit of climate information and prediction services, and the connection of those benefits with global observing, monitoring, prediction and applications.
- 4 To encourage the development of operational climate predictions for periods and regions that are feasible and directed towards useful, user-oriented applications

A network of national CLIPS focal points and of regional association CLIPS rapporteurs, which coordinate the activities of national focal points in support of national and regional capacity building. CLIPS focal points receive their training in CLIPS Training Workshops where they increase their skills in creating and distributing climate information and in valuing the usefulness of climate predictions to develop climate services in their respective countries and regions. CLIPS training workshops comprise integrated training activities on climate prediction techniques with a number of practical applications where curriculum aiming at enhancing the NMHSs' skill base has been developed. This curriculum, a proven excellent training support tool, benefits from high-quality submissions of modules developed by volunteer experts from around the world, in particular from large seasonal forecast centres. The workshops are led by international and regional experts and involved scientific, management (including project management) and applications modules.

Regional Climate Centres

Institutional structures as part of the framework for seasonal to interannual prediction include, among other options, the establishment of Regional Climate Centres (RCCs). An RCC is a Centre of Excellence that assists WMO Members in the given region to deliver better climate services and products including regional long-range forecasts, and to strengthen their capacity to meet national climate information needs. WMO designated RCCs will perform the following basic minimum functions:

- Operational Activities for Climate Monitoring:
- Operational Data Services, to support operational Long Range Forecast (LRF) activities and climate monitoring:
- Training in the use of operational RCC products and services

WMO is in advanced stages of the designation process for RCCs, and some centres are already implementing the concept in pilot mode. The first RCCs are expected to be designated in June 2009.

Regional Climate Outlook Forums

Within the framework of CLIPS, WMO and partner international and national agencies have organised *Regional Climate Outlook Forums (RCOFs)*, to provide real-time seasonal climate outlooks for the region and develop strategies on how the information can be used in support of decision making in climate-sensitive sectors. RCOFs provide a powerful mechanism for capacity building because participants are actively involved in the decision-making process. RCOFs in various forms and sizes are now in operation serving more than 10 sub-regions around the world, and concerted efforts are being made to extend the concept to several other regions. Despite the challenges of resources and human and infrastructural capacities, some of the RCOFs have achieved remarkable progress in regional networking and user liaison, and substantially contributed to capacity building and user awareness.

RCOFs bring together national, regional and international climate experts, on an operational basis, to produce regional climate outlooks based on input from NMHSs, regional institutions, RCCs and GPCs and other climate prediction centres. Through interaction with sectoral users, extension agencies and policy makers, RCOFs assess the likely implications of the outlooks on the most pertinent socio-economic sectors in the given region and explore the ways in which these outlooks could be made use of. RCOFs also review impediments to the use of climate information, experiences and successful lessons regarding applications of the past RCOF products, and enhance sector-specific applications. These RCOFs then lead to national forums to develop detailed national-scale climate outlooks and risk information including warnings for communication to decision-makers and the public at large.

Governance and coordination with other components of WCP

The WMO Commission for Climatology (CCI) is the main guiding agency for the implementation of WCASP through its specialized Open Programme Area Group (OPAGs) on the CLIPS project, and also on Climate Applications and Services. These OPAGs are assisted by expert teams dealing with specific aspects such as research needs, CLIPS operations, verification and user liaison, El Niño/La Niña, and sector-specific groups on health, energy, tourism and urban and building climatology. WMO Executive Council and Congress provide the necessary oversight and guidance in this regard. WCASP/CLIPS make special efforts to link its activities to WCRP, by inviting WCRP experts to the CCI teams and also by involving them in CLIPS training sessions and RCOF sessions. WCASP also has linkages with WCDMP, particularly in matters related to climate monitoring and climate watches which form integral components of RCC and RCOF activities. The coordination is also facilitated by the Regional Working Groups on Climate Related Matters, where all related aspects are jointly considered. Joint sponsorships of conferences of mutual interest and joint projects also help in the coordination activities.

Strengths

1. WCASP are resourced through regular budget and also the individually allocated human resources to undertake the activities.
2. WCASP has a good oversight and coordination mechanism through CCI, Secretariat structure and the associated bodies.
3. Partnerships with various sectoral agencies, international and regional institutions dealing with climate applications and services.
4. CLIPS project is well known both within the WMO entities and outside, and has a long tradition of working towards user needs of climate information
5. Recognized potential to support climate adaptation, through UNFCCC/SBSTA.
6. Existence of mechanisms within the GPC-RCC-RCOF-NMHS framework, with the broad framework elements in place.

Weaknesses

1. Inadequate resources, both financial and human, to match the magnitude of work involved.
2. Lack of adequate showcase projects and joint projects with sectoral partners and relatively slow pace of development in the design of user-tailored products.
3. Inadequate data in some regions to validate and calibrate prediction models, and lack of standardized approaches to climate prediction and verification at national and regional levels.
4. WCASP activities do not cover climate scenarios.

