

**PROCEEDINGS OF THE MEETING OF THE
RA II WORKING GROUP ON CLIMATE-RELATED MATTERS
INCLUDING CLIPS**

(Tokyo, Japan, 25 – 27 October 2004)

WCASP - No. 69

WMO-TD No. 1261

**WORLD METEOROLOGICAL ORGANIZATION
October 2004**

TABLE OF CONTENTS

| | |
|--|-----------|
| 1. OPENING OF THE MEETING | 5 |
| 1.1 Opening Address by Mr Koichi Nagasaka, Director-General of JMA and Permanent Representative of Japan with WMO | 5 |
| 1.2 Statement on behalf of the Secretary-General of WMO | 5 |
| 2. ORGANIZATION OF THE MEETING | 5 |
| 3. REVIEW OF PREVIOUS DISCUSSIONS ON REGIONAL CLIMATE CENTRES (RCCs) | 6 |
| 3.1 RCC-related discussions by WMO and the Technical Commissions..... | 6 |
| 3.2 RCC-related activities in the Regions | 6 |
| 4. SUMMARY AND REVIEW OF THE ‘QUESTIONNAIRE ON REQUIREMENTS FOR ESTABLISHMENT OF A REGIONAL CLIMATE CENTRE’ | 7 |
| 4.1 Analysis of the responses to the RA II survey on RCCs | 7 |
| 4.2 Highest priority RCC functions for RA II | 8 |
| 4.3 Conclusions and Discussion | 9 |
| 5. REQUIREMENTS AND EXISTING CAPABILITIES FOR RCC SERVICES | 12 |
| 5.1 China (W. Dong) | 12 |
| 5.1.1 Existing capabilities | 12 |
| 5.1.2 Discussion | 13 |
| 5.2 India (G. Srinivasan) | 13 |
| 5.2.1 Existing capabilities | 14 |
| 5.2.2 Discussion | 14 |
| 5.3 Japan (F. Watanabe) | 15 |
| 5.3.1 Climate Services in the Japan Meteorological Agency | 15 |
| 5.3.2 Tokyo Climate Center..... | 15 |
| 5.3.3 Capabilities of JMA for RCC activities..... | 15 |
| 5.3.4 Concluding Remarks | 17 |
| 5.3.5 Discussion | 17 |
| 5.4 Islamic Republic of Iran (S. Javanmard) | 17 |
| 5.4.1 Existing capabilities | 18 |
| 5.4.2 Discussion | 18 |
| 5.5 Republic of Korea (C.K. Park) | 18 |
| 5.5.1 The APCN MME Seasonal Prediction System..... | 18 |
| 5.5.2 Long-range forecasting in the Korea Meteorological Administration..... | 19 |
| 5.5.2.1 <i>Global ocean forecasting system and global LRF system</i> | 20 |
| 5.5.2.2 <i>Regional Climate Long-Range Forecasting System</i> | 21 |
| 5.5.3 Discussion | 22 |
| 5.6 Pakistan (A.B. Farooqi) | 22 |
| 5.7 Russian Federation (D.B. Kiktev) | 23 |
| 5.7.1 Specific features of the Russian Region from the point of view of RCC services..... | 23 |
| 5.7.2 Reasons for establishment of RCC in Russia | 23 |
| 5.7.3 Proposal for an RCC-Moscow | 24 |
| 5.7.4 Current capacity and products..... | 24 |
| 5.7.5 Recent history and future plans..... | 24 |
| 5.7.6 Discussion | 24 |
| 5.8 The Socialist Republic of Viet Nam (T. Nguyen Van) | 25 |
| 5.8.1 Current Capabilities | 25 |
| 5.8.2 Future plans..... | 25 |
| 5.8.3 Discussion | 26 |
| 6. STRUCTURE OF RCCs FOR RA II | 26 |
| 6.1 Structures of RCCs for RA II..... | 26 |

| | |
|--|-----------|
| 7. DESIGNATION PROCEDURES..... | 28 |
| 8. RECOMMENDATIONS..... | 29 |
| 9. CLOSURE OF THE MEETING | 30 |
| | |
| ANNEX I | 31 |
| ANNEX II | 32 |
| ANNEX III..... | 34 |
| ANNEX IV..... | 38 |
| ANNEX V..... | 39 |

1. OPENING OF THE MEETING

The meeting of the RA II Working Group on Climate-related Matters including CLIPS opened at 10:00 a.m. on Monday, 25 October 2004 in the Headquarters of the Japan Meteorological Agency (JMA), Tokyo, Japan.

1.1 Opening Address by Mr Koichi Nagasaka, Director-General of JMA and Permanent Representative of Japan with WMO

Mr Nagasaka welcomed the participants to Tokyo and to the meeting at the JMA. He referred to the recent severe climate extreme events in various parts of the world, events that took many lives and resulted in huge economic losses. National Meteorological Services are often called upon at such times to help stakeholders understand the facts, and preview the future in both short and longer time frames. Mr Nagasaka spoke of the recent, devastating earthquake that took place not far north of Tokyo, and the role of the JMA in coping with the catastrophe.

The World Meteorological Organization (WMO) has called upon its member countries to consider implementation of Regional Climate Centres (RCCs), to build vital skill in climate prediction and development of climate products and services, and to enhance the interface between nations throughout the regions. These actions will help the entire region cope better with climate variability and extremes. Establishment of RCCs, however, in spite of the decisions and guidance provided by the experts from the CBS, CCI and WMO, is still fraught with uncertainty. Nevertheless, noted Mr Nagasaka, it is important to make a beginning and work through any difficulties. He urged the meeting to develop recommendations that would enable RA II to begin the process.

1.2 Statement on behalf of the Secretary-General of WMO

On behalf of Mr Jarraud, Secretary-General of WMO, Mrs Malone offered commiseration with the people of Japan at the news of the earthquake, and thanked Mr Nagasaka for his encouragement for the meeting.

WMO noted that Member countries would benefit considerably from the support that could be provided through RCCs, particularly for operational development of specialized climate products and co-ordinated long-range predictions. The deliberations and decisions of WMO Executive Council and Congress on RCCs were reviewed (the details are available as **ANNEX III**) and it was noted that RCCs are meant to work within an integrated framework of global, regional and national meteorological and climate services, enhancing the role of NMHSs, particularly those of developing countries. The Guidelines developed at the Meeting on Organization and Implementation of Regional Climate Centres (Geneva, Switzerland, November 2003) set out clear suggestions to be used by Regional Associations in their considerations of RCCs, and at WMO Executive Council in June 2004 (EC-LVI) Members urged all Regional Associations to proceed with implementation.

It was noted that RCC support for development of effective climate products, services and predictions such as climate watches, outlooks and the alerts, warnings and advisories to be delivered by NMHSs would be very important in efforts to alleviate hunger and poverty in the world, and to reduce the impacts of natural hazards, especially in developing countries. The efforts of Regional Association II to consider implementation of RCCs were much appreciated.

2. ORGANIZATION OF THE MEETING

Dr Sugi, chair of the meeting, welcomed the participants and introductions were performed. The document package for the meeting was reviewed. The agenda for the session was adopted with

minor amendments. The final agenda is presented in **ANNEX I**, and the List of Participants is presented in **ANNEX II**.

3. REVIEW OF PREVIOUS DISCUSSIONS ON REGIONAL CLIMATE CENTRES (RCCs)

3.1 RCC-related discussions by WMO and the Technical Commissions

WMO reviewed the intended purpose of Regional Climate Centres and the RCC-development activities carried out by WMO Executive Council (EC) and Congress, the Technical Commissions (CCI and CBS) and the Inter-Commission Task Team on Regional Climate Centres (ICTT-RCC) from 1999 to 2004. The work to develop the concept of RCCs began in 1999 at the Thirteenth Session of WMO Congress. CCI conducted a survey in 1999; the ICTT was established at EC-LII, met in April 2001 and March 2002 and reported results to EC-LIII and EC-LIV respectively. The ICTT proposed potential functions of RCCs and possible mechanisms of cooperation within regions, set out the mechanism for implementation of such centres, and defined infrastructure needs for operational provision of seasonal to interannual forecasts and climate services. The ICTT further proposed expansion of the Terms of Reference of the OPAGS of the Technical Commissions (CBS, CCI, CHy, CAgM and CAS) to include a suite of RCC-related responsibilities intended to assist in the establishment of RCC functions.

Members at EC-LIV (2002) accepted the second report of the ICTT and agreed that the work of the ICTT was completed. They recommended, however, further development of the RCC concept within an integrated framework of global, regional and national meteorological services, and that the commitment of the global prediction centres be gained in support of RCCs. To that end, a workshop of global producers of climate predictions including GDPS centres was held in February 2003. WMO Congress, at its Fourteenth session (2003) urged the CCI to provide clear Guidelines and advice on procedures to assist the regional associations in implementation of RCCs.

