WORLD CLIMATE PROGRAMME

WORLD CLIMATE APPLICATIONS AND SERVICES PROGRAMME

REPORT OF THE CCI/CBS INTERCOMMISSION TECHNICAL MEETING ON DESIGNATION OF REGIONAL CLIMATE CENTRES

(Geneva, Switzerland, 21 – 22 January 2008)

WCASP - No. 77

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The **World Climate Programme (WCP)** implemented by WMO in conjunction with other international organizations consists of the following major components:

- World Climate Data and Monitoring Programme (WCDMP)
- World Climate Applications and Services Programme (WCASP)
- World Climate Impact Assessment and Response Strategies Programme (WCIRP)
- Coordination activities within the Climate Agenda (CCA)
- World Climate Research Programme (WCRP)
- Intergovernmental Panel on Climate Change (IPCC)
- Global Climate Observing System (GCOS)

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NOTE

TABLE OF CONTENTS

ANNEXES:

1. Opening of the Meeting

1.1 A CCl-CBS Intercommission Technical Meeting on Designation of Regional Climate Centres (RCCs) was held in Geneva, Switzerland, at WMO headquarters, on 21-22 January 2008. Mr Avinash Tyagi, Director of the WMO Climate and Water Department, welcomed participants to the session on behalf of the Secretary-General. In his opening remarks, Mr Tyagi noted that this meeting represented a key step forward in WMO's plan to establish a global network of Regional Climate Centres, and that RCCs would have a key role in future in assisting WMO Members in their work – both for the day-to-day climate needs in each region, and for adaptation to climate variability and change. He emphasized that many sectors, including water resources, had many uncertainties related to climate variability and change, and that there was an urgent need for WMO, through RCCs, to provide thorough and reliable information and products for effective decision-making. Mr Tyagi further noted the new Secretariat structure, bringing climate and water together into one Department, and expressed his hope for increased synergy between these sectors.

1.2 Mr Pierre Bessemoulin, president of the Commission for Climatology and chairman of the meeting, welcomed participants, and noted that although the meeting included representatives from CCl and CBS, other relevant Technical Commissions should be informed of the results of this session. He noted that key issues for the work ahead included RCC sustainability (the mandatory functions must be achievable in all regions with a need for RCC functions), and flexibility (the RCC structures and requirements must be designed to meet the different capabilities and needs in each region).

2. Organization of the Meeting

2.1 Participants briefly introduced themselves and identified their interests and background in assisting WMO in development of the RCC concept. It was noted that, due to a scheduling conflict, Dr Richard Graham could not participate in person, but that he had provided detailed written input for discussion. The List of Participants is attached as **ANNEX 2**.

2.2 The agenda was adopted with minor amendments, with the proviso that the order of discussions could vary to accommodate individual schedules. The final agenda for the session is attached as **ANNEX 1**.

2.3 Participants were informed that there would be a reception at 18:00 in the Attic. Working arrangements were agreed, noting that coffee breaks would be hosted in the cafeteria.

3. Review of the Background on WMO RCC Designation

3.1 The Secretariat reviewed the background to WMO's efforts regarding Regional Climate Centres (RCCs) and noted that WMO has formally sought to define and establish RCCs since the thirteenth World Meteorological Congress (Cg-XIII, May 1999). During Cg-XIII, Members were urged to define the requirements for, and objectives and responsibilities of regional and global centres to support operational national climate services; to define the use of existing regional structures and institutions; and to involve regional associations and other partners in the development of the concept of Regional Climate Centres (RCCs). An Inter-Commission Task Team on Regional Climate Centres (ICTT-RCC) was set up (Res. 2/EC-LII, 2000) with members from the Technical Commissions for Climatology (CCl), Agricultural Meteorology (CAgM) and Basic Systems (CBS) and several other members including regional

representatives. The second iteration of the ICTT included representatives as well from the Commission for Atmospheric Sciences (CAS) and the Commission for Hydrology (CHy). The results of their efforts were documented in WCASP No. 52, May 2001, and WCASP No. 54, March 2002 and presented at WMO EC sessions and at the Fourteenth World Meteorological Congress in May 2003. These sessions noted that RCC responsibilities should not duplicate or replace those of NMHSs; that establishment of RCCs should follow the steps set up for designation of Regional Specialized Meteorological Centres (RSMCs); and that the procedures for designation of RCCs needed to be defined. The range of Regional Climate Centre Functions developed by the ICTT-RCC was published in WCASP No. 52.

3.2 A meeting on the organization and implementation of RCCs (Geneva, 27-28 November 2003), developed Guidelines for the Establishment of RCCs. These Guidelines (WCASP No.62) covered, amongst other things, determination of requirements for an RCC; possible structures, the designation procedure as per the CBS Manual on the Global Data Processing and Forecasting System (Vol 1, global aspects), and establishment of centres by regional associations without formal WMO designation. The Guidance recognized that the requirements of NMHSs for RCC functions may vary from region to region, and that RCC functions for a region may be undertaken within a single centre, or may be distributed amongst various centres, or nodes, in a Regional Climate Centre Network.

3.3 Subsequent to the 2003 meeting on organization and implementation of RCCs, most regions have considered implementation of RCC(s) or an RCC network. At the fifteenth World Meteorological Congress in May 2007 (Cg-XV), RA II indicated that the Beijing Climate Centre (BCC) and Tokyo Climate Centre (TCC) would be recommended as components of the RA II network of RCCs, each of these centres being a multi-functional centre fulfilling a wide range of tasks in all 5 areas of RCC potential functions. In late 2007, the Russian Federation established a North-Eurasian Regional Climate Centre (NEA-RCC). In August 2007, the RA VI Working Group on Climate-related matters sought applications from members for establishment of a 4-node RA VI RCC Network, to cover areas of activity specialization for Long-range Forecasting; Climate Monitoring; Climate Data; and Climate Applications. RA V, at its fourteenth session (Adelaide, Australia, May 2006) noted its intentions to continue to fulfil its requirements for regional climate activity in a distributed system with 4 nodes (Melbourne, Australia; Auckland, New Zealand; Singapore (ASEAN); and Hawaii, USA). In 2004, RA IV developed and considered a virtual RCC model that would strengthen the capacities of institutions already serving the region, with services including training, data services, coordination of climate services, etc. No official request for establishment of an RA IV RCC has yet been made to WMO. The Working Groups on Climate-related Matters of RAs I and III have discussed RCC implementation, but have not yet issued surveys to gauge regional interest in needs for, or offers to host, RCC functions.

3.4 Cg-XV (May 2007) approved the establishment of nine Global Producing Centres (GPCs) along with the definitions of GPCs, description of their roles and a minimum set of products, for amendment to the Manual on the Global Data-Processing and Forecasting System (GDPFS) (Vol I). Cg-XV requested that the global LRF products be made available to as many RCCs and NMCs as possible for purpose of enabling them to perform their tasks, and further requested that CBS and CCl collaborate to develop the minimum set of functions and services required of RCCs, in order to support their official designation and inclusion in the Manual on the GDPFS (Vol I). Cg-XV noted that ongoing coordination would be required to ensure that operational products from the GPCs meet the requirements for seasonal forecasting services provided by RCCs and NMHSs, and that RCCs would need assistance for training users, and requested that

GPCs identify and provide suitable experts for interpretation and use of GPC LRF products, verification techniques (e.g. local verification of RCC-generated products) and applications.

3.5 Given the anticipated improvements in skill of LRF by using a multi-model ensembles (MME) approach, Congress XV agreed that some GPCs of LRF could serve as collectors of global LRF data to build MMEs, and requested standards for MME products be developed. Congress noted that ECMWF was already disseminating MME products based on Met Office, Météo-France and ECMWF LRF model output (EURO SIP) and that GPC Seoul and GPC Washington have agreed to explore the use of MME for LRF with a view to implement a joint Lead Centre for LRF MME.