Opportunities

1. The emerging needs for climate services at the national and regional levels, and the recognition of the importance of climate information in decision making.
2. Availability of advanced modelling and prediction techniques and downscaling strategies. However existing techniques (statistical, regional climate models) have their advantages and limitations

Challenges

1. Inadequate consideration, and cooperation with the risk management community and decision making bodies in climate sensitive sectors in all its forms and at all levels, and developing a comprehensive strategy to address them in a practical manner.
2. Quantifying and effectively communicating uncertainty in climate information products. Nevertheless, the multi-model approaches in chapter 10 of IPCC AR4 , which include assessment of uncertainty and the probabilistic aspects of LRF are successful examples.
3. Building a framework for NMHS-user partnerships at the national level
4. Inadequate technical capacities at the national and regional levels, particularly in developing countries
5. Taking partnerships with sectoral agencies to the next level, integrating their own initiatives in climate issues into WCASP activities.
6. Developing a strong and sustained working relationship with WCRP, GCOS and WCDMP to jointly address the goal of meeting the climate information needs of decision makers at national and regional levels.
7. Evolution of extremes in a changing climate, and their return periods, which are key parameters e.g. for infrastructure design
8. Implementation of RCCs will allow to conduct tasks that some NMHSs are not able to conduct alone, especially in developing countries.

ANNEX III**World Climate Research Program (WCRP)****Rationale**

Fundamental research into understanding the basic behavior of the physical climate system related to all scales and causes of natural climate variability, is essential for developing methods for predictions of global and regional climatic variability, and into sensitivity of the climate system to possible natural and human-induced stimuli that could result in changes in climate (e.g., changes in the frequency and severity of extreme events.) To coordinate research, WCRP was established in 1980 based upon a Memorandum of Understanding (MoU) between WMO, UNESCO's Intergovernmental Oceanographic Commission (IOC) and the International Council of Scientific Unions (ICSU) with an equal tri-partite role of the sponsors.

Terms of Reference

The main long-term objectives of WCRP are to determine the extent to which climate can be predicted and the extent of human influence on climate. These were reaffirmed at the Conference on WCRP: Achievements, Benefits and Challenges (Geneva, August 1997), where it was also agreed that the overall priorities for the next decade should be:

- (a) Assessing the nature and predictability of seasonal to inter-decadal variations of the climate system at global and regional scales, and providing the scientific basis for operational predictions of these variations for use in climate services in support of sustainable development;
- (b) Detecting climate change and attributing causes, and projecting the magnitude and rate of human induced climate change, regional variations, and related sea-level rise;
- (c) Responding to the research needs of the IPCC, UNFCCC and other climate-related conventions, and of the other components of WCP in the framework of the Climate Agenda;
- (d) Encouraging greater participation of scientists from developing countries in WCRP.

WCRP is currently implementing its Strategic Framework for the years 2005-2015, which aims to "facilitate analysis and prediction of Earth system variability and change for use in an increasing range of practical applications of direct relevance, benefit and value to society". WCRP activities contribute to the collection and improvement of climate observations, model development and understanding of the climate system necessary for the detection and attribution of past climate change, and the provision of climate information, including projections of future change, assessed by the Intergovernmental Panel on Climate Change (IPCC), the WMO/UNEP Scientific Assessment Panel on Ozone Depletion and other policy-relevant scientific bodies.

Activities

WCRP activities are designed to improve scientific understanding and knowledge of processes that in turn result in better forecasts and hence benefits to users of climate information products. WCRP studies are coordinated and integrated by four major core projects (GEWEX: Global Energy and Water Cycle Experiment; CLIVAR: project on Climate Variability and Predictability; SPARC: project on Stratospheric Processes and their Role in Climate; CliC: Climate and Cryosphere project); diverse working groups; various cross-cutting activities on urgent science questions relevant to society such as monsoons, extremes and risks; and many co-sponsored activities. Specifically, WCRP is advancing scientific research on:

1. climate modeling and numerical experimentation,
2. anthropogenic climate change;
3. ocean and climate interactions including understanding of sea-level rise and variability,
4. monsoon dynamics,
5. observations, data assimilation and analysis,

6. climate extremes.
7. seasonal to decadal predictions,
8. atmospheric chemistry and climate, and
9. surface fluxes and Surface Ocean Lower Atmosphere Study (SOLAS).

Along with significant advances in understanding the climate system and its processes, WCRP projects have also contributed to the development of global climatological datasets.

Governance and coordination with other components of WCP

To implement their shared responsibility for the WCRP, the co-sponsoring agencies established the Joint Scientific Committee (JSC) and a joint secretariat to service the needs of the programme.