To accomplish this, the CCI organized a meeting of experts in November 2003 (Geneva, Switzerland). The results were published as WCASP No. 62, and presented to WMO EC-LVI in June 2004. Extracts from the proceedings of EC-LIII, EC-LIV, Cg-XIV and EC-LVI are provided as **ANNEX III**. The Guidelines developed at the November 2003 meeting are published as WCASP-No. 62, and are also available in four languages at:

http://www.wmo.ch/web/wcp/clips_2001/html/Guidelines_RCC.htm

3.2 RCC-related activities in the Regions

A brief update on recent RCC-related activity in the WMO regions (since November 2003) was provided. Considerable climate prediction and product development activity is being carried out throughout all regions, however, no regional-level discussion is known to have been carried out in RAs I, III and V since the November 2003 meeting in Geneva. In RA IV (North America) a meeting took place in Miami, USA, in May 2004 during which Cuba made a firm offer to serve as an RCC node in a virtual system, along with the previously identified University of West Indies, the University of Costa Rica, the Caribbean Institute of Meteorology and Hydrology (CIMH) and the Central American Regional Committee of Hydrological Resources (CRRH). It was noted that some countries in the region (i.e. the USA, Canada and Mexico) already have climate centres and do not require the services of an RCC. Although these countries would help with the effort, they will not take the lead. Météo France offered some limited technical support to the virtual RA-IV RCC. In RA VI, a meeting of the RAVI WG on Climate-related Matters was held in Sofia, Bulgaria, April 2004. This group is working on statement of requirements for potential RCC functions; making an invitation to RA VI Members to offer RCC services; and nominating an Expert Team to assess any

offers. They will liaise with the RA VI WG on CLIPS and with the WMO Secretariat on the draft action plan for RA VI, which will be submitted to the fourteenth session of RA VI in 2005.

It was noted that there are some potential difficulties related to 'virtual' RCC networks, in that the current version of the Manual on the GDPS does not describe such networks or how they would function. If any region wishes to establish one or more RCCs, a description of the virtual network concept would have to be written into the Manual, but there is concern that virtual RCCs could not be designated through Volume I of the Manual on the GDPS.

It was further noted that some countries in Asia were sometimes dealing with RA II, sometimes RA V, and also had dealings with different (non-WMO) Asian groups. This will necessitate cross-region collaboration and cooperation.

4. SUMMARY AND REVIEW OF THE 'QUESTIONNAIRE ON REQUIREMENTS FOR ESTABLISHMENT OF A REGIONAL CLIMATE CENTRE'

Dr Sugi reviewed the results of the survey on RCCs that used the 'questionnaire on requirements for establishment of a regional climate centre' that had been proposed in the Guidelines for the Establishment of Regional Climate Centres (WCASP No. 62). Twenty-seven responses were received out of 35 Members in RA II, a 77 per cent response rate. A summary of the responses is presented in **Table 1**.

4.1 Analysis of the responses to the RA II survey on RCCs

The questionnaire covers five categories of RCC functions: Operational Activities, Co-ordination Functions, Data Services, Training and Capacity building and Research and Development, as indicated in the Guidelines. The questions raised and the results for each are:

Q1: Is your NMHS able to perform this activity to fulfil national needs?

The survey revealed that most RA II NMHSs have the capability of carrying out some of the activities in the functions of "Operational Activities" and "Data Services", but fewer indicated that they provide sufficient "Training and Capacity building" and "Research and Development" activities to serve their country's needs. With respect to coordination functions, only a few NMHSs can develop systems to facilitate harmonisation and assistance in the use of seasonal to interannual (SI) forecast products. However, most NMHSs can assist, to some extent, in coordination with end users, including organization of workshops and other forums on users needs, and can foster the sharing and use of data and information from climate and other scientific disciplines. The relative levels of implementation of these functions should be taken into consideration when discussing requirements for RCCs.

Q2: Is your NMHS able to perform this activity on behalf of the region?

Several respondents indicated capability to carry out RCC related functions in each of the individual areas. Six respondents answered "yes" to many items and eleven respondents answered "yes" to some items (not indicated on the table). Six countries indicated that they could carry out more than 20 of the suggested functions on behalf of the region.

Q3: Do you require this activity to be performed by an RCC?

Q4: Priority of the different functions or activities (High/Medium/Low)

These questions were evaluated together. Participants in the survey were asked to identify priorities of High, Medium or Low for each potential RCC activity, and for analysis purposes, scores were assigned as follows: ten-points for "HIGH" priority, five-points for "MEDIUM" priority and no points for "LOW" priority or for no response. The maximum score for each item is 270, so that a score of 180, or two thirds of the full score, is regarded as a threshold, assuming such item would gain "High" priority. Activities with high priority are indicated in bold text in **Table 1**.

4.2 Highest priority RCC functions for RA II

The survey revealed that the highest priority activities for RCC functions in RA II are:

Operational Activities

- To provide interpretation and assessment of relevant output products from global prediction centres
- To generate and distribute tailored products to meet NMHS needs including seasonal outlooks etc.
- To undertake product verification, including hind cast verification of the tools, and the necessary exchange of basic data
- To provide climate analysis, monitoring
- To provide climate advisories in coordination with NMHS
- To provide Climate Database Management (free access to data partners is key)

Co-ordination Functions

- To develop systems to facilitate harmonisation in interpretation and assistance in the use of SI forecast products;
- To assist in co-ordination with end users including organisation of workshops and other forums on users' need such as the Regional Climate Outlook Forum;
- To assist the introduction of climate information and predictions into early warning and disaster prevention systems.

Data Services

- To assist in the rescue of climate observation data;
- To provide climate observation database and archiving services;
- To advise in data quality management.

Training and Capacity building

- To train NMHS staff in SI forecasting methods and characteristics to assist NMHSs to strengthen their services;
- To assist in technical capacity building on NMHS level.

Research and Development

- To study climate variability, predictability and impact in the region;
- To develop tools for objective climate analysis and prediction.

This review reveals that NMHSs require most of the functions listed in Table 1 to be carried out in an RCC. It would be necessary that an RCC focus on some of the requirements listed above as priorities, taking into account the availability of resources.

Although four of the coordination functions were highly rated, it was queried whether, in fact, the first coordination function listed in the survey should be the responsibility of WMO or the Technical Commissions, rather than an RCC, and therefore, it is not included in the above high priority function list.

Even though the survey did not assign high priority to some RCC functions regarding applications for users, the RA II WG is expected to promote this activity. The EC LVI stressed the importance of projects that demonstrate the value of climate services and the importance of developing, within those projects, decision methods and processes that convert climate information and predictions into actions maximising the benefits. In this regard, RCCs are expected to promote application of climate information to end-users (regardless of the survey results).

Very few countries in RA II are capable of the following functions: to develop systems to facilitate harmonisation and assistance in the use of SI forecast products (in the area of “Co-ordination Functions”); and to train NMHS staffs in SI forecasting methods and characteristics to assist NMHSs to strengthen their services (in the area of “Training and Capacity building”). They are high priority, high requirement, but not many NMHSs in the region can deliver the services. RCCs should take on these tasks.

4.3 Conclusions and Discussion

Even though many countries are presently capable of developing a number of products themselves, they still requested RCC function. This is interpreted as meaning that it would make the products better, and that the added perspectives, information and data from outside the country, would be of great value in improving these products. It was noted that this survey is also of value to individual services for use in discussions with their respective governments, because it shows what products, services, activities are of value throughout the region. Overall, the survey revealed that there are a number of NMHSs that have the capacity, and willingness to deliver a broad suite of RCC functions to serve the needs of the region.

In discussion, the issue of climate change was raised. It was noted that in the survey, and in the WMO CBS and CCI discussions these last 5 years, that climate change had not been a key focus for RCCs. However, progress in seasonal prediction and applications will in the end make adaptation exercises easier.

It was further noted that WMO already has a number of specialized training centres around the world, and that they should be considered for inclusion in RCC networks, provided they can include training for seasonal to interannual forecasting, climate applications modules etc. to their curricula.

Table 1: Responses to Questionnaire on Requirements for Establishment of a Regional Climate Centre

(Parenthesis indicates the mean value in each area)

| Questions | Is your NMHS able to perform this activity to fulfil national needs? (Y/N)* (% of "Y") | Is your NMHS able to perform this activity on behalf of the Region?(Y/N)* (Number of "Y") | Do you require this activity to be performed by a regional climate centre? (Y/N) (% of "Y") | Prioritize the different functions or activities as "HIGH" (10), "MEDIUM" (5) or "LOW" (0). (Priorities with scores**) |
|---|--|---|---|--|
| Functions | | | | |
| Operational Activities: | (71) | (8.0) | (79) | (196) |
| Provide interpretation and assessment of relevant output products from global prediction centres | 67 | 8 | 81 | 185 |
| Generate and distribute tailored products to meet NMHS needs including seasonal outlooks etc. | 63 | 6 | 85 | 185 |
| Undertake product verification, including hind cast verification of the tools, and the necessary exchange of basic data | 59 | 7 | 85 | 185 |
| Provide climate analysis, monitoring | 81 | 9 | 74 | 215 |
| Provide climate advisories in coordination with NMHS | 74 | 8 | 74 | 190 |
| Climate Database Management (free access to data partners is key) | 81 | 10 | 74 | 220 |
| Co-ordination Functions: | (63) | (6.6) | (84) | (172) |
| Strengthen collaboration between NMHS on related observing, communication and computing networks including data collection and exchange (level of data to be discussed) | 78 | 6 | 85 | 205 |
| Develop systems to facilitate harmonization and assistance in the use of Seasonal and Interannual (SI) Forecast products | <u>37</u> | 7 | 93 | 200 |
| Assist in coordination with end users, including organization of workshops and other forums on users' needs | 81 | 9 | 74 | 180 |
| Assist NMHSs in the development of a media and public awareness strategy relating to SI Forecasts | 59 | 6 | 89 | 175 |
| Assist in coordination of research concerning the best means of communicating climate products and other information | 63 | 6 | 70 | 155 |
| Foster the sharing and use of data and information from climate and other scientific disciplines | 85 | 5 | 85 | 155 |
| Assist the introduction of climate information and predictions into early warning and disaster prevention systems | 67 | 7 | 85 | 200 |
| Represent the needs of associated NMHSs in climate related matters | 74 | 7 | 74 | 150 |
| Facilitate links to external climate community | 52 | 6 | 89 | 160 |
| Internally coordinate all parts of the RCC collective | <u>48</u> | 7 | 85 | 165 |
| Coordinate relevant training of RCC staff | <u>44</u> | 7 | 93 | 150 |