3.6 The Commission for Climatology Implementation Coordination Team (CCl ICT) which met 9-11 October 2007 in Geneva, Switzerland, with representation from the six regional Working Groups on climate-related matters and of the WMO World Weather Watch and the CBS, agreed on definitions of RCCs and RCC-Networks, and also agreed that the terms RCC and RCC-network would be exclusively used for centres designated by WMO under the Manual on the Global Data Processing and Forecasting System (Volume 1, global aspects) (the 'GDPFS Manual'). Roles and responsibilities of RCCs and RCC-Networks were identified in two categories: mandatory functions that would be common to all designated RCCs or RCC-Networks, and highly desirable functions. It was decided that RCCs and RCC-Networks will be considered, in the GDPFS manual, as a type of Regional Specialized Meteorological Centre (RSMC), and will be 'centres in a cooperative effort', a concept already defined in the GDPFS manual. These decisions underpin the concept that RCCs and RCC-Networks will be centres of excellence, with uniformity of service around the globe in their mandatory functions. The CCl ICT established a technical expert group, with CCl and CBS representation, to address and resolve remaining issues, and to develop the amendments required for the GDPFS manual to support formal WMO designation of RCCs or RCC-Networks, and established a workplan for this activity. This present session is the result of those decisions.

3.7 In discussion it was noted that user requirements are prone to frequent changes, so these should not be specified in the manual on the GDPFS. It was also noted that a standardized verification system (SVS) for long-range forecast (LRF) was already part of the GDPFS Manual (December 2007 version, attachment II.8, including the role of the SVSLRF Lead Centre). It was agreed that performance should be monitored and evaluated accordingly, and that regular assessments of the users of the products should be made. This will be conducted as part of performance measurement and evaluation of the diverse aspects of the overall WMO Operating Plan. Because tools and methods for socio-economic evaluation of products and services are in development stage, it was agreed that reference to socio-economic value of RCCs would be made only under Research and Development, in 'Highly recommended' RCC functions.

3.8 References to the evolution of the RCC concept include:

- Abridged Final Report with Resolutions of the Thirteenth World Meteorological Congress (WMO-No. 902, section 3.2.5…(May 1999)
- General Summary of the session of the Inter-Commission Task Team on Regional Climate Centres (WMO-TD No. 1070, WCASP-No. 52) (May 2001)
- Report of the Second Session of the Inter-Commission Task Team on Regional Climate Centres (WMO-TD No. 1107, WCASP No. 54)(March 2002)

- Abridged Final Report with Resolutions of the Fourteenth World Meteorological Congress (WMO-No. 960, sections 3.1.3, 3.2.0, 3.2.5 and Resolution 11(Cg-XIV) (May 2003)
- Proceedings of the Meeting on Organization and Implementation of Regional Climate Centres (WMO-TD No. 1198, WCASP – No. 62) (November 2003)
- Proceedings of the Meeting of the RA-II Working Group on Climate-Related Matters including CLIPS (WMO-TD No. 1261) (October 2004)
- Review of Activities to Implement a Regional Climate Centre (RCC) for Regional Association IV (RA IV), during the RA IV Hurricane Committee meeting, Miami, USA, 1 May 2004
- Report of the meeting of the WMO RA V Working Group on Climate Matters (February 2006)
- Final Report of the Joint Expert Teams on Long-Range Forecasting (infrastructure and Verification), CBS OPAG on Data Processing and Forecasting Systems (April 2006)
- Report of the RA III Working Group on Climate Matters, (Montevideo, Uruguay, 15-17 May 2006)
- Report of the Working Group on Climate-Related Matters of RA VI (October 2006)
- Report of the RA I Working Group on Climate Matters (WMO-TD No. 1351, WCDMP NO. 59) (October 2006)
- Abridged Final Report of CBS-Ext.(06), Seoul, November 2006
- Report of the Meeting of the Working Group on Climate-Related Matters for Regional Association II (WMO-TD No. 1382) (April 2007)
- Report of the RA VI training seminar on capacity building in climate related matters (WMO-TD No. 1386, WCDMP No. 63) (May 2007)
- Abridged Final Report with Resolutions of the Fifteenth World Meteorological Congress (WMO-No. 1026, (May 2007)
- Report of WMO/KMA Workshop of global producing centres on lead centre for long-range forecast multi-model ensemble prediction; Busan, Republic of Korea, (September 2007) (*http://www.wmo.ch/pages/prog/www/CBS-Reports/DPFS-index.html*
- Report of the CCl Implementation Coordination Team first session (9-11 October 2007)
- Manual on the Global Data -Processing and Forecasting System (GDPFS), Vol. 1 (global aspects), November 2007 revision (WMO – No. 485).

4. WMO Information System (WIS) and Relevance to RCCs

4.1 Mr David Thomas provided an overview of the WMO Information System (WIS), including information on designation of Data Collection or Production Centres **(**DCPCs), noting that in the WIS concept, RCCs would act as data centres for climate activities within each WMO region, and that RCCs would therefore be considered as DCPCs under WIS. The full background is attached as **ANNEX 3**. In his presentation, Mr Thomas noted that DCPCs would:

- Collect information intended for dissemination to National Centres (NCs) within their area of responsibility (i.e. regional collections);
- Collect special programme-related data and products;
- Produce regional or specialized data and products;
- Provide information intended for global exchange to their responsible GISC;
- Disseminate information not intended for global exchange;

- Support access to their products via WMO request/reply ("Pull") mechanisms in an appropriate manner;
- Describe their products according to an agreed WMO standard and provide access to this catalogue of products and provide this information as appropriate to other centres, in particular a GISC;
- Ensure that they have procedures and arrangements in place to provide swift recovery or backup of their essential services in the event of an outage (due to, for example, fire or a natural disaster);
- Participate in monitoring the performance of the system.

4.2 WIS recommendations for RCC designation included that:

- CCl and CBS follow WIS procedures for designation of DCPCs, as identified in Annex III of the final report of CBS-Ext(06)-7.8 and as endorsed, in principle, by Cg-XV;
- RCCs ensure they are able to meet the relevant interface compliance specifications of a DCPC as laid out in the WIS Compliance specifications of GISC, DCPC and NC, noting that WIS Compliance specifications of GISC, DCPC and NC are available on the WIS reference page (see http://www.wmo.ch/pages/prog/www/WIS-Web/Centres.html);
- RCCs understand the role of DAR metadata; assist in ensuring their contributors and data services create accurate and useful DAR metadata entries; and encourage their users to provide feedback and participate in the continuous improvement of metadata;
- RCCs register both electronically available holdings, and non electronic products or services in RCC catalogues for WIS (in particular, it was proposed that data identified under CCl data rescue projects could be registered here and electronic links added once the data was digitised and available for access);
- Call on WIS & WIGOS project offices for support.

4.3 In discussion, it was noted that WIS is being designed to respect WMO's data policies, and that readers will know what information is available, but WIS will not give access to that information. The custodians of the data will retain full command over access, and their data security. It was further noted that, while it is not yet possible to identify exactly what an RCC or RCC-Network node will have to do to become recognized as a WIS DCPC (this is a work in progress), all candidate RCCs and RCC-networks must be aware that WIS compliance will eventually be required. It was agreed that working towards WIS compliance and DCPC designation would be listed as a 'highly recommended' function for RCCs and RCC-Networks in the category of 'non-operational data services'.

5. CBS Manual on the Global Data-Processing and Forecasting System, Volume 1, Global Aspects

5.1 Purpose and structure

5.1.1 The Manual on the Global Data-Processing and Forecasting System is designed: to facilitate cooperation in data-processing and forecasting among Members; to specify obligations of Members in the implementation of the World Weather Watch (WWW) Global Data-Processing and Forecasting System (GDPFS); and to ensure adequate uniformity and standardization in the practices and procedures employed in achieving these goals. The Manual consists of Volumes I and II, which deal with global and regional aspects, respectively. Volume I of the

Manual (global aspects) consists of Part I (Organization and functions of the GDPFS), Part II (Data-processing and forecasting aspects) and Part III (Data management aspects), which contain regulatory material for the global aspects of the WWW Global Data-processing and Forecasting System. The regulatory material stems from recommendations of the Commission for Basic Systems (CBS) as well as from decisions taken by Congress and the Executive Council.