Modelling is the link between observations, scientific insights, and delivery of forecasts, predictions, and scenarios that the full range of stakeholders need. For this reason, WCRP must work with the numerical weather prediction community as well as other programmes such as IGBP in order to ensure that climate scientists are incorporating the full range of relevant disciplines in its models. WCRP and CAS have a joint Working Group on Numerical Experimentation (WGNE) to provide better coordination of model developments to meet the full range of weather prediction and climate research needs. The IPCC assesses the climate change related research that is coordinated by, *inter alia*, the WCRP. In essence, while WCRP coordinates climate related research, WCASP is charged with the delivery of research results to the community through operational services.

WCRP should continue to cooperate closely with related programmes such as IGBP, IHDP and Diversities through the Earth System Science Partnership (ESSP), recognizing that there are many common objectives of these Programmes with WMO's Technical Commission on Climatology (CCI). It should also be involved in activities such as the ICSU Integrated Research on Disaster Risk (IRDR) project.

WCRP is currently developing its intermediate implementation plan and its long-term research strategy to guide its activities during the next two decades. Towards this goal, WCRP envisions great opportunities for the World Weather Research Programme (WWRP) and WCRP to work together towards a seamless prediction of weather, climate, water and environmental conditions, offering improved services through National Meteorological and Hydrological Services (NHMSs) worldwide. The WCRP should also contribute to support the WMO's capacity building and training activities through cross cutting activities that contribute to the WMO's expected results. This work would form one of the strategies that would contribute to its sustainability as well as adding value, globally, from its work.

Strengths

1. WMO considers WCRP as one of its very high profile, high impact, co-sponsored programmes.
2. Active involvement of three cosponsors committed to the objectives of WCRP
3. Access to a global network of research organizations and researchers focused on climate studies which has been developed over the past 30 years.
4. Established track record in effective integration and coordination of national and regional research activities to focused global activities such as WOCE, TOGA, ACSYS, etc.
5. Recognized world leading organization for climate model development, evaluation and their use in major environmental assessments such as Ozone and Climate.

Weaknesses

1. Weak linkages between WCRP and NMHSs at the national and regional levels,

2. Uneven financial contributions from the three sponsors and perhaps differing expectation in respect of outcome from their sponsorship.

Opportunities

1. Greater awareness of the challenge to human kind from climate variability and change,
2. Enable development of regional climate model downscaling, projection and prediction capabilities
3. Enable a Climate Information System to meet 21st Century climate information for managing risks and opportunities associated with climate variability and change.
4. Joining forces with the numerical weather prediction research and operations communities to meet 21st Century weather, climate, water and environmental information needs.

Challenges

1. Resourcing of the large infrastructure required in experimental observations, modelling, and process studies,
 2. Need to build research capacity with diversity of age, gender and nationality and in the involvement of developing country scientists;
 3. Need to engage the next generation of scientists
 4. Need to include the range of land, ocean, atmosphere, cryosphere and ecosystem processes, as required in the next generation of climate system models.
 5. Integration of natural sciences and socioeconomic aspects of climate agenda.
 6. Need for greater breadth required by broadening its scientific base in observations, modelling, and process studies.
-

ANNEX IV

**World Climate Impacts Assessment and
Response Strategies Programme (WCIRP)**

WCIRP is targeted at assessing the impacts of climate variability and changes that could markedly affect economic or social activities and thus contributing to the development of a range of socio-economic response strategies that could be used by governments and the community. UNEP is the leading agency within WCIRP and implements the programme in partnership with WMO, FAO, IPCC and UNFCCC Secretariats.

Terms of Reference

To contribute, in cooperation with United Nations Organizations and Specialised Agencies, governmental and non/governmental organisations, to international action to protect the atmospheric environment by facilitating consensus building on response strategies, research needs and assessment methodologies related to the impact of climate' variability and change.

The main thrusts of WCIRP include:

- Testing methodologies for assessments of impacts of climate change and sea level rise;
- Promoting and improving coordination of national climate impact and response strategies programmes;
- Improving techniques for making inventories of sources and sinks of GHGs;
- Developing national strategies for responding to climate fluctuations and change;
- Improving dissemination of accurate, complete and timely information to governments and the public;
- Assessing air quality and air pollution mitigation strategies.

WCIRP was constituted in 1979 and since then UNEP contributed substantially to fulfilling the WCIRP goals by providing major inputs in the following core areas:

- Sustainable Development and Climate Change,
- Vulnerability Assessment and Cost Effective Adaptation,
- Integrating Land Use and Forestry Issues and Climate Change,
- Sustainable Energy and Climate Change Mitigation,
- Kyoto Mechanisms and National Policy Instruments,
- Technology,
- Finance and Insurance,
- Support to IPCC, Information, Dissemination and Outreach.

IACCA recognized that governments around the world were very much interested in climate assessment, nevertheless, many of the potential impacts of global warming were country-specific and depended on geography, social and economic systems. These facts have limited developed country involvement in UNEP's WCIRP. As a result, UNEP conducted a number of country studies in developing countries in line with requirements of the UNFCCC. IACCA had proposed that integrated assessment studies (largely economic) be conducted and recommended to IHDP to be included in this activity. IACCA always considered WCIRP as the least successful component of WCP. It also felt that there were some overlap between activities/mandate of WCIRP and those of WCASP (e.g. impacts of ENSO).