| | | | | |
|---|-------------|--------------|-------------|--------------|
| Data Services: | (80) | (6.8) | (86) | (191) |
| Assist in the rescue of climate data sets | 81 | 6 | 85 | 205 |
| Provide climate database and archiving services | 93 | 8 | 81 | 215 |
| Assist in the development and maintenance of software modules for standard applications | 67 | 6 | 85 | 160 |
| Advise in data quality management | 78 | 7 | 93 | 185 |
| Training and Capacity Building: | (48) | (4.3) | (84) | (176) |
| Train NMHS staff in SI Forecasting methods and characteristics to assist NMHSs to strengthen their services | <u>44</u> | 5 | 93 | 205 |
| Assist in the training of end-users on the application and impact of SI Forecast products | 56 | 3 | 78 | 175 |
| Assist in the introduction of appropriate decision models for end-users, especially as related to probability forecasts | <u>30</u> | 5 | 78 | 140 |
| Assist in technical capacity building on NMHS level | 63 | 4 | 85 | 185 |
| Research and Development: Develop a climate Research and Development agenda to promote and undertake studies the following: | (51) | (6.6) | (81) | (169) |
| Study climate variability, predictability and impact in the Region | 67 | 9 | 74 | 205 |
| Develop tools for objective climate analysis and prediction | 56 | 7 | 89 | 190 |
| Promote research, development, and application of methodologies to harmonize and unify information from varied sources for regional and sub-regional products | <u>44</u> | 7 | 89 | 165 |
| Develop verification procedures relating to SI Forecast products in coordination with other centres and WMO guidelines | 48 | 8 | 85 | 170 |
| Develop and/or validate regional models and methods of downscaling of global output products | <u>41</u> | 7 | 81 | 165 |
| Undertake application research, and assist in the specification and development of sector specific products | 56 | 3 | 67 | 140 |
| Promote studies of the economic value of climate information | <u>44</u> | 4 | 81 | 150 |

NOTE

*: Each NMHS was requested to reflect true capacity to deliver the function, in consideration of the required human resources, computing and telecommunications capacities including equipment, power, hardware, software, etc., and other infrastructure requirements.

***: A score of each item is evaluated with giving a ten-point to "high" priority, a five-point to "medium" one, and a nil to "low" one or no response. Scores above 180 corresponding to 2/3 of the full score (270) are indicated with italic and bold letters.

--- Italic with underline indicates less than 50% and italic with bold indicates more than 2/3 (=180).

5. REQUIREMENTS AND EXISTING CAPABILITIES FOR RCC SERVICES

Participants, representing China, India, the Islamic Republic of Iran, Japan, the Republic of Korea, Pakistan, the Russian Federation and the Socialist Republic of Viet Nam each made a presentation on the current climate-related activities in their respective countries, including information on existing capabilities, and requirements for coordinated regional climate support. Brief summaries of these presentations follow.

5.1 China (W. Dong)

In China, there are many natural disasters. In 2003, 1600 people died, and there were 200 trillion RMB in losses. Seventy to eighty per cent of these losses were related to weather (droughts, heat waves, dust storms, storms, floods, etc.). RCCs would help in China to:

- ✓ Meet the requirements of decision/policy makers
 - State council, premier, local government need information on flooding and drought in flooding season; for frequency and intensity of ENSO; on typhoons; dust storms; forest fires and heat waves; to help in decision-making. (prediction, prevention)
- ✓ Meet the requirements of the public
 - Climate system monitoring service and climate concept training give people information on what has happened, and what is now happening. Suggestions and advisories are provided through web sites, the media, newspapers, etc.
- ✓ Meet specialized requirements
 - On a cost recovery basis, specialized services are provided to enterprises, private, commercial uses and local governments (e.g. 3 Gorges Dam, transport and power companies, international trade, etc.).
- ✓ Improve International data and product exchange
 - International services are provided for APCN/APCC, for training, for the Joint Summer/Winter Monsoon prediction (China, Japan, Korea, etc.) and to Israel for winter precipitation.
- ✓ Provide different kinds of services for different needs for different people.

Other needs include: special data (GCOS type beyond the WWW network) exchange; cooperation on extreme climate events; for training and to support the visitor scholar programme; and to develop international programs and projects of common interests.

5.1.1 Existing capabilities

The National Climate Centre (NCC) was approved by the China state council in 1994, and founded in 1995. The Beijing Climate Centre (BCC) was set up in 2003. There are about 120 staff, 60 graduate students and visiting scholars. There are 4 divisions, and a key lab (the Laboratory of Climate Study). There are about 35 provincial or city level centres (20 staff). Twelve institutes from the Chinese Academy of Sciences and universities also contribute. The BCC runs an IBM supercomputer.

The model systems used at the BCC were described. The model output goes into a product system, to develop climate information and products for end users (public and others). The BCC does validation, checks skill, develops products such as temperature anomalies. The models have skill on monthly level, especially for precipitation. The BCC has a web site to share information.

Successful predictions including the 1998 precipitation forecast, mean that government and decision makers and the public are much more aware of climate forecasts and products. The Government invested more in the BCC, and there is a lot more media attention as well.

The BCC models also do some climate projections (for the IPCC). The BCC has a plan detailing what it can and intends to produce for various users over time. Also described were the new 126-unit Doppler radar installations throughout China, and the 600 AWS units, the GAW network, and the contribution of China to the WMO satellite network. The new satellite-based telecom network and the supercomputing capacity were described. CMA has the best computer in China. CMA does important climate system monitoring (satellite observations, forest fire monitoring, vegetation, water level, soil moisture, etc.). CMA also produces a number of newsletters and other publications to tell people what impact climate has on certain things, such as the generation of power.

The BCC offers training, and hosted a major course on short-term climate prediction in Beijing (October 2003). They offer summer school programmes, with international instructors. Dr Dong noted the need to work together with all nations affected by the Asian Monsoon.

The BCC is willing to be an RCC for climate operational prediction, climate data and monitoring, Climate Research and Development, assessment of climate impacts, training and coordination, to serve RA II, and the global community.

5.1.2 Discussion

On the issue of probabilistic forecast products, it was noted that the public are not yet comfortable with them. China (the BCC) does not always provide probability-based output to users, and find that provision of verification information is useful.

It was noted that China is using a global coupled GCM, and then a regional model for Asia (dynamical downscaling) is applied, using a model developed in China, with 60 km resolution.

China (BCC) noted that it has a number of commercial clients for seasonal prediction (such as the agriculture sector), and that both statistical and deterministic methods are used. Thirty-two parameters are used for monthly prediction, and 6-8 are used for prediction for longer periods.

The positive benefits of Regional Climate Outlook Forums, or RCOFS (i.e. better dialogues and communications, better understanding of climate, etc.) were noted. It is recognised that RCOFS are very useful for capacity building within the met services and for development of enhanced relationships with user groups, although face-to-face meetings are expensive. Alternatives, especially technological solutions, are being explored. Funding agencies increasingly insist on having 'specific' information (hard data) on the socio-economic benefits of the predictions and products as a rationale for continued financial support.

5.2 India (G. Srinivasan)

The India Meteorological Department (IMD) has a rich history of observations and experience in the area of operational climate applications, long-lead forecasts and climate research. India also has many other institutions that are involved in ocean observations, satellite derived climate information and research in dynamical techniques. At present the IMD observational network consists of networks of surface, upper air, agromet, ocean observations, ozone and GAW stations. Radar and satellite observations further augment the strengths of the IMD, particularly in forewarning extreme weather phenomenon like tropical cyclones and severe storms. The IMD presently caters to a number of different sectors of activities for climate forecasts and products, with growing demand for

tailored services. There is also a strong need for science inputs impact assessments and advisories on possible influences of anthropogenic climate change.

5.2.1 Existing capabilities

The IMD provides a wide range of public weather services, including user-specific services for agricultural and aviation sectors. The climate-based products and advisories for agriculture, for example, include agricultural advisory bulletins, farmer weather bulletins, crop weather outlooks, crop yield forecasts, crop weather calendars, aridity indices and some tailored climatological studies. The IMD also provides services to users in other sectors including defence, environment, transport, power, water resources, tourism, marine, and non-conventional energy sources. With the growth in activities in these sectors there is an increased demand for climate information and forecast products in recent years. There is also a need for tailored weather and climate products that are tuned to very specific user requirements, including products with greater spatial resolution. Crop-specific advice that integrates weather, climate and agricultural information is one example of a tailored product in great demand.

Long-range forecasts were started in India as early as 1886. In recent years, long-range forecast models developed by IMD using statistical techniques have proven to be reasonably accurate and successful in more than 90% of the occasions in predicting the long-period average of the southwest monsoon rainfall season for the country as a whole. These techniques are being continually updated and, at present, a set of two statistical models using 8- and 10-parameters (such as Eurasian snow cover, SSTs, European pressure gradient, wind patterns at 50 hPa, etc.) are used to give operational monsoon rainfall forecasts about 45 days in advance and enable updates during the season. Techniques have also been developed for providing seasonal forecasts for three homogenous zones in the country.