5.1.2 The Volume I of the Manual on the GDPFS – Global Aspects (WMO – No. 485) forms part of the WMO Technical Regulations and is referred to as Annex IV to the Technical Regulations. It is part of the Rules and Regulations to which the WMO Members have to abide, particularly when they are requesting special recognition due to their performed functions to the larger benefit of WMO. In that context the rules, regulations and list of functions expressed in the Manual are written in a specific, concise, accurate and clear manner so that the all Members understand how a designated centre has confirmed its commitment of functions and services (e,g, operational products). Regulatory texts to be incorporated into the Manual should, as much as possible, stand the test of time, with little or no future modification anticipated. This is to avoid confusion in the Members' understanding of the commitments.

5.2 Process for updating and maintenance of the manual

The WMO Secretariat DPFS Division is responsible for the process of maintenance of the manual. Proposals requiring amendments and updates can come from countries or regions or from technical bodies of the CBS such as the Expert Team on LRF or the CBS ICT on DPFS. When an amendment is proposed, the Secretariat ensures it is discussed by an appropriate CBS body. This body submits the proposal to CBS for decision. A decision in favour of the amendment is then submitted to WMO Executive Council for approval, after which the amendment is incorporated into the Manual and the revised version is shared with members.

5.3 Recent modifications of the GDPFS Manual on Global Producing Centres

As noted in paragraph 3.4 above, Cg-XV (May 2007) approved the establishment of nine Global Producing Centres (GPCs) along with the definitions of GPCs, description of their roles and a minimum set of products, for amendment to the Manual on the Global Data-Processing and Forecasting System (GDPFS) (Vol I). Subsequently, WMO-No. 485 was updated as of November 2007, to include this information, and the identification of the nine newly designated GPCs.

5.4 Existing CBS designation process (e.g. for RSMCs)

The process for designation of new RSMCs by CBS is described in Appendix I-2 of the manual on the GDPFS. Basically, it is required to produce a statement of requirements, identify capabilities of the proposed centre, state the formal commitment to host the centre, demonstrate capability to CBS, and finally, acceptance (approval) by WMO Congress or Executive Council (see **ANNEX 4** for full text).

5.5 Mechanism to amend the Manual for designation of RCCs

As agreed by CCl and CBS at the meeting of the CCl ICT in October 2007, the WMO Division on DPFS will work with the Secretariat Divisions responsible to the CCl and with experts from CBS and the CCl to finalize the CCl submission to CBS, for amendments to the Manual on the GDPFS (Vol. 1, global aspects) for designation of RCCs. Following a coordinated

effort of these groups including several CCl and CBS meetings, the president of the CCl will send the proposed amendment to the president of CBS for consideration at the next session of the CBS (fall 2008). There should be implicit agreement between CCl and CBS on the content of the amendment before this stage. The final version will be submitted for consideration of CBS at its next session (2008), and if approved, CBS will submit the amendment to EC-LXI (2009) for its approval for implementation.

6. Working Session

The meeting reviewed the Table of Contents of the latest version of the manual, and the draft amendments proposed by the WMO Division on DPFS. These had been based on the principle of least interference to the manual, and on the decisions of the CCl ICT in October 2007. The final set of amendments, as agreed by all participants, is attached as **ANNEX 5**.

7. Summary of Progress and Next Steps

7.1 Participants were satisfied that they had achieved the goals for the meeting, and had developed a workable, comprehensive draft amendment to the Manual on the GDPFS. This amendment contains changes to Parts I and II for designation of RCCs, and also includes several changes related to GPCs, that must be made for consistency with the new text for RCCs.

7.2 Following finalization of the report for the session, implying agreement by both CCl and CBS representatives on the content, style and format of the amendment, the proposed amendment will be submitted to the CBS Expert Team on LRF and then the CBS ICT on the Data Processing and Forecasting System. Any suggested CBS modifications will be reviewed and undertaken by the Intercommission expert group, and approved by the CCl Management Group. The president of the CCl will submit the proposed amendment to the upcoming session of CBS (November 2008) for endorsement. CBS will submit the proposed amendment to WMO Executive Council in 2009 (EC-LXI) for approval. CCl and CBS recognise the importance of adherence to the timeframe identified by the CCl ICT, in order to support the wishes of the Members to have the first RCCs designated at EC-LXI in 2009.

8. Other Business

8.1 Guidelines on Implementation of RCCs - Participants noted that the Guidelines on Implementation of RCCs developed in 2003 had been helpful, but that recent decisions by the CCl ICT (October 2007) and this CCl/CBS Technical meeting on designation of RCCs (January 2008) made the Guidelines outdated in some aspects. The meeting therefore recommended that WMO update the Guidelines to reflect the latest agreements, and to include two templates in the Guidelines:

- for application by a WMO Member to the president of a Regional Association for consideration to enter a pilot phase for becoming an RCC.
- for the president of a Regional Association to nominate a centre for WMO designation as an RCC.

8.2 Steps for designation of a WMO RCC or RCC-Network - The meeting also recommended the following steps for designation (for the revised Guidelines), when a Member or organization wishes to become a WMO RCC or to join a WMO RCC-Network:

1) The Member or organization contacts the president of the Regional Association (P/RA), noting that a non-NMHS must do this through, or with the endorsement of, a WMO member, expressing intent.

2) P/RA, perhaps in consultation with the Working Group on Climate-related Matters (WGCRM) for the region and with the CCl, considers the criteria for designation (as per the manual on the GDPFS, Vol 1, global aspects) and the pilot or existing RCCs or RCC-Network(s) in the region against regional requirements, and may agree to support the proposal. If needed, the P/RA will provide information on regional needs and WMO designation criteria.

3) The candidate RCC or RCC node will work with (or maintain contact with) the regional WGCRM if it exists, the CCl, with other experts nominated by the President of the Regional Association, and with other existing RCCs or RCC-networks in the region during its preparations for designation.

4) When the candidate, its peer RCCs and RCC-Ns, the WGCRM and/or other experts, other members in the RA (and possibly the existing GPCs) are satisfied that the candidate is ready and able to fulfil the requirements, P/RA will contact P/CCl and will provide information on the process followed, and an assessment of the capability to meet requirements.

5) If P/CCl agrees that all appropriate steps have been followed, and that the candidate meets the WMO and regional requirements, P/RA will contact WMO SG to request formal designation for the candidate.

6) WMO SG will forward the request to CBS for action (to inform the CBS ET on ELRF and the CBS OPAG on DPFS, to submit the proposal to CBS and to arrange for demonstration/presentation at the next session of the CBS; cc CCl for information.

7) CBS ET on ELRF and the OPAG on DPFS will review the submission and will take up any concerns with the RA. The proposal may be resubmitted with all required clarifications.

8) When appropriate, the proposal will be tabled by the Member(s) in question (in the form of an amendment to the Manual) at a session of CBS for decision.

9) With CBS approval, the amendment to the Manual will be sent to Congress or to Executive Council for approval.

10) With this WMO approval, the manual will be revised and the Regional Association and the candidate will be advised in writing.

9. Closure of the Meeting

The Chairman, Mr Bessemoulin, thanked all participants and the Secretariat for their time and inputs, and for having worked late on the final day in order to complete the tasks. He noted that there may still be a need to discuss this further, by teleconference, to clear up any remaining uncertainties. The meeting closed at 8:00 p.m.

ANNEX 1

AGENDA

1. OPENING OF THE MEETING

2. ORGANIZATION OF THE MEETING
- i) Introduction of participants
- ii) Adoption of the agenda
- iii) Working arrangements for the session

3. REVIEW OF BACKGROUND ON WMO RCC DESIGNATION
- i) Previous intercommission and expert activities
- ii) Decisions of the CCl ICT, October 2007

4. WMO INFORMATION SYSTEM (WIS) AND RELEVANCE TO RCCs
- i) WIS overview: goals, milestones, benefits
- ii) Discussion on establishing WIS compliance in RCC activities

5. CBS MANUAL ON THE GLOBAL DATA PROCESSING AND FORECASTING SYSTEM, VOLUME 1, GLOBAL ASPECTS
- i) Purpose and structure
- ii) Process for updating and maintenance of the manual
- iii) Recent modifications of the GDPFS Manual on Global Producing Centres
- iv) Existing CBS designation process (e.g. for RSMCs)
- v) Mechanism to amend the Manual for designation of RCCs

6. WORKING SESSION

7. SUMMARY OF PROGRESS AND NEXT STEPS
- Discussion on developing the relationship between GPCs and RCCs, especially related to products and services made available to RCCs.