GLOBAL CLIMATE OBSERVING SYSTEM

The Global Climate Observing System (GCOS) was established in 1992 to ensure that the observations and information needed to address climate-related issues are obtained and made available to all potential users. It is co-sponsored by the

- World Meteorological Organization ([WMO](#)),
- Intergovernmental Oceanographic Commission ([IOC](#)) of UNESCO,
- United Nations Environment Programme ([UNEP](#)), and
- International Council for Science ([ICSU](#)).

Terms of Reference

The objectives of GCOS are to support all aspects of the World Climate Programme, the climate change assessment role of the WMO-UNEP Intergovernmental Panel on Climate Change (IPCC), and the international policy role of the United Nations Framework Convention on Climate Change (UNFCCC); and, in particular, to provide sustained, comprehensive, climate and climate-related observations to meet the needs for:

- (i) Climate system monitoring;
- (ii) Climate change detection and attribution;
- (iii) Research to improve understanding, modelling and prediction of the climate system;
- (iv) Operational climate prediction on seasonal to interannual time scales;
- (v) Assessment of the impacts of, and vulnerability and adaptation to, natural climate variability and human-induced climate change;
- (vi) Applications and services for sustainable economic development;
- (vii) The climate change assessment role of the Intergovernmental Panel on Climate Change; and
- (viii) The climate change policy role of the UNFCCC and other international conventions and agencies.

GCOS is not a separate observing system additional to WMO's global observing systems, the IOC-led Global Ocean Observing System (GOOS), and the FAO-led Global Terrestrial Observing System (GTOS). Rather it is the climate-focussed 'system-of-systems' framework, or interface, through which all the global observing systems of WMO and its UN and non-UN system partners work together to meet the totality of national and international needs for climate observations.

Drawing from the comprehensive observing system for the atmosphere coordinated by the WWW, GAW and WCRP, the Global Ocean Observing System (GOOS) and the Global Terrestrial Observing System (GTOS) programmes, it addresses the total climate and environment system including physical, chemical and biological processes and atmospheric, oceanic, terrestrial, hydrologic, and cryospheric components.

The GCOS programme stimulates, encourages, coordinates and otherwise facilitates the taking of the needed observations by national or international organizations in support of their own requirements as well as of common goals. It provides an operational framework for integrating, and enhancing as needed, observational systems of participating countries and organizations into a comprehensive system focussed on the requirements for climate issues.

Activities

GCOS builds, to the extent possible, on existing observing, data management and information distribution systems, both operational and research, and on further enhancements of these systems.

These include the:

1. [WMO Global Observing System](#) for atmospheric physical and dynamical properties
2. [WMO Global Atmosphere Watch](#) for atmospheric constituent and chemical properties
3. The climate module of the [IOC/WMO/ICSU/UNEP Global Ocean Observing System](#) for physical, chemical and biological properties
4. [FAO/ICSU/UNEP/WMO Global Terrestrial Observing System](#) for land surface ecosystem, hydrosphere, and cryosphere measurements
5. [WCRP GEWEX Baseline Surface Radiation Network](#) for surface radiation budget measurements,
6. [IGBP](#) and [WCRP](#) research networks, for monitoring of terrestrial ecosystems, clouds and the hydrological cycle, the earth's radiation budget, ice sheets and precipitation over the oceans
7. Data communication and other infrastructures necessary to support operational climate forecasting, including the World Climate Data and Monitoring Programme ([WCDMP](#)) and the Climate Information and Prediction Services ([CLIPS](#))
8. World Data Centres

Governance and coordination mechanism with WCP

GCOS is directed by a Steering Committee that provides guidance, coordination and oversight to the programme. Three science panels, reporting to the Steering Committee, have been established to define the observations needed in each of the main global domains (atmosphere, oceans, and land), to prepare specific programme elements and to make recommendations for implementation. The [GCOS Secretariat](#) located at the WMO headquarters in Geneva, Switzerland, supports the activities of the Steering Committee, the panels and the GCOS programme as a whole.

ANNEX VI**WMO Programmes contributing to climate activities**

A number of WMO programmes contribute to the climate agenda directly or indirectly. These are described briefly in the following paragraphs.

Climate Observations, Monitoring and Data Management

Comprehensive and accessible global databases of physical, biological and chemical variables in the atmosphere, land and ocean are critical for understanding the earth's complex climate system, for developing capabilities to predict natural climate variability and to project anthropogenic climate change. Readily accessible climatological data sets are also essential for analyzing and quantifying the societal impact of climate variability and climate change and for the development of mitigation strategies.