In the near future it is proposed to start forecasts on seasonal mode from dynamical GCMs and to use down scaling techniques to generate forecasts at higher spatial resolution. In addition to its own operational numerical weather forecasting division, the IMD is supported by the National Centre for Medium Range Weather Forecasting (NCMRWF), running a suit of models in the medium range time-scale, and the Indian Institute of Tropical Meteorology (IITM) on longer time scales. IMD would be easily able to add regional-scale operational products to the Regional Climate Centre activities in the RA II, and particularly so with its experience of serving a WMO Regional Specialised Meteorological Centre (RSMC) in the region.

The IMD also places emphasis on research and capacity building, with the help of a number of high quality research institutions in India, including an advanced centre being implemented to build S&T capacity for dealing with issues related to climate change. The IMD successfully functions as a designated WMO Training Centre in the region, and would be willing to extend this activity to training for climate prediction and development of climate products. With this profile of activities in climate-related services ranging from operational services to training and research, the IMD could significantly contribute to the region's RCC network.

5.2.2 Discussion

With respect to extending predictions and products from statistical models to other nations (i.e. outside the boundaries of India), it can be done using other's data. The output from the models would be validated to ensure it is useful.

It was noted that regression equations in statistical models are used for agricultural forecasts, using long series of observed data (although over time, crop varieties have changed, so existing data are

not completely homogeneous). The prediction group also works with the output of the satellite group, who use satellite data to develop aridity maps.

5.3 Japan (F. Watanabe)

5.3.1 Climate Services in the Japan Meteorological Agency

The Japan Meteorological Agency (JMA) provides a variety of climate services. JMA field offices conduct climate observations. The observation data is quality-checked and archived in the Observation Division. The Climate Prediction Division (CPD) operates Climate Monitoring, Analysis and Prediction System, and then provides the many climate products to users. Long-range forecasts have been issued since 1940's. At present, a dynamical prediction model has been introduced to all kinds of long-range forecasts. Probabilistic representation in place of deterministic one has been employed for long-range forecasts. The Climate Research Department of the Meteorological Research Institute (MRI) conducts various climate studies, such as research on the mechanism of climate variability, numerical modelling for climate prediction, the global warming, and so on. CPD also has research and development activities, such as the reanalysis project, development of seasonal prediction models and downscaling techniques, and so on.

5.3.2 Tokyo Climate Center

The JMA established the Tokyo Climate Center (TCC) in CPD in April 2002. The mission of the TCC is to assist climate information services of National Meteorological and Hydrological Services (NMHSs) in the Asia-Pacific region, with the aim of mitigating climate-related disasters and contributing to the sustainable development. Although the activities of the TCC were started as the JMA's own initiative, they could contribute a lot to the WMO planning framework of Global Producing Centres (GPCs) and Regional Climate Centres (RCCs). TCC has two major tasks: to provide the basic climate data and products to NMHSs and to assist capacity building in NMHSs in the Asia-Pacific region.

5.3.3 Capabilities of JMA for RCC activities

The JMA capabilities include:

- Operational Activities
 - CPD operates the Climate Monitoring, Analysis and Prediction System. Products from the system include the monitoring of the global climate and extreme climate events, the monitoring and diagnosis of the global climate system, ENSO monitoring and prediction, and the dynamical ensemble prediction products for long-range forecasts. These climate products are disseminated to NMHSs by the TCC.
 - The Dynamical Ensemble Prediction System, which consists of a global atmospheric circulation model and a land process model, the El Niño Prediction System (ocean-atmosphere coupled model), and the Ocean Data Assimilation System (ODAS), are operated in CPD. Noting that homogeneous, consistent data is necessary for accurate monitoring of the global climate, JMA employed the Preliminary JMA Climate Data Assimilation System (PRE-JCDAS) in 2001. Because such data is also useful for other NMHSs, TCC has a plan to provide the GPs of PRE-JCDAS on the TCC website by the next March.
 - JMA has been developing the Japanese Reanalysis Project (JRA-25), to provide long-term, homogeneous data for 1979-2004. This data will improve climate products (e.g., JRA-25

provides improves precipitation results in the tropics). After the completion of JRA-25 production, the system will be operated as the operational JCDAS in place of the current PRE-JCDAS. A new Japanese Reanalysis Project will be launched then.

- JMA has been monitoring the global climate system for about 20 years, and has issued the monitored results as Monthly Report on Climate System every month since 1986. It is available on the TCC website. The global extreme climate events are monitored with CLIMAT and SYNOP messages on weekly, monthly and seasonal basis, and the results are issued as a report to users. It is also available on the TCC website.
- *Climate Observation Data Services*
 - Concerning Climate Observation Data Services, JMA has much experience of operating climate observations at surface stations, with sounding balloons, with research vessels and buoys, and with satellites. JMA implements quality-check and archives of these climate observation data.
 - JMA operates two WMO centres related to quality management of CLIMAT messages: the GCOS Surface Network (GSN) Monitoring Centre and CBS Lead Centre for the GSN Data. High-quality climate data extracted from CLIMAT messages is sent to the World Data Centre in Asheville, USA. The data could be used for monitoring of climate system, detection of climate change, and assessment of impacts of climate change.
- *Capacity Building Activities*
 - Regarding training and capacity building activities, TCC has held Training Workshops on climate system monitoring, diagnosis and prediction in the Asia-Pacific region in December 2002 and November 2003. The workshops had seminars on the climate data and products available from TCC, and some lectures on seasonal to interannual (SI) prediction. The TCC made Training Modules available on its own website.
 - The JMA and the Japan International Co-operation Agency (JICA) have carried out a training course in meteorology, which includes lectures on climate information as one of three main subjects, for developing countries every year since 1973.
 - The TCC supports capacity building for CLIPS Focal Points around the world through sharing training modules via the WMO CLIPS web pages.
- *Research and Development Activities*
 - The JMA is conducting research and development activities, not only in MRI, but also in CPD and keeps a close collaboration with universities and institutes, where advanced climate studies are carried out. In CPD, the JRA-25 project is ongoing as already mentioned, numerical prediction models for SI forecasts and El Niño prediction, down-scaling techniques for SI forecasts, monitoring techniques for the global climate system, and so on are developed.
- *Co-ordination Functions*
 - According to a survey by the TCC, there is a requirement to hold Regional Climate Outlook Forums (RCOFs) in Southeast Asia and East Asia. RCOFs were initiated in 1996 in order to mitigate El Niño-related disasters with application of El Niño prediction. Since that time RCOFs have developed to more comprehensive mechanism to promote effective use of climate information. The collaboration among scientists studying scientific bases for SI

forecasts, NMHS forecasters responsible to SI forecast services, and users of SI forecasts, is necessary for holding an RCOF. To set up the forum in Asia is a future activity plan of the TCC.

- Other future plans for TCC activities are to continue to disseminate basic climate data and products to NMHSs through the TCC website; to improve them according to the requirements of NMHSs in Asia-Pacific region; to develop downscaling techniques for regional climate prediction and application techniques to end-users; and to transfer these techniques to the NMHSs. Such activities could contribute to activation of climate services in Asia, and cover the significant part of expected tasks for RCC activities including co-ordination functions.

5.3.4 Concluding Remarks

It is concluded that JMA has enough capability as an RCC as to most items of the expected tasks for RCC activities.

5.3.5 Discussion

It was noted that the future plans for the JMA and TCC are in line with the needs of the region as identified through the RA II survey on RCCs. The tailored products to be developed by the JMA will be an important aspect of the regional services needed by NMHSs and users in the region. Global products alone are not enough. It was further noted that the GPVs of dynamical ensemble prediction in JMA are available to NMHSs in the region, but are password controlled (i.e. not available to the public).

NMHSs involved in provision of tailored products for various sectors are finding that it is difficult and expensive to meet very specific and detailed requirements, and, of course, there is still limited skill in seasonal forecasts. It was suggested that provision of tailored services might, in some cases, need to include the private sector.

5.4 Islamic Republic of Iran (S. Javanmard)

The Islamic Republic of Iran Meteorological Organization (IRIMO) was described as a leading organization, which collects weather data, produces statistical information, weather forecasts and warnings, conducts meteorological research, and also provides training services. The observing networks cover synoptic, agro-meteorological, marine, climatological, upper air, evaporation, ozone, air pollution, road meteorology observations, and include satellite receiving stations and meteorological radar stations. The telecommunications network, IRIMO database and current computing capacity were described. In addition to public weather forecasts, IRIMO provides specialized forecasts for the aeronautical, marine, agricultural and hydrological communities.

The IRIMO, as a WMO RMTTC, provides training for Class III technicians, and cooperated with Universities for higher degrees. Research fields include dynamic & synoptic meteorology, physical meteorology, weather modification, climatology, atmospheric sounding, and hydrometeorological, agrometeorological, aeronautical, marine and pollution issues.

The National Centre for Climatology in Iran (NCC) is located in Mashhad City, Khorasan province, and was established in 1996 to address the role of climate in human activities. It was decided to locate it in the region of the country with the most diverse climatic conditions. The NCC objectives include research and other academic climate activities, collaboration with international organizations and participation in activities such as Climate Change Convention and the Commission for Climatology, centralizing climatic forecasting and monitoring activities in the

country and region, developing applied climate services and extending these to the public, and reducing climate risk. A research council guides its scientific activities.