8. OTHER BUSINESS

9. CLOSURE OF THE MEETING

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ANNEX 2

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ANNEX 3

WMO INFORMATION SYSTEM

Regional Climate Centres & DCPCs

Introduction

The Commission for Climatology (CCl) is considering the designation of Regional Climate Centres (RCCs) to act as data centres for climate activities within each WMO Region. It has long been believed that such centres will be Data Collection or Production Centres (DCPCs) under WIS. This paper describes background and the implementation plan of WIS highlighting some issues for CCl to consider in its designation of RCCs.

Background

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

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

3) The World Meteorological Congress in 2003 (Cg XIV) formally adopted the concept of WIS, stating that an overarching approach was required for solving the data management problems for all WMO and related international programmes. The Report of Cg XIV states that WIS will:

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

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

5) Much like modern library systems, WIS is designed around catalogues that contain metadata describing the full set of data and products available across WMO. These catalogues, plus metadata describing dissemination options, will be hosted by up to ten WIS Global Information System Centres (GISCs). Collaboration across all GISCs will assure that each not only supports comprehensive search across catalogues, but each can disseminate WMO data and products intended for global exchange and hold them for at least 24 hours. An important WIS component, the Integrated Global Data Distribution System (IGDDS) focuses on the exchange and dissemination of data and products generated by space-based observing systems. Data and products will flow to a GISC from Data Collection or Production Centres (DCPCs) and from National Centres (NCs) within its area of responsibility. The relationship between these centres is shown in figure 1, The WIS Vision.

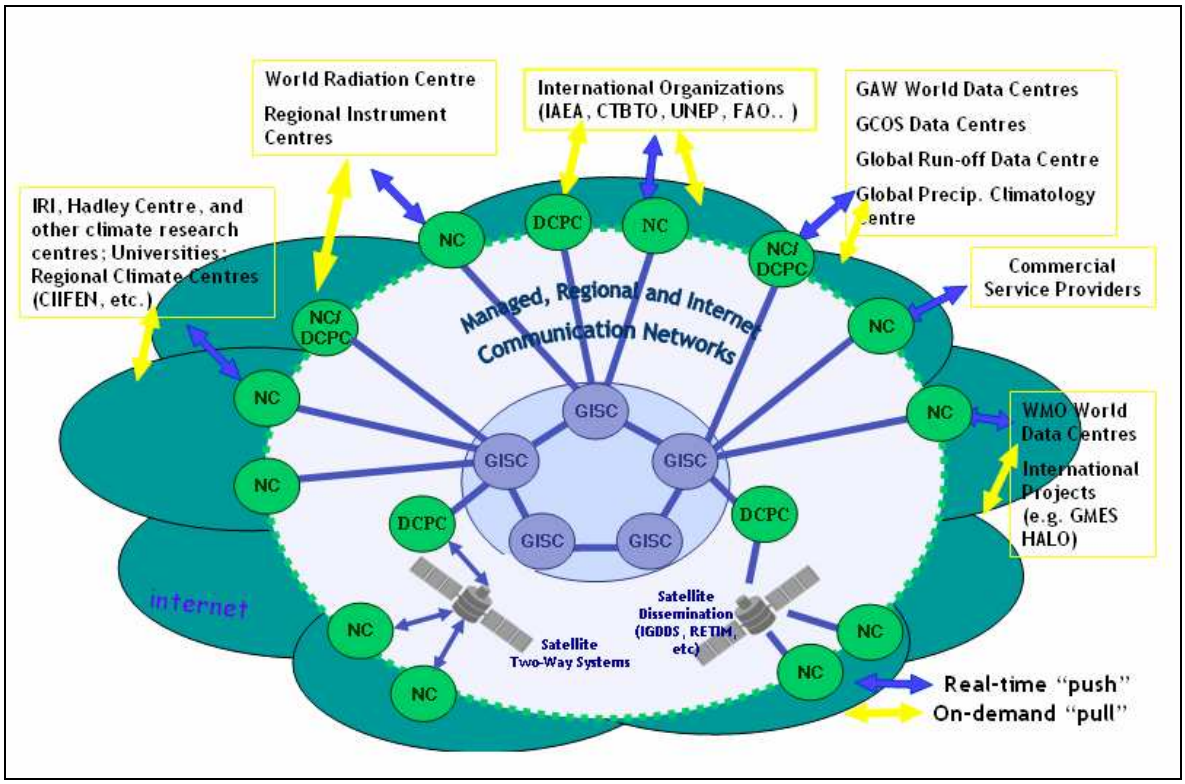

Figure 1 The WIS Vision

Implementation of WIS

6) As described in the WIS Project Plan, development of WIS depends on WMO Members and related organizations taking on the roles delineated for GISCs, DCPCs and NCs. There is clear consensus that the benefits of WIS will far outweigh the costs overall, but potential participants need to know exactly what is expected of each type of WIS Centre. Accordingly,

the WIS Project Plan is supplemented by two other documents: one describing User Requirements and one providing Compliance Specifications for a GISC, DCPC, or NC. These will form the basis for the required statement of compliance with the prescribed WIS functions, compiled and regularly reviewed by the Commission for Basic Systems, the Inter-Commission Coordination Group on WIS (ICG/WIS) and finally endorsed by the WMO Executive Council. These and other supporting documents are available from the WIS web page[1] under Reference Documents.

7) Cg XIV requested particular attention be given to the impact of WIS on Members' responsibilities and resources. Existing National Meteorological Centres, as defined in the Manual on GTS, are expected to become WIS NCs. The Report of Cg XIV asserted that introduction of WIS would not result in new responsibilities or additional resource requirements for most Members. Rather, the stated expectation is that WIS would result in lower costs, especially for the least developed Members, through expanded use of commercial off-the-shelf technology and increased use of the Internet. With regard to DCPCs, it was noted that Members operating a Regional Specialized Meteorological Centre (RSMC) or a Regional Telecommunication Hub (RTH) were likely to operate as a DCPC. In addition to handling time critical data for others, DCPCs have the responsibility of providing data and products through request/reply services especially via the Internet. The Report of Cg XIV also noted that various centres around the world provide through international agreements a variety of products for WMO Programmes, such as specialized data (e.g. buoys), hydrological products, and climatological products. Such centres could participate in WIS as a DCPC, or arrange for another DCPC to receive and disseminate its products. Either case does entail changes in practices and procedures, such as providing metadata associated with the products.

8) The Report of Cg XIV stated that no centre was currently providing all of the functions envisioned for a GISC, although the function somewhat corresponds to those RTHs associated with large numerical modelling centres as these already provide global products. In becoming a GISC, creation and maintenance of a data and product catalogue would be the most significant additional responsibility.

9) Considering Congress's requirements from a project management perspective, the WIS project can be viewed as having six main activities: 1) consolidation of WIS plans, 2) establishment of the WMO metadata standard, 3) development of WIS regulatory documents, 4) implementation of WIS Part A, 5) implementation of WIS Part B, and 6) coordination with other major projects. It should be noted that each of these activities will entail some amount of capacity building and training investments as well. These activities are shown in Figure 2 "WIS Milestone Activities" and described in the following paragraphs.