WMO, through its various programmes and sponsored programmes, assumes the leading role in coordination, facilitation, collection, archiving, dissemination, and utilisation of climate data and related products. WMO Members operate, in a coordinated manner, complex networks in space, atmosphere, on land and over oceans. Currently, more than 10000 manned and automatic surface weather stations, 1000 upper-air stations, over 7000 ships, more than 100 moored and more than 3200 ARGO floats, hundreds of weather radars and over 3000 specially equipped commercial aircraft measure key parameters of the atmosphere, land and ocean surface every day.

WMO created the WMO Integrated Global Observing System (WIGOS) to provide an organizational, programmatic, procedural, and governance structure that will significantly improve the availability of observational data and products, and which will provide a single focus for the operational and management functions of all WMO observing systems as well as a mechanism for interactions with WMO co-sponsored observing systems. WIGOS components include:

- (a) The Global Observing System of the World Weather Watch;
- (b) Regional, river basin, and global hydrological networks;
- (c) The Global Atmosphere Watch networks and systems for observations of atmospheric chemical composition and related environmental parameters;
- (d) The various radiation networks observing both solar and net radiation, for example, the Regional Basic Synoptic Network;
- (e) Marine meteorological and oceanographic observations from ships including the Ship Observations Team;
- (f) Moored and drifting buoy arrays developed as research arrays during Global Atmospheric Research Programme (GARP) and World Climate Research Programme related research projects, and which are now operational networks and arrays supporting weather and climate as well as oceanographic objectives;
- (g) The WMO component of atmospheric, oceanographic and terrestrial observing systems contributing to GCOS observing requirements;
- (h) Aircraft Meteorological Data Relay systems initially developed and implemented under the GARP project and subsequently expanded to an operational status including expansions of aircraft measurement capability for atmospheric composition constituents;
- (i) Space-based observing systems that are currently a major component of virtually all WMO observing programmes, including the geostationary meteorological satellite constellation, the core polar-orbiting meteorological constellation, and the other components of the space-based observing system serving the needs of operational and research applications'
- (j) The observing component of the Cryosphere Watch approved by Fifteenth Congress; and
- (k) Other possible components yet to be defined.

WIGOS ensures availability of required data and information and facilitates access through the WMO Information System (WIS) according to identified requirements. Additionally, it helps ensure high data quality standards and benefits from archival and technological innovations. Through its Instruments and Methods of Observation Programme (IMOP), WMO ensures that meteorological instruments, including manual and automatic ground-based stations and space-based observing systems, are accurate and provide standardized data.

GCOS is fundamentally a system of largely domain-based climate-relevant observing systems (including especially GOOS, GTOS, and the new WIGOS). In establishing GCOS, its Sponsors (WMO, UNEP, IOC, and ICSU) desired that all these systems work together as an integrated whole to serve the full range of climate-related needs for observations. GCOS is thus essentially the climate-observing subset of the Global Earth Observation System of Systems (GEOSS). Annex V provides additional information on the objectives of GCOS.

As part of the global climate monitoring activities, WMO coordinates since 1993 through WCDMP and CCI, the provision of the world authoritative voice on the status of the global climate system each year. To achieve this task, WMO activates climate monitoring networks composed of several world leading climate institutions (providing high quality climate data sets and climate monitoring products) and advanced NMHSs as well as several experts affiliated under other WMO programmes, in particular GAW and WCRP. As outputs, WMO produces various climate monitoring publications, in particular the annual brochure on the WMO statement on the status of the global climate system in the six WMO official languages.

Climate Research, Modelling and Tools

WMO contributes to the advancement of atmospheric sciences and assists Members in providing better meteorological and environmental services through the Atmospheric Research and Environment Program (AREP), which has four main components:

- 1) The World Weather Research Programme (WWRP) and its THORPEX
- 2) The Tropical Meteorology Research Programme (TMRP)
- 3) The Global Atmosphere Watch (GAW)
- 4) The Physics of Clouds and Weather Modification Programme

AREP works closely with WCRP through its Commission for Atmospheric Systems (CAS), which has a joint Working Group on Numerical Experimentation (WGNE) to provide better coordination of model developments to meet the full range of weather prediction and climate research needs. Through WGNE the programme integrates advances in scientific understanding of physical chemical processes with parallel technological advancements, such as in computing, communications and observational technologies. The WGNE also ensures the full application of computer modeling and the automated collection and processing of global observations to meet weather forecasting and climate modeling needs.

CAS and IUGG have established a joint initiative on scientific assessment of the effect of air pollution aerosols on surface precipitation on local, regional and global scales. Research into tropical cyclone prediction with their frequency and intensity on inter-annual timescales and with the variability of monsoons and tropical droughts on regional and seasonal scales is a priority. AREP has also collaborated with WCRP for comprehensive field measurements through research programmes.

Operational Climate Forecasting and Analysis Systems

As part of the WWW Programme, WMO has established its Global Data Processing and Forecasting System (GDPFS), with the main purpose to prepare and make available to Members, in the most cost-effective way, meteorological analyses and forecast products.