5.4.1 Existing capabilities

The NCC includes the Climatological Research Institute (CRI) established in 2001, and potentially could serve RA II as a Regional Climate Centre in West Asia. The CRI has three scientific departments: climatology of natural disasters, climate change and applied climatology. Its capabilities to serve as a Regional Climate Centre for west Asia include availability of staff with advanced degrees. Further, it was noted that, on the basis of an agreement made by WMO, countries in the region including newly independent states of Central Asia can participate in the training courses carried out in Iran through financial support from WMO and UNDP, and that the CRI has arranged a joint collaboration with the Regional Meteorological Training Center RMTC-Tehran and adequate facilities have been made available for this purpose. Beside these short-training courses, University degrees (M. Sc. and Ph. D) will be offered on climatologic and associated topics in the near future, through collaboration with universities. Preliminary steps have been taken to achieve this goal.

Regarding computing capability, it was noted that 40 personal computers with Main Frame are available in the centre for numerical modeling, data processing and training purposes. The main system is also connected to IRIMO database in Tehran. Future plans include a cluster lab for parallel processing. E-Mail and Internet facilities are also available. The centre can reach International and National data base through a new switching system. There is also a publishing unit and a library.

The NCC serves as a regional centre for risk management for natural disasters (especially drought monitoring and early warnings, and the Early Warning centre). Finally, the Islamic Republic of Iran proposed a network of three multi-functional RCCS for RA II, namely Japan, China and Iran.

5.4.2 Discussion

It was noted that the NCC is linked to, and uses, the seasonal prediction output (for temperature and precipitation) developed at the IRIMO. The IRIMO produces regional forecasts for a broad region using global model output, and produces 3-month and 6-month products. Global materials are fed into a regional model. The NCC is willing to provide products and services for the countries in western Asia.

5.5 Republic of Korea (C.K. Park)

5.5.1 The APCN MME Seasonal Prediction System

The Korea Meteorological Administration (KMA) has been operating the Asia-Pacific Economic Cooperation (APEC) Climate Network (APCN) to collect climate prediction data from several dynamic climate model-holders in the Asia-Pacific region including NMHSs and non-WMO climate institutions, and optimizes them to produce multi-model ensemble (MME) prediction information for real-time dissemination to Members and participating institutions in the Region.

The objective of APCN is to establish a well-validated multi-model ensemble system (MMES) for short-term climate prediction. The APCN MMES is based on the global models developed at different institutes of several APEC member economies (China, Chinese Taipei, Japan, Korea, Russian Federation and the USA), which have been partially validated in operational climate seasonal forecasts. At present, 13 GCM models based on a 2-tier approach are participating in the real-time multi-model ensemble experiments to build-up the infrastructure for the joint operational

seasonal forecast. The hind cast data with the observed SST and sea ice for 21 years from 1979 to 1999 are used in training the models and cross-validation.

The data used include: Surface air temperature; Sea Surface Temperature; Total Precipitation Rate; Mean Sea Level Pressure; Outgoing Longwave Radiation; 850hPa Temperature; 500hPa geopotential height; 850hPa zonal and meridional velocity; and 200hPa zonal and meridional velocity.

Data Types include: Monthly mean (total) data for individual ensemble members; Daily mean (total) data for individual ensemble members; and Monthly and daily climatology data.

The Data Resolution is a 2.5 x 2.5 degree interval over global domain (144 x 73 grids).

Deterministic and probabilistic forecasts have been performed in APCN-MMES. For deterministic forecasts, three kinds of MME techniques are used, namely simple composite, conventional point-wise SVD, and coupled pattern projection method (CPPM) with statistical downscaling. The CPPM is used to obtain the large-scale coupled pattern between predicted circulation fields and the observed field in each grid during training period, and the large-scale coupled pattern is projected on the forecasting field to produce a regional climate prediction. For probabilistic forecast, three tercile ranges are determined by ranking method based on the percentage of ensemble members from all the participating models in those three categories.

The vision of the APCN is primarily to develop a reliable seasonal prediction system by utilizing forecast products available from organizations currently generating dynamical forecasts and by optimally coordinating research and operational resources over the Asia-Pacific region, and ultimately to develop a next generation seasonal prediction system applicable to various sectors. The first vision can be achieved by coordinated activities, but the ultimate goal should be achieved by an institutional organization.

Recently, the APCN was recognized as an example of International S&T Network by the Fourth APEC Science and Technology Ministers Meeting (New Zealand, early March 2004). At that meeting, the Ministers recognized the work of APCN and the proposed initiative of APEC Climate Centre (APCC) for furthering advancement. At the 27th APEC Industrial, Science and Technology (ISTWG) Meeting held in Singapore on 14-15 September 2004, the APEC member economies supported the establishment of APCC to systematically implement its mandated role and effectively meet the challenges ahead.

APCC will be a regional climate program designed to set up an institutionalized communication channel for more effective exchanges of regional climate information among APEC member economies. Therefore, the APCC aims at realizing the APEC vision of regional prosperity through the reduction of economic losses by producing real-time operational climate prediction information based on a well-validated multi-model ensemble system, sharing high-cost climate data and information, and enhancing capacity-building in the monitoring and prediction of unusual climate in the Asia-Pacific region.

5.5.2 Long-range forecasting in the Korea Meteorological Administration

KMA produces three types of long-range weather forecasts: the monthly, seasonal, and 6-month forecasts. The monthly forecasts are announced three times a month and include temperature, precipitation, and air pressure pattern for the next 30 days. The seasonal forecasts, which are presented 4 times a year, include the trends of temperature, precipitation, Asian dust, Typhoon, Changma, and snowfall for the next 3 months. The 6-month forecast is issued two times a year.

5.5.2.1 Global ocean forecasting system and global LRF system

For the 6-month forecast system, KMA has operating the existing long-range forecasting system and adjusting the system to produce the objective data proper to the operational system. To predict the global sea surface temperature as a boundary condition for the 2-tier system, the global ocean forecasting system is developed as a combined system of dynamical and statistical models. The global long-range forecasting system, using global climate models, is also being developed, and the SMIP-type summer and winter climatology for each model is produced for removing model bias and improving predictability. As the basis for the multi-model ensemble, various MME techniques are being tested. All systems are connected to the web-based climate prediction display system and tentatively expressed in intranet.

The ***El Nino prediction system*** (Kang and Kug, 2000) is based on the intermediate ocean and statistical atmosphere model. The ocean model differs from the Cane and Zebiak (1987) model in the parameterization of subsurface temperature and the basic state. The statistical atmosphere model is developed based on the singular value decomposition (SVD) of wind stress and SST.

To reduce the uncertainty of initial field on the ENSO model, the breeding technique is applied. In the case of an ideal experiment, it works for better predictability, while for our El Nino prediction model, its effect is not so clear because it has weak nonlinearity. Therefore, it shows some possibilities to contribute the improvement of predictability for the complicated future ENSO prediction using coupled GCM.

In order to improve the western Pacific SST prediction, KMA introduced the heat flux formula and vertical mixing parameterization to the ocean model. The initialization of the model is done by combining observed SST and wind stress. Wind stress is calculated by using the 925hPa wind of NCEP/NCAR reanalysis data. Using calculated wind stress for initialization has a better forecast skill than the FSU wind stress in recent predictions. (Kug et al., 2001). In addition, the present prediction is attended with random noise considered weather noise, and generates many sets of prediction. Our approach for random noise is similar to Kirtman and Schopf (1998).

Then, to correct the systemic error in the prediction model, the statistical model is also applied. The used coupled pattern projection model (CPPM, Lee and Kang 2003) is a kind of pointwise regression model, and the main idea of the model is to generate realization of predictions from projections of covariance patterns between the large-scale predictor field and regional predictions onto large-scale predictor field at the target year. By applying this model to the dynamic model results and compositing the results from both the dynamical and statistical models, the predictability over the tropical Pacific is improved than before.

The model results for 6-month predictions of the tropical SST anomaly, thermo cline depth, and Nino 3 index are provided on the KMA Internet home page.

With respect to the ***global SST forecasting system***, most of the seasonal predictions by the dynamical model are performed using a two-tiered approach in which SSTs are first predicted and then used to force an atmospheric model because of the primitive state of coupled ocean-atmosphere GCMs. Thus, the accuracy of global SST prediction plays an important role in long-range climate prediction of the dynamical model, although persistent global SST prediction is quite effective in short-range prediction (Goddard and Graham, 1977). Persistence remains the best strategy at short lead times (1 or 2 month) for any part of the global oceans (Landman and Manson, 2001). In the tropics and subtropics, long-lead SST predictions easily outperform persistence, and are regarded as useful in the dynamical model as well as the statistical model (Barnston et al, 1994; Landman and Manson, 2001; Kang et al, 2001). However, long-lead extratropical SST prediction has a very poor skill (Landman and Manson, 2001).

To predict the whole global ocean, a statistical global SST prediction system is being developed by combining CPPM, LLRM, El Nino, and persistence. In the tropical Pacific, predictions produced by El Nino model are used, and in other regions the best results between CPPM, LLRM, and persistence are used. The LLRM (Lagged Linear Regression Method) is one of the point wise statistical model based on the lag relationship between the global SST and ENSO index and the optimal lag is selected by the hindcast process in the model. This is developed to determine predict the Indian SST prediction. Using this global ocean forecasting system, the boundary conditions for the global climate model are also produced.

With respect to the ***global LRF system using global climate models***, the KMA carries out seasonal dynamic prediction employing an AGCM (Atmospheric Global Climate Model) for given SST and sea ice boundary conditions and initial conditions at needed point in time. In the case of performing hindcast for climatology, predicted SST is used, and in other cases, i.e. prediction, forecasted SST of the "SST prediction system" is used.