[1] WIS Home Page http://www.wmo.int/pages/prog/www/WIS-Web/home.html

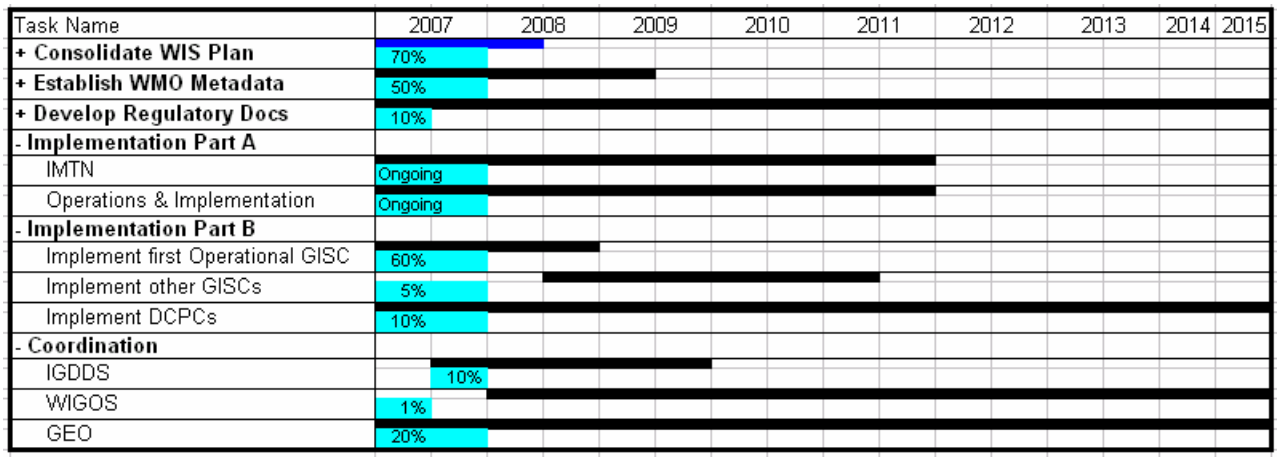

Figure 2 WIS Milestone Activities

10) The first activity, the WIS Project Plan, commenced in March 2007, was reviewed by ICG/WIS in September 2007 and the EC WG WIGOS-WIS in December 2007. The plan is to be finalised for CBS and the EC in 2008. The plan provides a project management framework and an implementation plan for WIS and is already being used to identify priority issues that need to be addressed if WIS is to be delivered in a timely manner. The latest version of the project plan is online at http://www.wmo.int/pages/prog/www/WIS-Web/RefDocuments.html

11) The second activity concerns the WMO metadata, a profile of the ISO 19115 standard. Version 1 has been approved, though it has yet to be documented in full and an appropriate metadata entry tool is under development. The need for metadata entry tools is included along with a capacity building requirement to ensure Members can benefit from the new facilities.

12) The third activity, development of WIS regulatory documents, will be closely aligned with WIGOS and will include revision of the Technical Regulations related to information management and associated manuals. Other deliverables will be the guidelines for metadata entry and management, and a guideline on WIS, which will lead to a Manual on WIS. Interim governance documents for designation of GISCs and DCPCs have been approved. This task extends out to beyond 2015 in order to accommodate the consultative processes necessary, especially as it is expected the Technical Regulation 49 will need to be extensively restructured to properly incorporate WIGOS. These timelines will be refined as WIGOS implementation plans are consolidated.

13) The fourth activity, implementation of WIS Part A, is being accomplished in the Improved Main Telecommunication Network project and in the improvement of regional GTS parts. A crucial requirement in managing Part A is that there will be no interruption to GTS functionality in exchanging time-critical and operational-critical information.

14) The fifth activity, implementation of WIS Part B, is to deliver the new functionality of WIS, including the creation and hosting of metadata catalogues and the use of the internet to facilitate authorized users to find and retrieve any information available within WIS. This process, referred to as Discovery, Access and Retrieval (DAR), is a key to opening access to all WMO Members to all WMO Programme's information.

15) The sixth activity is coordination with related major projects. Among the major concerns are assuring that: IGDDS is integrated as a core component of WIS; WIGOS interdependencies

with WIS are addressed; and WIS is viewed as an exemplar operational system in the context of GEOSS. The metadata catalogue, DAR and use of the internet will enable interoperability with external information systems.

16) At present, the WIS project is on track for success. However, the overall project is complex and may be perceived as a steep climb with regard to implementing information and communication technologies. It is critical that the evolution to WIS not be disruptive to the present systems as these already have the necessary qualities of high availability, robustness and performance. This is especially the case where WMO systems support high profile or life-critical activities such as the preparation and distribution of natural hazard warnings.

RCCs, WIGOS and WIS

17) WIGOS incorporates the collection of data needed for RCC activities and is dependant on WIS at many stages including the collection of data and dissemination of products. WIGOS and WIS also support real time activities which are playing an increasingly important role in climate services.

18) As well as being a mechanism for collecting and distributing data under WIGOS, WIS is also dependant on some key components of WIGOS. Volume A exemplifies this through providing a catalogue of observation stations that includes critical information such as location, elevation, observation program and so on essential for users of WIGOS data. By keeping such information in accessible catalogues, WIS can be far more efficient in collecting and distributing data by only sending those elements of the data that are regularly changing. This information can be recombined by users, or by the DAR services through which WIGOS data is made available.

19) Similarly, WIS is reliant on information suppliers to provide DAR metadata for their data and products. This metadata is necessary for aiding DAR and for informing WIS on how to handle information providers' messages and files. The metadata will tell WIS what the RCC files are and link them to the Volume A type catalogues. It will also link them to WIS distribution catalogues. To facilitate the linking of files to metadata and to avoid having to open each file or message to understand its content, WIS developers have recommended a file naming convention that ensures data and product families have unique file names. This filename convention is based on the present GTS message headers and has incorporated the needs of all WMO Programmes.

20) As with the GTS and the use of Table Driven Code Forms, all Programmes are encouraged to utilise WIS conventions to ensure they also benefit. However, the minimum requirement of WIS on RCCs is for RCCs to provide information as uniquely named files, and associated metadata files compliant with the WMO profile for ISO 19115 for those files. These files, as with changes to the present Volume A, should precede the message files, and only need to be sent when there is a change to the metadata. In order to facilitate implementation of WIS, Météo France has developed a system for creating these metadata files for information already circulating on the GTS as a part of the European VGISC project. Also EUMETSAT is investigating the adaptation of their file naming conventions to the recommended practices as a part of the IGDDS implementation plan. Similar pilot work would be necessary in other climate themes.

21) A common area of confusion with WIS is the use of the word metadata. For the sake of clarity in the technical specifications prepared for WIS, the metadata that is used to identify messages and files is referred to as DAR metadata. Metadata that describes the distribution

of information is referred to as dissemination metadata, and the metadata such as Volume A is referred to reference information. Of these three forms of metadata, it is only the DAR that needs to be compliant with the WMO profile of ISO19115.

22) Because of the reliance of WIS on DAR metadata, a part of RCC designation process should ensure that metadata will be generated by information systems and production centres using appropriate tools.

23) Another form of metadata which is especially important to users of WIGOS information will be the station history metadata. This is not a part of WIS, however, CBS Ext(06) has identified a desire to be able to access this information along with the data. In particular 6.2.56 states "Version 1.0 of the WMO Core Metadata Profile uses simple catalogues for its information: in addition to those required by the relevant ISO standard, a thesaurus for keywords, a list of the CCCC country codes and a gazetteer to allow the translation of station names, station identifiers and station numbers into their geographical positions. The Commission invited the OPAG-ISS, in consultation with the OPAG-IOS, to further develop with a high priority methods of representing comprehensive information related to observing stations using the metadata, such as the catalogue of variables measured by a standard observing station or the catalogue of instruments used for variables measured by standard observing station, in particular:

a) Using unambiguous and standard terminology for key words/key phrases based on International Meteorological Vocabulary (WMO-No. 182), Technical Regulations (WMO No. 49);
b) Keeping the station history for different reasons, an example being the homogeneity of data times series for the monitoring of climate changes;
c) Tracking changes of station data (i.e. metadata of the station) that can be done any day;
d) Not having this capability could negatively influence results.

Recommendations regarding the designation of RCCs

24) In order to take full benefit from WIS, CCl is encouraged to identify their programmes' candidate DCPCs (i.e. RCCs and World Climate Centres) and to follow the WIS procedures for the designation of a DCPC as endorsed in principle by Cg XV. See Annex III of the final report of CBS-Ext(06)-7.8. In this framework, RCCs should ensure they are able to meet the relevant interface compliance specifications of a DCPC as laid out in the WIS Compliance specifications of GISC, DCPC and NC available on the WIS reference page. A copy of the Annex III is attached.

25) In addition to the interface and compliance specifications, RCCs are encouraged to clearly understand the role of DAR metadata and to assist in ensuring their contributors and data services create accurate and useful DAR metadata entries. They should also encourage their users to provide feedback and participate in the continuous improvement of metadata.