Real time operations of GDPFS include, among others:

- Preparation of forecast products (fields of basic and derived atmospheric parameters) with up-to-global coverage for one to 10 days ahead;
- Preparation of specialized products such as limited area very fine-mesh short-, medium-, extended-, and long-range forecasts, tailored products for marine, aviation, environmental quality monitoring, and other purposes;
- Monitoring of observational data quality.
- Post-processing of NWP data generation of weather and climate forecasts directly from model output.

Non-real time functions involve:

- Preparation of special products for climate-related diagnosis (i.e. 10-day or 30-day means, summaries, frequencies and anomalies) on a global or regional scale;
- Long-term storage of GOS data and GDPFS products, as well as verification results for operational and research use;
- Maintenance of a continuously updated catalogue of data and products stored in the system.

The operational development and delivery of these products and services is organized as a three-level system of: World Meteorological Centres (WMCs), Regional Specialized Meteorological Centres (RSMCs) and National Meteorological Centres (NMCs). These Centres carry out GDPFS functions at the global, regional and national levels, respectively. The GDPFS operational framework and protocols underpin the development of the Regional Climate Centres and Regional Drought Monitoring Centres .

Data exchange and discovery

The WMO Information system (WIS) provides an integrated approach suitable for all WMO Programmes to meet the requirements for regular collection and automated dissemination of observed data and products, as well as data discovery, access and retrieval services for all weather, climate, water and related data produced by centres and Member countries in the framework of any WMO Programme.

WIS encompasses three types of centres. For regional and global connectivity, Global Information System Centres (GISCs) will collect and distribute the information meant for routine global dissemination, while serving as collection and distribution centres in their areas of responsibilities; they provide entry points, through unified portals and comprehensive metadata catalogues, for any request for data held within the WIS. Connected to the GISCs, the Data Collection or Production Centres (DCPCs) will be responsible for the collection or generation of sets of data, forecast products, processed or value-added information, and/or for providing archiving services. National Centres (NCs) will collect and distribute data on a national basis and will coordinate or authorize the use of the WIS by national users, normally under a policy established by the respective permanent representative with WMO.

Climate Assessment

The Intergovernmental Panel on Climate Change (IPCC) was established with the goals to:

- (1) Assess available scientific information on climate change
- (2) Assess the environmental and socio-economic impacts of climate change
- (3) Formulate response strategies

The IPCC First Assessment Report of August 1990, concluded that emissions of greenhouse gases (GHGs), resulting from human activities, were increasing the atmospheric concentrations of GHGs and that the increased concentrations would enhance the so-called greenhouse effect, leading to further warming of the earth's surface.

The IPCC in its Second Assessment Report in December 1995, released shortly before the second meeting of the Conference of the Parties to the Convention, held in Geneva, Switzerland in June 1996, concluded that “the balance of evidence suggests that there is a discernible human influence on global climate”. The assessment also proposed “no-regrets” options and other perceived cost-effective strategies for combating climate change.

The IPCC Third Assessment Report, in 2001, concluded that “there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities” and confirmed previous findings about the trend and magnitude of recent climate change and the projections of global warming due to human influences.

The IPCC Fourth Assessment Report 2007, concludes that, “warming of the climate system is unequivocal”, and “most of the global average warming over the past 50 years is very likely due to anthropogenic greenhouse gases increases”. It emphasizes that the vulnerable regions face multiple stresses that affect their exposure and sensitivity to various impacts as well as their capacity to adapt and that the non-climate stresses can increase vulnerability to climate change by reducing resilience and can also reduce adaptive capacity because of resource deployment towards competing needs.

The successive assessment reports published by the IPCC since 1990 demonstrate the progress of scientific knowledge about climate change and its consequences. This progress has been made possible by the combined strength of growing evidence of the observations of changes in climate, dedicated work from the scientific community in developing and using advanced modeling techniques to attribute the past changes and project the future changes in the climate system including the associated impacts, and improved efforts in communication of science.

Sectoral Applications

Effective utilisation of climate information in sector-specific climate risk management on both policy and business decision-making fronts remain underdeveloped. Beyond the Climate Agenda, WMO has continued its sector-specific applications programmes and capacity building and educational activities, to enhance utilisation of climate information for sector-specific decisions. However, the effectiveness of these initiatives may have been limited by lack of clear priorities and inconsistency in the sector-specific activities.

Agriculture - NMHSs provide meteorological and hydrological data and other information products to support decision-making across the agricultural sector. Timely provision of relevant agro-meteorological information in a user-friendly format is recognized as an essential component of agro-meteorological services. Through Agricultural Meteorology Programme (AgMP), WMO assists NMHSs in the provision of meteorological and related services to the agricultural community.

The Agricultural Meteorology Programme has also been focusing on the impacts of extreme meteorological events on agriculture, horticulture, herding, forestry and fisheries, and how to cope with them. The provision of early warning services by NMHSs protects operational systems and has substantial economic benefit.