The experimental design for AGCMs is the SMIP type integration. It is a part of SMIP (Seasonal Climate Model Intercomparison Project) that has been proposed for evaluating the actual predictability of AGCM through numerous international co-operations of atmospheric societies (organized by WGSIP/CLIVAR). Unlike the method of Atmospheric Climate Model Intercomparison Project (AMIP), which is integrated for several decades from one specific initial time and mainly affected by boundary conditions, i.e. observed monthly SST, seasonal climate prediction is started each year for several months and affected mainly by initial conditions. From a specific time (initial time), we carried out the integration for 7 months with 10 ensembles. The global climate models used are KMA GDAPS (Global Data Assimilation and Prediction System) and KMA/SNU GCPS (Global Climate Prediction System).

To obtain the proper model climatology for removing model bias and achieving proper anomaly values, two models are integrated during the 24 years from 1979 to 2002, respectively. As initial data, the NCEP/NCAR CDC reanalysis 6-hourly surface and surface flux data for land surface and NCEP/NCAR CDC reanalysis 6-hourly pressure data for 5 days (00Z and 12Z in every day) in each month for atmospheric data are used. Starting from the end of April and October, the SMIP-type summer and winter climatology are produced.

After removing the climatology from the original data, the model anomaly data is obtained and used for investigating the characteristics of each model. This predictability study includes the effect of lead-time, interannual variability, signal to noise analysis, potential predictability, and correctable systemic errors in dynamics models, etc.

5.5.2.2 Regional Climate Long-Range Forecasting System

To predict the regional climate over Korea using global climate model results, two kinds of forecasting systems have been developed. One is the statistical downscaling and the other is the analog method.

Future plans for development related to operational LRF system include that the KMA will continue the improvement of operational LRF system in cooperation with universities and research institutes. The future systems under research and development include 12-month forecast system, 3-month forecast system and seasonal/annual typhoon forecast system. The 12-month forecast system will be based on the global SST prediction & tier-2 LRF system, coupled GCM (tier-1 system) and statistical downscaling. The 3-month forecast system will be based on regional dynamical and statistical downscaling and multi-model ensemble. The seasonal/annual typhoon forecast system

will be based on the dynamical and statistical methods. These systems are being developed for operational use in 2006.

5.5.3 Discussion

It was noted that the summer of 2003 was the hottest in 10 years, and that the values of forecast updates, verification and evaluation were demonstrated.

It was further noted that China, Japan and Korea have been working together since 1998 on summer and winter East-Asian monsoon forecasts, and that the KMA hosts the APCN secretariat. Current members include China, Chinese Taipei, Japan, Korea, the Russian Federation and the USA. Australia and Canada are joining. The APCN forecast product web site is not open to the public. NMHSs that belong to APEC and other APEC members can access the information under password.

KMA does training and capacity building on meteorological technology and policy); on weather forecasting for operational meteorologists; and hosts workshops for the ASEAN region. With respect to RA II RCC activities, the ACC does operational, and coordination activities, but data services are domestic, mainly. Training is not yet up to providing regional level support.

APEC and CLIVAR are collaborating on modelling issues such as drift and weighting functions. Many models are used, because even low-resolution models sometimes show good results.

Dr Park noted that WMO has discussed GPCs, but only generally, and that there should be a parallel effort in designating RCCs and getting the products from GPCs. CBS provided a list of variables to be provided by GPCs, so far there is no restriction proposed by WMO to give the GPC output only to formally designated RCCs. As well Formats and standards have been proposed, but not finalized through CBS. These may all be discussed at the upcoming meeting in November.

5.6 Pakistan (A.B. Farooqi)

Perspectives on climate change in Pakistan were reviewed. There are several centres in Pakistan using such studies, including the Global Change Impacts Study Centre. The objectives of a recent study were to assess past climate changes and computer projected changes in various agro-climatic regions of the country for the next half century using regional and global climate models. Objectives included assessment of the vulnerabilities and suitable coping mechanisms.

The premise is that climate change is occurring, and this is causing shifts in meteorological conditions lasting years or longer. Past climate data (1951-2000) are used for trend analysis of Temperature and Precipitation for Pakistan. The country is located in the sub-tropics and partly in a temperate region. It has a long-latitudinal extent. Most parts are arid to semi-arid. Fifty-nine percent of the rainfall is from the monsoon. Snowmelt contribution from the Himalayas maintains river flows throughout the year.

The global climate model SCHENGIN, and regional climate model RegCM2 were used to plot trend changes for Temperature and Precipitation. Pakistan is experiencing general temperature increase and a rise in extreme climate events. The Dokriani glacier retreated 66 m in 1998 in spite of a severe winter. Central and eastern glaciers in Himalayas could disappear by 2035.

El Niño and La Niña have an effect on the weather of Pakistan. The All-Pakistan rainfall time series shows that monsoon rainfall was diminished in the 8 strongest El Niño events. In moderate to weak El Niño events, rainfall for the most part tends to be normal to somewhat below normal but there

are exceptions. There are varying impacts on precipitation in Pakistan with La Niña conditions, depending on the season.

In discussion, the chair clarified the response of Pakistan to the recent survey. Pakistan confirmed that it requires RCC support for most areas including training, but doesn't require operational service and support from RCCs.

5.7 Russian Federation (D.B. Kiktev)

It was noted that the total annual direct losses in Russia associated with dangerous weather and hydrological events are estimated to be USD 1-2 billion. Recent massive economic losses and human casualties resulting from floods, avalanches and torrential storms in the North Caucasus, Siberia and the Far East have showed how vulnerable the Russian Federation is today with respect to weather hazards.

5.7.1 Specific features of the Russian Region from the point of view of RCC services

There are a number of features of the Russian Federation and current capabilities that must be taken into account in consideration of establishment of an RCC:

- The Russian Federation is an enormous territory (mostly in RA II, but there is also a considerable part in RA VI);
- There is a great diversity of weather and climate conditions;
- The observational network and data exchange facilities for the full area are not uniform;
- There are elements of integration between the former USSR countries. The Automatic System of Data Transfer (ASDT) of Roshydromet is used for data exchange between the members of the Commonwealth of Independent States (CIS). These countries have access to all operational data circulating via ASDT. From their part, these countries transmit their data to Roshydromet;
- The absence of serious lingual barriers between Russia and other CIS countries is an asset;
- There is relatively low predictability on the seasonal time scale for most of the territory. For the major part of Russia, useful predictability is limited to approximately 1 month; and,
- There is a relatively low ENSO influence on climate variability.

It was noted that, given the current low level of skill of seasonal forecasts for the extra-tropics, the relative role of LRF interpretation might not be in the foreground of RCC functions for this area (i.e. the higher northern latitudes), as it might be for more tropical latitudes.

5.7.2 Reasons for establishment of RCC in Russia

The rationale for establishment of an RCC in Russia includes:

- Specificity (from the point of view of predictability and climate conditions) and dimensions of the territory of the country. It is considered to be preferable for Russian economy to be served by one RCC responsible for the whole territory of the country;
- There are already existing elements of RCC infrastructure in Russia and the Commonwealth of Independent States;
- The World Data Centre in Obninsk provides a unique environmental data bank and facilities;
- There is an already issued spectrum of prognostic and diagnostic climate products;
- Technical modernization of Roshydromet is planned.

5.7.3 Proposal for an RCC-Moscow

As no single organization in Roshydromet can deal with the full spectrum of climate issues for Russia, a distributed structure of RCC-Moscow was proposed. Potential participants (in the first stage of the system would include: the Hydrometeorological Research Centre of Russia; the Main Geophysical Observatory; the Institute for Global Climate and Ecology; and the All-Russian Research Institute of Hydrometeorological Information – World Data Centre. This list might be expanded in the future, to include, for example, the Research Institute for Agricultural Meteorology and the Arctic and Antarctic Research Institute (World Data Centre for Sea Ice). All the members are connected by the scientific subject matter and through the process of data collection, processing and archiving, and dissemination of information products.

5.7.4 Current capacity and products

There is a WMO Regional Meteorological Training Centre (RMTC) in the Russian Federation, in Kuchino, near Moscow. This centre organizes specialized training for specialists from RA VI and other regions (to WMO standards), and collaborates with other RMTCs on exchange of experience and methods.

SI empirical and statistical forecasting has been an object of research in Russia for several decades. A string of operational regional forecast products based on statistical methods is issued. Meteorological forecasts include 1-month forecast of temperature and precipitation anomalies (issued monthly) and 6-month forecast of temperature anomalies for vegetation and heating seasons. Marine forecasts include forecast of Caspian Sea level and forecast of ice conditions (dates of the ice phases beginning, ice period duration, ice thickness, ice boundary location) for non-Arctic seas for 1 month and for the cold season. Hydrological forecasts include forecasts of water inflow into large water reservoirs for a decade, month, quarter; maximum water level of spring floods for up to 4 months ahead; minimum water level forecast for navigable rivers for 1 month ahead; and ice appearance / disappearance and freezing / breaking-up forecasts for up to 2 months. Agro-meteorological forecasts cover an aridity Index forecast for the next month for the territory of CIS; phenological dates forecasts of the main grain crops ripening and fruit florification for 1 month ahead; yield forecasts of main agricultural crops for 1-3 months ahead; and forecasts of grain crops wintering for 2-3 months ahead.

With respect to dynamical LRF products, global hydrodynamic-statistic 1-month forecasts have been issued since 2000; dynamical seasonal forecasts of the MGO have been issued since 2002; and WMC-Moscow began to issue dynamical seasonal forecasts in 2004. Future plans include development of multi-model products (Hydrometcentre + MGO).