26) The functionality of WIS, especially DAR, does not have to be restricted to electronically available holdings of RCCs. Members may utilise WIS by registering non electronic products or services in RCC catalogues. In particular, data identified under the CCl data rescue project could be registered here and electronic links added once the data was digitised and available for access.

Attachment
Annex III of the final report of CBS-Ext(06)-7.8.

ATTACHMENT I
Designation Procedures for GISC and DCPC

From CBS Ext (2006) WMO-1017

ANNEX III
Annex to paragraph 7.8 of the general summary

RECOMMENDED DESIGNATION PROCEDURES FOR GISCs AND DCPCs

1. Designation Procedure for Global Information System Centres (GISCs)

1.1 The procedure for the designation of GISCs consists of four steps, namely:

i) Statement of WIS requirements and acceptance by the programme bodies

The WMO Technical Commissions and other bodies representing the participating programmes state their requirements for WIS services and will review them periodically. The list of all relevant requirements will be compiled and regularly reviewed by the Inter-Commission Coordination Group on WIS (ICG/WIS) which reports through the president of CBS to EC.

ii) Service offers by potential GISCs

The list of WIS requirements and functions as compiled by the ICG/WIS will be published to serve as a basis for offers to perform the required duties. Existing centres from the WMO basic systems may wish to apply for designation as GISC forming the core infrastructure of WIS. The service offer should include:

- A statement of compliance with the required WIS functions,
- A proposal for the area of responsibility for WIS data services, and a
- Formal commitment by the PR of the Member to provide such services on a routine basis.

The service offer should be addressed to WMO and will be submitted to the ICG/WIS, which will inform the president of the Regional Association(s) concerned; the ICG/WIS will analyse the proposed services versus WIS requirements as well as the compliance to the required WIS/GISC functions and specifications, and will formulate a recommendation.

iii) Demonstration of GISC capabilities

The candidate GISCs will be invited to demonstrate to CBS their capabilities to provide WIS services to the accredited users with the necessary reliability and quality. This refers to the real-time functions of data and product collection and dissemination as well as to non real time services for requests. It should also include storage functions for the complete set of WIS data and products and relevant up-to-date metadata catalogues. The coordination functions with other GISCs and the planning of mutual back-up services should also be demonstrated. Furthermore, the adherence to WIS standards and relevant data exchange policies and access rights must be granted. A formal commitment and time schedule to implement the GISC and to provide GISC services in accordance with the offer will be given by the PR of the Member operating the candidate GISC. Upon acceptance of the demonstration of capabilities of the candidate GISC, CBS will formulate the recommendation for the GISC designation.

iv) Designation of GISCs

The Executive Council will consider for approval the ICG/WIS recommendation and CBS recommendation for the GISC designation; after the EC approval, the GISC will be included in the relevant WMO programme documentation.

2. Designation of Data Collection or Production Centres (DCPCs)

2.1 There are a considerable number of centres that meet the functional specifications of a DCPC already, either partly or fully. These centres are natural candidates for integration under WIS. Many of these centres have been established under the WWW Programme and have been submitted for a formal acceptance process within CBS (e.g. the World Meteorological Centres (WMC), the Regional Telecommunication Hubs of the GTS (RTH) and the Regional/Specialized Meteorological Centres).

Apart from the operational WWW centres, there are many other centres that have been established under other WMO Programmes for the purpose of collecting programme related data or of providing products and making them available to NMHSs and other users in the form of real-time dissemination or non real-time data services. Most of the above centres and additional centres established under national responsibility have important contributions in the form of data and products to be included in WIS. Some are offering well-developed data management and data dissemination services which are of great interest to WIS.

In view of the fact that many programmes will be participating in WIS, there will be a large number of DCPC candidates. The ICG/WIS has to determine which centres should be integrated in WIS in which function. The total number of DCPCs, unlike the number of GISCs, has no, a priori, limitation, provided the GISCs are able to handle the synchronization and other communications with their attached DCPCs.

2.2 In view of the above, the procedure for the designation of DCPCs consists of three steps, namely:

i) Service offers by potential DCPCs

Since potential DCPCs functions would be undertaken by centres that have been established under the respective WMO Programmes, the relevant Technical Commissions are expected to consider the service offers by potential DCPCs (likely according to procedures similar to 1.1 ii above), and to endorse their programmes' candidate DCPCs.

The programmes' candidate DCPCs should then be submitted to the ICG/WIS; the ICGWIS will analyse the compliance to the required WIS/DCPC functions and specifications, and will formulate a recommendation.

ii) Demonstration of DCPC capabilities

As for candidate GISCs, the candidate DCPC will be invited to demonstrate to CBS their capabilities to provide WIS services in compliance with the DCPCs functions and responsibilities. This refers to the possible real-time functions of data and product dissemination as well as to non real-time services for requests. It should also include the provision of relevant up-to-date metadata catalogues. The coordination and synchronization functions with the associated GISC should also be demonstrated. Furthermore, the adherence to WIS standards and relevant data exchange policies and access rights must be granted. Upon acceptance of the demonstration of capabilities of the candidate DCPC, CBS will formulate the recommendation for the DCPC designation.

iii) Designation of DCPC

The Executive Council will consider for approval the ICG/WIS recommendation and CBS recommendation for the DCPC designation; after the EC approval, the DCPC will be included in the relevant WMO programme documentation.

ANNEX 4

APPENDIX I-2
PROCEDURES FOR BROADENING THE FUNCTIONS OF EXISTING RSMCs AND FOR DESIGNATION OF NEW RSMCs

The procedures are as follows:

1. Establishment of a statement of requirements for WWW products and services initiated and endorsed by the WMO constituent body or bodies concerned;

2. Identification of capabilities of relevant existing RSMCs and/or candidate RSMCs, to meet the requirements;

3. Determination in principle whether there is a requirement to:

   (*a*) Broaden the functions of an existing RSMC; and/or
   (*b*) Establish a new RSMC;

4. Formal commitment by a Member or a group of cooperating Members to fulfill the required function(s) of a centre; the prospective RSMC should:

   (*a*) establish a closely defined relationship between the RSMC and the WWW Meteorological Centres as users of RSMC products;
   (*b*) commit itself to make available a set of products and services designed to meet the given requirements, where appropriate, in terms of specific forecast parameters and formats, the frequency of their issue and targets for timeliness, overall reliability and quality;
   (*c*) propose method(s) and procedures by which such products and services will be delivered;
   (*d*) propose method(s) and procedures by which ongoing performance will be assessed (e.g. by verification);
   (*e*) propose method(s) by which particular WWW Meteorological Centres' changing requirements could be made known and improvements in operational performance introduced by the RSMC;
   (*f*) address the question of contingency and back-up arrangements to cover situations where the RSMC may not be able to provide the required services.

5. Demonstration of the capabilities to CBS and the constituent body or bodies referred to under (1);

   The prospective RSMC should expect to demonstrate its general capabilities of relevance to the service to be offered (such as access to relevant data and processing capability), its ability to meet the above commitment and the suitability of its other proposals.

6. Recommendation by CBS to include in the *Manual on the GDPFS*:

   (*a*) The new function(s) of the existing centre; or
   (*b*) The identification and function(s) of the new centre.

7. Acceptance of the CBS recommendation by Congress or the Executive Council.

_____

ANNEX 5

Modifications to the Manual on the GDPFS Vol 1 (global aspects) (WMO-- No 485) Relevant to the Designation of Regional Climate Centres

Part I

Part I: page I-1, section 2 (Functions of the GDPFS), Section 2.1 item (e) shall be amended to read:

'Preparation of specialized products such as limited area very-fine mesh short-, medium, extended- and long-range forecasts, regional climate watches, tailored products for marine, aviation, environmental quality monitoring and other purposes;'

Part I: Page I-1, section 2 (Functions of the GDPFS), Section 2.2 item (a) shall be amended to read:

'Preparation of special products for climate-related diagnosis (e.g. 10-day or 30-day means, summaries, frequencies and anomalies, historical reference climatologies) on a global or regional scale;'

In Part I: Page I-2, section 4.1.2 (Regional Specialized Meteorological Centres (RSMCs)), insert a new paragraph 4.1.2.5 after paragraph 4.1.2.4, and rename existing paragraph 4.1.2.5 as 4.1.2.6. The new paragraph shall read as follows:

'4.1.2.5 Centres designated by WMO for the provision of global long-range forecasts are called Global Producing Centres for Long-range forecasts (GPCs). Centres designated by WMO for the provision of regional long-range forecasts and other regional climate services, or groups of centres who collectively provide these forecasts and services in a distributed network, are called Regional Climate Centres (RCCs) or RCC-Networks, respectively (see notes under (e) in paragraph 1.4.1.2 of Part II).'