In cooperation with other UN agencies, particularly the FAO and UNESCO, the AgMP has supported multidisciplinary studies to better understand the links between climate variability and land productivity, including management practices that lead to degradation. AgMP addresses the special data needs, analysis tools and delivery mechanisms to ensure that services make the best use of available infrastructure technology. In the development of applications, particular emphasis is given to a multidisciplinary “end-to-end” framework that allows incorporation of input from the farm community to the research programmes. In this context, cooperation between the experts of the national Agricultural Ministries and NMHSs is very important.

Water Resource Management - While mitigation to climate change is achieved primarily through policy changes in the energy sector, adaptation to climate change would have to be accomplished to a large extent through the water sector. The impacts of climate change on freshwater resources in many regions are likely to make the Millennium Development Goals even more difficult to attain as the effectiveness of actions taken may be reduced by the effects of more frequent flooding, drought and severe storms expected to be exacerbated by climate change.

Effective water resource development requires the availability of hydrological information to provide up-to-date, accurate and exhaustive information on the water resources situation. Hydrology and Water Resources Programme (HWRP) through the World Hydrological Cycle Observation System (WHYCOS) program is supporting the NMHSs in strengthening the hydrological networks and establishing water resources information systems. In order to establish appropriate methods aimed at meeting demands, including improving the effectiveness of irrigation, recycling and re-use, desalination, etc., suitable technologies and practical tools and solutions are made available to water resource managers based on the climate information.

Disaster Risk Reduction (DRR) – Every year, disasters related to meteorological, hydrological and climate hazards cause significant loss of life, and set back economic and social development by years, if not decades. In light of the increasing risks associated with these hazards, linked to climate variability and change, there is need for strengthening preventive and mitigative approaches to disaster risk management.

Disaster risk management can be framed under three main areas: Risk Identification, Risk Reduction and Risk Transfer. These should be supported by effective governance (e.g. legislation, policies, planning, legal frameworks, etc), as well as, institutional capacities at national to local levels, supplemented by effective information and knowledge sharing mechanisms among different stakeholders.

With a deep commitment to savings of lives and livelihoods, WMO established its DRR Programme (in 2003) to strengthen contributions of NMHSs for disaster risk reduction. Through this crosscutting Programme, WMO is leveraging capacities and projects from its operational and research networks, together with those from partner agencies, to develop capacities at national, regional and international levels for disaster risk management, with strong focus on prevention and preparedness. Specifically, WMO strategic priorities in disaster risk reduction is underpinned by key activities of the Hyogo Framework for Action (HFA) falling under the mandates of the NMHSs. Through a coordinated mechanism involving strong partnership with users and stakeholders in disaster risk management at international, regional and national levels, DRR Programme is addressing:

- Development, improvement and sustainability of early warning systems, for weather-, water-, climate-related hazards;

- Development, improvement and sustainability of systems, methods, for recording, analyzing and providing hazard information for risk assessment, sectoral planning and other informed decision-making;
- Development and delivery of warnings, specialized forecasts and other products driven by requirements of disaster risk reduction decision processes and operations;
- Strengthening of capacities for better integration of NMHSs' products and services in disaster risk reduction, and continued public education and outreach campaigns;
- Strengthening of WMO and NMHSs cooperation and partnerships for implementation of disaster risk reduction in national, regional and international mechanisms and structures.

WMO's strategic goals in disaster risk reduction are being realized through an action plan, built upon the following five major thrusts:

1. Modernize NMHSs and observing networks
2. Implement national operational multi-hazard early warning systems
3. Strengthen hazard analysis and hydrometeorological risk assessment tools
4. Strengthen NMHSs cooperation with civil protection and disaster risk management agencies; and
5. Coordinate training and public outreach programmes.

Other Climate Sensitive Sectors

WMO has pursued application of climate information in several other core socio-economic sectors such as health, energy, tourism and urban and building climatology, through joint activities with the related UN agencies (WHO, UNEP, UN World Tourism Organization (UNWTO)) and professional bodies such as International Society for Biometeorology, International Association for Urban Climate (IAUC), etc. These activities, carried out as part of WCASP, helped in building partnerships at global, regional and national levels, which is crucial to facilitate effective utilization of climate information in these sectors. Joint workshops and technical guidance documents in collaboration with the relevant agencies have helped in identifying the sector-specific needs of climate information, and also enhance user awareness.

The Climate Information and Prediction Services (CLIPS) project was established in 1995 by the Twelfth World Meteorological Congress as an implementing arm of WCASP. The principal objective of CLIPS is to develop the capacity of NMHSs to take advantage of advances in the science of climate and in the processing and dissemination of climate information, and to pass along the benefits of the improved climate services to the user community. CLIPS provides an essential link between climate prediction/ information and their applications – bridging the gaps between the science and the applications to promote development activities in a manner beneficial to both producers and users of climate information and prediction products. The ultimate goal of CLIPS is to develop climate services in all WMO Member countries on timescales up to a few seasons, extending to interannual scales. The climate services not only deliver climate information from analysis of past climatological records, but also incorporate routine climate monitoring and prediction of likely conditions in the future and the applications of this information to various socio-economic sectors.