5.7.5 Recent history and future plans

The capacity of Roshydromet to provide services to Russia and globally has declined since the economic transition began. As a result, Roshydromet's capacity to help prevent economic and human losses deteriorated. In the last few years, however, the Government has made a renewed commitment to improve Roshydromet's performance, and its observational and other infrastructure (radar, generators, supercomputer, etc.). A large-scale Roshydromet modernization project is to start in 2005. In near future, therefore, Roshydromet's potential for provision of RCC functions is expected to increase.

5.7.6 Discussion

It was noted that the distributed system proposed to serve the RCC needs of the enormous territory of the Russian Federation would likely also be able to serve some needs of neighbouring countries.

There are already some strong ties existing. It was further noted that increasingly products are being placed on the web site, particularly on the Russian web site. The English site is developing.

5.8 The Socialist Republic of Viet Nam (T. Nguyen Van)

The geographical situation of Viet Nam was described. Viet Nam crosses 15 degrees of latitude, and has abundant rainfall from summer monsoon, typhoons and cold fronts. The rainy season is May to October, while December to March is dry.

5.8.1 Current Capabilities

Current efforts are to predict seasonal total rainfall and seasonal mean temperature. Predictors, for the statistical models, include SSTs in the NINO regions and the SOI (both 122 months before forecast season); and twelve SSTA principal components (from BOM). Stepwise multiple linear regression is used and cross-validation is performed.

Viet Nam issues a climate bulletin (past 3 months, covering ENSO, monsoon and trades activities, and climatic variation in Vietnam specifically, along with overviews of the various elements and impacts) and a seasonal climate outlook (next three months, covering ENSO, IRI and ECMWF seasonal temperature and precipitation forecasts, and numbers of cold fronts and cyclones for Viet Nam).

5.8.2 Future plans

Plans for the immediate future include:

1. Operating Seasonal Climate Prediction (seasonal temperature, rainfall, numbers of cold fronts, long consecutive hot, dry spells, heavy rainfall and cyclones);
2. Providing Operational Climate Bulletin and Outlook (monthly);
3. Applying Climate Empirical Methods obtained from NOAA (USA), ASMC (ASEAN):
Statistical Transformation of Dynamical Model Output (Statistical Downscaling Method):
 - a. Data: Monthly and seasonal rainfall and temperature (from 1950 to 2000) at 150 stations in 7 climatic zones of Viet Nam; Monthly SSTA, SLPA, Wind, OLR (from 1950 to 2000) of grid boxes in the binary form.
 - b. Methods: Using the Grads software to calculate the correlation coefficients of rainfall or temperature indices with the anomalies of grid boxes SSTA, SLPA, WindA, OLRA in different lags of one to several months in order to find the best correlation to predict the seasonal rainfall/ temperature indices based on regression equations of the observed and predicted SSTA, SLPA, WindA, OLRA data at selected areas; Running the Systat10 software to estimate and test simple and multiple linear regression models, then to determine the quality of the Forecast Model (Forecast Verification Methods).

Longer-term plans include:

1. Continuing survey and study on dynamic models (GCMs and RCMs);
2. Developing Regional Climate Model for Southeast Asia and Viet Nam (Dynamical Downscaling Method);
3. Establishing and implementing a Project: "Climate Information and Prediction Services (CLIPS) for Sustainable Socio-Economic Development, Natural Disasters Mitigation and Environmental Protection in Viet Nam".

To carry out these activities, Viet Nam will need training on Regional Climate Models; installing and running the NCAR/RegCM2 and NCEP/RSM97 in Viet Nam; and Grid data and monthly gridded

data (SST, SSTA, SLP, SLPA, Wind, Wind Anomaly, OLR, OLR Anomaly) from 2001 to present (how to download and update data) to serve the empirical climate prediction models (statistical downscaling).

5.8.3 Discussion

It was noted that in the survey, Viet Nam indicated it could carry out many functions for the region. The country hopes, with the support of WMO, NOAA, IRI, etc, to improve its functionality and become an RCC for the region. Viet Nam is now performing climate prediction, and has a number of bi-lateral agreements within the region already.

6. STRUCTURE OF RCCs FOR RA II

Dr Sugi reviewed the guidance on structures (WCASP No. 62), and suggested various RA II options for each. Considering the survey and the regional priorities it revealed, along with regional circumstances, an RCC network, linked by the Internet was proposed. Each RCC in the network would cover some functions and would tend to cover different sub-regions. The difference from a virtual system is in how the coordination would take place.

Participants unanimously agreed on the optimal structure of RCCs for RA II, including functions, eligibility criteria and on the role of an oversight committee. Key features of the discussions were flexibility and inclusiveness. An important aspect was that RCCs need to be, eventually, capable of official designation through the WMO Technical Regulations, under Volume I of the manual on the GDPS (WMO No. 485). Single-focus centres (i.e. for training, or research, for example) would not be RCCs in RA II. It was further noted that existing WMO specialized training centres must adapt their programmes to include training in, for example, climate prediction and development of specialized climate products, in order to be part of the RA II-RCC network.

6.1 Structures of RCCs for RA II

The complete agreed text regarding RCC structure for RA II, including responsibilities for the oversight committee, to be proposed to the Thirteenth Session of RA II (December, 2004, Hong Kong China) for approval, is as follows:

6.1.1 The CCI Ad Hoc Expert Team, in the Meeting on Organization and Implementation of Regional Climate Centres (RCCs) (Geneva, Switzerland, 27-28 November 2003), developed "Guidelines for the establishment of Regional Climate Centres" that provides possible structures of RCCs and designation procedures.

6.1.2 The Guidelines point out that there are a number of factors that should be taken into account when considering the structure of RCCs in a Region. These factors include:

- sub-regional needs and capacities,
- cost-effectiveness and inclusiveness to allow all Members as well as non-WMO climate institutions such as universities and specialised agencies, providing these institutions comply with WMO data policies and regulations, to participate, and
- flexibility to allow for overlap and co-ordination between Regions.

6.1.3 The Guidelines show the following options as the possible structure of RCCs in a Region:

- Single centre: one single, multifunctional centre for the whole region
- Distributed system: a distributed function with several RCCs within the region, each providing a unique focus,

- Multiple centres: distributed multifunctional and/or single functional centres
- Virtual system: multiple centres linked and identified as one RCC.

Feasible structures of RCCs in RA II

6.1.4 Considering that each one of the six WMO Regions has a geographically large extent and is diverse with a complexity of climatic, political and socio-economic conditions, the Guidelines suggest establishing multiple climate centres in a WMO Region rather than the establishment of a single, multifunctional Regional Climate Centre to meet the needs of the entire Region. The Guidelines state that much duplication of work is unlikely in a multiple-centre structure. While some functions might be similar, they would apply to different sub-regional interests and provide different outcomes.

6.1.5 The questionnaire survey on requirements for RCCs in RA II revealed Members require RCCs to carry out a wide range of functions in the areas of “Operational Activities”, “Co-ordination Functions”, “Data Services”, “Training and Capacity Building” and “Research and Development.”

6.1.6 Considering the above requirements for RCCs in RA II and the fact that RA II covers a very large geographical area with a large range of climates, it would not be always feasible to establish a single, multifunctional centre that covers all or part of the required activities for the whole Region.

6.1.7 In the questionnaire, many NMHSs indicated that they are able to perform part of the activities required for RCCs. But considering that climatological science, technology and application are rapidly developing, it would be appropriate to keep each RCC’s activities as flexible as possible.

Proposal for the structure for RCC activities in RA II

6.1.8 Taking these circumstances into consideration, the Working Group proposes a network of multiple multifunctional centres (RCCs) complemented by specialised centres (RA-II RCC network), as the structure for implementing RCC activities in Region II. All of the centres are linked through the Internet and loosely coordinated by an oversight committee described in 6.1.13.

Functions of RCC

6.1.9 RCC’s functions should include most of “Operational function”, “Co-ordination function”, “Data services function”, “Training and capacity building function” and “Research and development function”, as identified in the survey (see **ANNEX V**). The listed functions are the high priority functions identified by the survey. In addition, the functions regarding applications for users are added in the list, according to the discussion in 4.2. Functions of specialised centres will focus on any one of the five key categories. All components of the RCC network will adhere to WMO resolutions including those on exchange of meteorological and hydrological data (Resolutions 40 and 25).

6.1.10 In order to keep the flexibility of RCC, climate products and services provided by each participating centre may be subject to change (to be coordinated through the oversight committee).

Eligibility and overall structure

6.1.11

1. An NMHS responsible for climate-related services that intends to serve as an RCC and is able to implement most of the listed functions, preferably including most operational activities for all or part of the Region, will be eligible to be an RCC in Region II.

2. NMHSs or organizations approved by RA II that are able to implement any one category of RCC functions for all or part of the Region are able to become a specialised centre in the RCC network of Region II.

6.1.12 In the RA-II RCC network (see 6.1.8), each NMHS that provides climate services for RCC activities should establish and manage its web site of the NMHS's own initiative, in compliance with WMO data policies. All of the web sites will be integrated by linking to a central homepage (RAII-RCC homepage), to ensure the visibility of the whole structure of the system as well as their activities.

Role of Working Group on climate-related matters

6.1.13 It is suggested that the Region II Working Group on climate-related matters including CLIPS (WGC) be responsible for RCC's overall co-ordination through various activities such as:

- To identify responsible member NMHS to host the RAII-RCC homepage;
- To receive and consider applications from or through NMHSs to serve as volunteer for RAII-RCC network;
- To monitor and review the status of existing RCC activities and report to the President every year and at the regular session of RA II every 4 years;
- To review NMHS's requirements for RCC activities;
- To propose remedial measures for outstanding RCC activities; and
- To deal with other issues related to RCC activities, such as inter-Regional coordination.