In Part I, Appendix I-1, section 3 (The RSMCs with activity specialization are the following:), add the following text:

GPC Beijing }
GPC Exeter }
GPC Melbourne }
GPC Montreal }
GPC Seoul } Global Producing Centres of long-range forecasting products
GPC Tokyo }
GPC Toulouse }
GPC Washington }
GPC ECMWF }

RCC CITYNAME…. } Regional Climate Centres providing regional long-range forecasts and other regional climate services
RCC-Network (region), and 'CITYNAME' Node) …

Part II

Part II: page II-4, section 1.4.1.2 (Regional Specialized Meteorological Centres (RSMCs) with activity specialization), item (b) shall be amended to read as follows:

'Global extended- and long-range weather forecasts and related mean analysed values and anomalies;' and item (e) shall be amended to read as follows: 'Regional LRF products, climate monitoring, climate watches, drought monitoring, climate data services, and tailored climate products.'

Part II page II-4, section 1.4.1.2 (Regional Specialized Meteorological Centres (RSMCs) with activity specialization), immediately following the new **item (e)**, add the following:

'NOTE: Centres producing regional long-range forecasts and other regional climate services or groups of centres who collectively provide these forecasts and services in a distributed network, and are recognized as such by CBS and CCl at request of Regional Associations, are called Regional Climate Centres (RCCs) or RCC-Networks, respectively. Definitions of RCCs and RCC-Networks, the list of official recognized RCCs and RCC-Networks, and mandatory functions of RCCs and RCC-Networks can be found in APPENDIX II-10. The criteria to be recognized as an RCC or RCC-Network can be found in APPENDIX II-11.'

APPENDIX II-8 (provided by CBS, DPFS)

DESIGNATED GLOBAL PRODUCING CENTRES FOR LONG-RANGE FORECASTS AND DESIGNATION CRITERIA

1. Centres that are designated as Global Producing Centres for Long-range Forecasts (GPCs) are as follows: Melbourne, Montreal, Beijing, Toulouse, Tokyo, Seoul, Washington, Exeter and ECMWF.

2. In order to be officially recognized as a Global Producing Centre for Long-range Forecasts, a centre must, as a minimum, adhere to the following criteria:

- Have fixed production cycles and time of issuance;
- Provide a limited set of products as determined by chapter 4.2 of Appendix II-6 of this Manual;
- Provide verifications as per the WMO SVSLRF;
- Provide up-to-date information on methodology used by the GPC;
- Make products accessible through the GPC website and/or disseminated through the GTS and/or the Internet.

In APPENDIX II-6:

4.2 **Long-range forecast products**
Minimum list of LRF products to be made available by Global Producing Centres (GPCs):

FORECAST PRODUCTS

NOTE: It is recognized that some centres may provide more information than the list including, for example, daily data or hindcast data.

Basic properties:

Temporal resolution: Averages, accumulations or frequencies over 1-month or longer periods (seasons)

Spatial resolution: 2.5° x 2.5°

NOTE: Selected to match resolution of current verification data.

Spatial coverage: Global

(Separate areas of interest to users, down to subregions of a continent or ocean basin, may be provided on special request from Members.)

Lead time: Any lead times between 0 and 4 months

(Definition of lead time: for example, a three-monthly forecast issued on 31 December has a lead time of 0 months for a January-to-March forecast, and a lead time of 1 month for a February-to-April forecast.)

Issue frequency: Monthly or at least quarterly

Output types: Either rendered images (e.g. forecast maps and diagrams) or digital data. GRIB-2 format should be used for products posted on FTP sites or disseminated through the GTS.

Indications of skill including hindcast should be provided in accordance with recommendations from CBS on the Standardized Verification System (Attachment II-8). The minimum required is level 1 and level 2 verification. The verification of the Niño 3.4 index will only apply to those centres producing such indices. However, GPCs are encouraged to provide level 3 verification. Verification results over the hindcast period are mandatory.

Content of basic forecast output:

(Some products are intended as directly meeting NMHS requirements with regard to information needed for end-user applications (direct or further processed); others are to assist the contributing global centres in product comparison and in the development of multimodel ensembles. These products are regarded as feasible from current systems.)

(*a*) Calibrated outputs from ensemble prediction systems showing the mean and spread of the distribution for:

- 2-metre temperature over land;
- Sea-surface temperature;
- Precipitation;
- Z500, MSLP, T850.

NOTE: These fields are to be expressed as departures from normal model climate.

(*b*) Calibrated probability information for forecast categories for:

- 2-metre temperature over land;
- SST (atmospheric coupled models only);
- Precipitation.

NOTES:

1. The minimum requirement is (b); (a) should be provided, at least, by request.
2. Tercile categories should be provided, consistent with present capabilities. Information for larger numbers of categories (e.g. deciles) is foreseen, however, as capabilities increase and to match better the anticipated end-user requirements. These targets are implied also for forecasts from statistical/empirical models.
3. Information on how category boundaries are defined should be made available.
4 "Calibrated" implies correction based on systematic errors in model climatology, using at least 15 years of retrospective forecasts.

In Part II, add new **APPENDIX II-10** as follows:

DESIGNATION AND MANDATORY FUNCTIONS OF REGIONAL CLIMATE CENTRES (RCCs) AND RCC-NETWORKS

1. A multifunctional centre that fulfils all the required functions of an RCC for the entire region, or for a sub-region to be defined by the regional association may be designated by WMO as a 'WMO Regional Climate Centre' (WMO RCC). A group of centres performing climate-related activities that collectively fulfil all the required functions of an RCC may be designated by WMO as a 'WMO Regional Climate Centre Network' (WMO RCC-Network). Each centre in a designated WMO RCC-Network will be referred to as a 'node'. A node will perform, for the region or sub-region defined by the regional association, one or several of the mandatory RCC activities (e.g. long-range forecasting (LRF), climate monitoring, climate data services, training). Only centres or groups of centres designated by WMO will carry the title 'WMO RCC' or 'WMO RCC-Network' respectively. Recipients of RCC products and services will be NMHSs, other RCCs and international institutions recognized by the regional association and will be referred to as 'RCC Users'. WMO RCCs and RCC-Networks shall follow Guidance published by the Commission for Climatology on technical, climate-related matters.

2. Designated Regional Climate Centres and RCC-Networks are as follows: ……..

3. In order for a centre or a group of centres in a cooperative effort to be officially recognized as a WMO RCC (Regional Climate Centre), or a WMO RCC-Network, it shall perform the following minimum* set of functions, criteria and products for which are defined in **Appendix II-11**:

   Note: *****Additional requirements for RCC functions may vary in detail from Region to Region**.** A list of 'highly recommended', but not mandatory, functions is given in Attachment II-10.

   Note: An RCC is not necessarily an NMHS, but a non-NMHS candidate for RCC designation must be nominated by the Permanent Representative of the concerned country

   - **Operational Activities for LRF*:**
     - o Interpret and assess relevant LRF products from Global Producing Centres (GPCs), distribute relevant information to RCC Users; and provide feedback to GPCs
     - o Generate regional and sub-regional tailored products, relevant to RCC User needs, including seasonal outlooks etc.;
     - o Perform verification of RCC quantitative LRF products, including the necessary exchange of basic forecasts and hindcast data;
     - o Generate 'consensus' statement on regional or sub-regional forecasts (see Appendix II.11 for details).
     - o Provide on-line access to RCC products/services to RCC Users;
     - o Assess use of RCC products and services through feedback from RCC Users.