ABBREVIATIONS AND ACRONYMS

ACMAD	African Centre of Meteorological Application for Development
AeMP	Aeronautical Meteorology Programme
AgMP	Agricultural Meteorology Programme
AR 4	IPCC 4 th Assessment Report
ASEAN	Association of Southeast Asian Nations
AU	African Union
CDMS	Climate Database Management System
CEB	United Nations Chief Executive Board for Coordination
CIDA	Canadian International Development Agency
CIIFEN	Centro Internacional de Investigaciones Para el Fenomeno el Nino
CLIPS	Climate Information and Prediction Services
CLIVAR	Climate variability and predictability (a WCRP programme)
CLW	Climate and Water (Department)
CAeM	Commission for Aeronautical Meteorology
CAGM	Commission for Agricultural Meteorology
CBS	Commission for Basic Systems
CCI	Commission for Climatology
CHy	Commission for Hydrology
CMIP	Coupled Model Intercomparison Project
COF	Climate Outlook Forum
COP	Conference of the Parties
DFID	(UK) Department for International Development
DPFS	Data Processing and Forecasting System
DRA	Development and Regional Activities (Department)
DRR	Disaster Risk Reduction
DRRP	Disaster Risk Reduction Programme
EC	Executive Council
ECV	Essential Climate Variable
EC WG CWE	EC Working Group on Climate and related Water and Environmental matters
ESSP	Earth System Science Partnership
FAO	Food and Agriculture Organization
GAW	Global Atmosphere Watch
GEOSS	Global Earth Observing System of Systems
GIS	Geographic Information System
GCM	Global Climate Model
GCOS	Global Climate Observing System
GEF	Global Environmental Facility
GOOS	Global Ocean Observing System
GPC	Global Producing Centre of Long-range Forecasts
GPCC	Global Precipitation Climatology Centre
GRDC	Global Runoff Data Centre
GTOS	Global Terrestrial Observing System
HWRP	Hydrology and Water Resources Programme
ICAO	International Civil Aviation Organization
ICID	International Centre for Infectious Diseases
ICPAC	IGAD Climate Prediction and Applications Centre
ICSU	International Council for Science
IFRC	International Federation of Red Cross and Red Crescent Societies
IGAD	InterGovernmental Authority on Development
IGBP	International Geosphere-Biosphere Programme
IGFA	International Group of Research Funding Agencies
IHDP	International Human Dimensions Programme on Global Environmental Change
IOC	Intergovernmental Oceanographic Commission
IPCC	Intergovernmental Panel on Climate Change
IRI	International Research Institute for Climate and Society

ISDR	International Strategy for Disaster Reduction (UN)
IUCN	International Union for Conservation of Nature
JCOMM	Joint WMO-IOC Technical Commission on Oceanography and Marine Meteorology
LC	Lead Centre
LDC	Least Developed Country
LRF	Long-range Forecasting
MDG	Millennium Development Goal
NASA	National Aeronautics and Space Administration
NCI	Network for Climate Information
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration
NWP	Nairobi Work Programme
NMHS	National Meteorological and Hydrological Service
NGO	Non-Governmental Organization
NSIDC	National Snow and Ice Data Center
RCC	Regional Climate Centre
RCM	Regional Climate Model
RCOF	Regional Climate Outlook Forum
SADC	Southern African Development Community
SVSLRF	Standardized Verification System for Long-range Forecasts
UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UN-Energy	UN interagency mechanism on energy
UNEP	United Nations Environment Programme
UN-Water	UN interagency mechanism on water
UN WTO	UN World Tourism Organization
WB	World Bank
WCASP	World Climate Applications and Services Programme
WCC	World Climate Conference
WCDMP	World Climate Data and Monitoring Programme
WCIRP	World Climate Impact Assessment and Response Strategies Programme
WCP	World Climate Programme
WCRP	World Climate Research Program
WDC	World Data Centre (ICSU) (WDCs for Meteorology are: Asheville, NC, USA, Beijing, China, and Obninsk, Russian Federation)
WDCA	World Data Centre for Aerosols
WDCGG	World Data Centre for Greenhouse Gases
WDCPC	World Data Centre for Precipitation Chemistry
WDCSO	World Data Centre for Surface Ozone
WHO	World Health Organization
WIGOS	WMO Integrated Global Observation System
WIS	WMO Information System
WISCCA	WMO Initiative to Support Climate Change Adaptation
WMO	World Meteorological Organization
WOUDC	World Ozone and UV Data Centre
WRDC	World Radiation Data Centre
WWF	Worldwide Fund for Nature
WWRP	World Weather Research Programme
WWW	World Weather Watch