   Note: *Both dynamical and statistical, within the range of 1 month to 2 year timescale, based on regional needs.

- **Operational Activities for Climate Monitoring:**
  - Perform climate diagnostics including analysis of climate variability and extremes, at regional and sub-regional scales;
  - Establish an historical reference climatology for the region and/or sub-regions;
  - Implement a regional Climate Watch.

- **Operational Data Services, to support operational LRF and climate monitoring:**
  - Develop regional climate datasets, gridded where applicable;
  - Provide climate database and archiving services, at the request of NMHSs;

- **Training in the use of operational RCC products and services**
  - Provide information on methodologies and product specifications for mandatory RCC products, and provide guidance on their use
  - Coordinate training for RCC Users in interpretation and use of mandatory RCC products.

In Part II, add new **ATTACHMENT II-10** as follows:

ADDITIONAL 'HIGHLY RECOMMENDED' FUNCTIONS OF DESIGNATED WMO RCCs OR WMO RCC-NETWORKS:

- **Climate Prediction and Climate Projection (beyond 2 years timeframe)**
  - Assist RCC Users in the access and use of WCRP-CMIP climate model simulations
  - Perform downscaling of climate change scenarios
  - Provide information to RCC Users for use in development of climate adaptation strategies
  - Generate, along with warnings of caution on accuracy, seasonal forecasts for specific parameters where relevant, such as:
    - onset, intensity and cessation of rainy season;
    - tropical cyclone frequency and intensity
  - Perform verification on consensus statements for forecasts;
  - Perform assessment of other GPC products such as SSTs, winds, etc.

- **Non-operational data services:**
  - Keep abreast of activities and documentation related to WMO WIS, and work towards WIS compliance and DCPC designation;
  - Assist NMHSs in the rescue of climate data from outmoded storage media;
  - Assist NMHSs to develop and maintain historical climate datasets;
  - Assist RCC Users in the development and maintenance of software modules for standard applications;
  - Advise RCC Users on data quality management;
  - Conduct data homogenization, and advise RCC Users on homogeneity assessment and development and use of homogeneous data sets;
  - Develop and manage databases, and generate indices, of climate extremes;
  - Perform Quality Assurance/Quality Control on national datasets, on request of an NMHS;
  - Provide expertise on interpolation techniques;
  - Facilitate data/metadata exchange amongst NMHSs, including on-line access, through an agreed regional mechanism;
  - Perform Quality Assurance/Quality Control on regional datasets.

- **Coordination Functions:**
  - Strengthen collaboration between NMHSs on related observing, communication and computing networks including data collection and exchange;
  - Develop systems to facilitate harmonisation and assistance in the use of LRF products and other climate services;
  - Assist NMHSs in user liaison, including the organisation of climate and of multidisciplinary workshops and other forums on user needs;
  - Assist NMHSs in the development of a media and public awareness strategy on climate services.

- **Training and Capacity building:**
  - Assist NMHSs in the training of users on the application and on implications of LRF products on users;
  - Assist in the introduction of appropriate decision models for end-users, especially as related to probability forecasts;

- Promote technical capacity building on NMHS level (e.g. acquisition of hardware, software, etc.), as required for implementation of climate services.
- Assist in professional capacity building (training) of climate experts for generating user-targeted products.

- **Research and Development:**
  - Develop a climate Research and Development agenda and coordinate it with other relevant RCCs;
  - Promote studies of regional climate variability and change, predictability and impact in the Region;
  - Develop consensus practices to handle divergent climate information for the Region;
  - Develop and validate regional models, methods of downscaling and interpretation of global output products;
  - Promote the use of proxy climate data in long-term analyses of climate variability and change;
  - Promote application research, and assist in the specification and development of sector specific products;
  - Promote studies of the economic value of climate information.

In Part II, add new **APPENDIX II-11** as follows**:**
DETAILED CRITERIA FOR RCC MANDATORY FUNCTIONS

Functions	Activities	Criteria
Operational Activities for LRF (both dynamical and statistical, within the range of 1 month to 2 year timescale, based on regional needs)	Interpret and assess relevant LRF products from Global Producing Centres (GPCs), distribute relevant information to RCC Users; and provide feedback to GPCs	***Product:*** assessment of the reliability and outcomes of GPC products including the reasoning, for the region of interest, in the form of texts, tables, figures, etc. ***Element:*** 2-m mean temperature, total precipitation ***Update frequency:*** monthly or at least quarterly
	Generate regional and sub-regional tailored products, relevant to RCC User needs, including seasonal outlooks etc.	***Product:*** probabilities for tercile (or appropriate quantile) categories for the region or sub-region ***Element:*** 2-m mean temperature, total precipitation ***Output type:*** *rendered images (maps, charts), text, tables, digital data* ***Forecast period*****:** one month up to 6 months ***Update frequency:*** 10 days to one month
	Generate consensus* statement on regional or sub-regional forecasts. **NB: A collaborative process involves discussion with experts in the region (e.g. through Regional Climate Outlook Forums (RCOFs), teleconferencing, etc.).* *Consensus is both the agreed process, and its joint conclusion, and can be that there is limited skill in the prediction for a region or sub-region*	***Product:*** *consensus statement on regional or sub-regional forecast****.*** ***Element:*** *2-m mean temperature, total precipitation* ***Output type:*** *report* F***orecast period*****:** *a climatologically significant period (from one month to one year)* ***Update frequency:*** *at least once per year (to be defined by the region)*
	Perform verification of RCC quantitative LRF products, including the necessary exchange of basic forecasts and hindcast data.	***Products:*** verification datasets (e.g. from Brier Skill Score; ROC; Hit Rate Skill Score) ***Element:*** 2-m mean temperature, total precipitation
	Provide on-line access to RCC products/services to RCC Users.	***Product:*** an on-line data/information portal

	Assess use of RCC products and services through feedback from RCC Users.	***Product:*** analysis of feedback (which is made available using a template) ***Update frequency:*** annually, as part of a regular reporting of RCCs to WMO RAs
Operational Activities for Climate Monitoring	Perform climate diagnostics including analysis of climate variability and extremes, at regional and sub-regional scales	***Products:*** climate diagnostics bulletin including tables, maps and related products ***Element:*** Mean, Max and Min temperatures, Total precipitation; other elements (esp. GCOS essential climate variables) to be determined by the region, ***Update frequency:*** monthly
	Establish an historical reference climatology for the region and/or sub-regions	***Product:*** database of climatological means for various reference periods (e.g. 1931-60; 1951-80; 1961-90; 1971-2000; etc) ***Spatial resolution:*** *by station* ***Temporal resolution:*** *monthly at a minimum* ***Elements:*** Mean, Max and Min temperatures, Total precipitation; other elements (esp. GCOS essential climate variables) to be determined by the region, ***Update frequency:*** at least 30 years, preferably 10 years
	Implement a Regional Climate Watch	***Products:*** climate advisories and information for RCC Users ***Update:*** whenever required, based on the forecast of significant regional climate anomalies.
Operational Data Services, to support operational LRF and climate monitoring	Develop quality controlled regional climate datasets, gridded where applicable	***Products:*** regional, quality controlled climate datasets, gridded where applicable, following CCl guidance on QA/QC procedures ***Elements:*** Mean, Max and Min Temperature, and Precipitation, at a minimum ***Temporal resolution:*** *daily* ***Update:*** monthly
	Provide climate database and archiving services, at the request of NMHSs	***Products:*** national databases with metadata, accessible to the NMHS in question (backup service, development site, etc). ***Elements:*** as determined by the NMHS ***Update:*** at the request of the NMHS

Training in the use of operational RCC products and services	Provide information on methodologies and product specifications for mandatory RCC products, and provide guidance on their use	***Products:*** *Manuals, guidance documents and information notes*. ***Update frequency:*** when methods/products are revised or introduced or discontinued
	Coordinate training for RCC Users in interpretation and use of mandatory RCC products	***Products:*** survey and analysis of regional training needs, and proposals for training activities.

NOTE: An RCC is expected to perform certain functions (e.g. for homogeneity testing; database management; metadata management, statistical evaluation of climate data, etc.) using procedures proposed in the WMO Guide to Climatological Practices and in other official Commission for Climatology Guidance documents.