6.1.14 Each centre of the RCC network should develop its implementation plan and submit it to the WGC before implementation and should submit activity reports to the WGC annually.

7. DESIGNATION PROCEDURES

WMO reviewed the information on designation from the Guidelines (WCASP No. 62) and the extract from the Manual on the Global Data Processing System (WMO No. 485) presented in **ANNEX IV**. It was noted that at the November 2003 meeting on the Organization and Implementation of RCCs, CBS/WWW strongly urged formal designation for RCCs, but that not all regions agreed. It was further noted that formal designation of RCCs would allow a strict evaluation of performance and capacity to deliver the regional requirements, and would lead to identification of centres of excellence for climate, which would, for some NMHSs, be highly desirable.

The extract in **ANNEX IV** describes the process that would be required. According to the Manual on the GDPS, there are two options of procedures for the establishment of RCCs as follows:

- Designation in accordance with Volume I (Global Aspects) of the Manual,
- Establishment with full responsibility of the Regional Associations in accordance with Volume II (Regional Aspects) of the Manual.

The Working Group noted that there has been no decision on the designation procedures for RCC or standards of implementation yet, either globally or in RA II. Therefore, it would be premature to decide the issue of designation procedure at present.

However, the Working Group was of the view that it is not desirable to postpone RCC activities due to the need to establish designation procedures for RCCs. Therefore, the Working Group proposed procedures to begin an RCC Feasibility Study Experiment in RA II (RCC-FSE), with voluntary participation of NMHSs in the Region, to evaluate and demonstrate the effectiveness of RCCs.

Proposed procedures to begin the RCC-FSE are as follows:

- To invite RA II at its thirteenth session to approve the RCC-FSE for the intersessional period,
- To identify NMHSs which are willing to participate in RCC-FSE and capable to implement RCC-FSE activities as participating institutions,
- To begin RCC-FSE activities for the Region on a pilot basis, and
- To invite the Working Group on Climate Matters, to be re-established in XIII RA II, to monitor and evaluate RCC-FSE activities, consider the designation options and make a final report to RA II President at the Fourteenth session of RA II.

8. RECOMMENDATIONS

The Working Group summarized the results of its deliberations and agreements in a recommendation, to be tabled for approval at the upcoming Thirteenth Session of RA II (December 2004, Hong Kong). The full text of the draft recommendation is as follows:

The RA II Working Group on Climate-Related Matters including CLIPS in Region II,

NOTING:

- (1) Resolution 7 (XI-RA II): WORKING GROUP ON CLIMATE RELATED MATTERS INCLUDING CLIPS IN REGION II,
- (2) Proceedings of the Meeting on Organization and Implementation of Regional Climate Centres (WMO-TD No. 1198)

RECOGNIZING:

- (1) EC-LVI (2004) urged regional associations interested in RCCs to proceed quickly toward implementation.
- (2) RA II President's request to conduct a survey on requirements for the establishment of RCCs in RA II and report the result to XIII RA II,
- (3) the urgent needs in Region II, identified by the survey, to establish a system of Regional Climate Centres (RCCs) in order to enhance the climate information services of NMHSs,
- (4) capacity in Region II, identified by the survey, to perform a broad range of RCC functions for the Region, and
- (5) designation procedures for RCCs are subject to agreement between CBS and CCI, which is yet to be concluded,

RECOMMENDS REGIONAL ASSOCIATION II (ASIA):

- (1) To take steps to implement a network of multiple multifunctional centres and specialised centres (RA-II RCC network), as the structure for implementing RCC activities in Region II,
- (2) To begin the RCC Feasibility Study Experiment in RA II (RCC-FSE) on a pilot basis by inviting voluntary participation of NMHSs in the Region in order to evaluate the effectiveness of RCC activities,
- (3) To approve the RCC-FSE network, which is the network of multiple multifunctional centres and specialised centres linked by Internet, as the structure for implementing RCC-FSE activities with the following functions:

Functions of RCC-FSE

- (a) RCC-FSE's functions should be composed of "Operational function", "Co-ordination function", "Data services function", "Training and capacity building function" and "Research and development function". Its functions and activities are listed in the **ANNEX V**.
- (b) In order to keep the flexibility of RCC-FSE, climate products and services provided by each participating institution may be subject to change over the course of this experiment.

Eligibility and overall structure

- (a) An NMHS, or an organization recommended by an NMHS, responsible for climate-related services, that intends to provide services of RCC-FSE on its own initiative and on a voluntary basis (participating institution), is eligible to participate in RCC-FSE. A participating institution should be able to perform at least some of the listed functions, preferably including several operational activities, for all or a part of the Region, and must adhere to WMO regulations and resolutions including data policy (Resolutions 40 and 25).
 - (b) In the RCC-FSE network, each participating institution should establish and manage its web site on its own initiative. All of the web sites are integrated by linking to the RCC-FSE network homepage, to ensure the visibility of the whole structure of the system and their activities.
 - (c) Each participating institution should develop its implementation plan and submit it to the Region II Working Group on climate-related matters including CLIPS (WGC) in advance. In addition, participating institutions should submit activity reports on an annual basis to WGC.
- (4) To authorize WGC to be responsible for RCC-FSE overall co-ordination that includes:
- (a) To identify NMHS to host the RCC-FSE network homepage;
 - (b) To receive and consider applications for FSE and identify participating institutions for the experiment;
 - (c) To monitor and review the current status of RCC-FSE activities and report to RA II President every year and submit a final report to XIV RA II;
 - (d) To review NMHS requirements for RCC-FSE activities;
 - (e) To propose remedial measures for outstanding RCC-FSE activities;
 - (f) To deal with other issues related to RCC-FSE activities; and
 - (g) To consider the adequacy of eligibility and overall structure of RCC through reviewing this RCC-FSE.

9. CLOSURE OF THE MEETING

On behalf of WMO, Mrs Malone thanked the host for the meeting, the Japan Meteorological Agency, for their excellent hospitality and support for the session, and for their helpful logistical arrangements. She thanked the participants as well for their enthusiastic efforts that made the meeting a great success. Dr Sugi extended his gratitude at the satisfactory conclusion to the meeting, and the participants in turn, thanked Dr Sugi and his team for their excellent leadership throughout the meeting.

The meeting was closed at 5:00 p.m. on 27 October 2004.

WORLD METEOROLOGICAL ORGANIZATION

MEETING OF THE
RA II WORKING GROUP ON CLIMATE MATTERS

TOKYO, JAPAN, 25 – 27 OCTOBER 2004

AGENDA

1. Opening of the Meeting
2. Organization of the Meeting
3. Review of Previous Discussions on Regional Climate Centres (RCCs)
4. Summary and Review of "Questionnaire on Requirements for Establishment of a Regional Climate Centre"
5. Requirements and Existing Capabilities for RCC Services
6. Structures of RCCs for RA II
7. Designation Procedures
8. Recommendations
9. Closure of the Meeting

WORLD METEOROLOGICAL ORGANIZATION

MEETING OF THE
RA II WORKING GROUP ON CLIMATE MATTERS

TOKYO, JAPAN, 25 – 27 OCTOBER 2004

LIST OF PARTICIPANTS

China

Prof Dr Wenjie DONG
China Meteorological Administration
Deputy Director
General National Climate Center 46,
Zhongguancun Nandajie Haidian
District 100081 BEIJING
Tel: 86 10 6840 8474
Fax: 86 10 6217 6804
Email: dongwj@cma.gov.cn

The Islamic Republic of Iran

Dr Sohaila JAVANMARD
Deputy for Climate Research
Islamic Republic of Iran Meteorological
Organization (IRIMO)
Meraj Avenue, Azadi Sq.
P.O. Box 13185-461
TEHRAN
Tel: 98 21 6025047, 98 711 7269951
Fax: 98 21 6000417, 98 711 7268518
Email: sjavanmard2004@yahoo.com

Republic of Korea

Dr Chung-Kyu PARK
Korea Meteorological Administration
Director
Climate Prediction Division, Climate Bureau
460-18, Sindaebang-dong
Dongjak-Gu
SEOUL 150-720
Tel: 82 2 836 6754
Fax: 82 2 832 6018
Email: ckpark@kma.gov.kr

India

Dr Govindarajan SRINIVASAN
India Meteorological Department
Director
Climate Change Analysis Group
609, Mausam Bhawan, Lodi Road
NEW DELHI 110003
Tel: 91 11 2461 1710
Fax: 91 11 2461 1792, 91 11 2461 1710
Email: srini@imdmail.gov.in
srinidst@alpha.nic.in

Japan

Dr Masato SUGI
Japan Meteorological Agency
Director
Climate Prediction Division Climate and Marine
Department 1-3-4 Otemachi, Chiyoda-ku
100-8122 TOKYO
Tel: 81 3 3212 8341 (Ext: 3151)
Fax: 81 3 3211 8406
Email: msugi@met.kishou.go.jp

Pakistan

Mr Anjum Bari FAROOQI
Pakistan Meteorological Department
Chief Meteorologist
Headquarters Office
Sector H 8/2, PO Box 1214 Sector H-8/2
ISLAMABAD 44000
Tel: 9251 9257313
Fax: 9251 4432588
Email: pmisba@isb.paknet.com.pk
pmd@pakmet.com.pk

Russian Federation

Dr Dmitry B. Kiktev
Hydrometeorological Research Centre of
Russia
Deputy Director
11-13, Bolshoy Predtechensky st.
123242 MOSCOW
Tel: 7 095 255 1354
Fax: 7 095 255 1582
Email: kiktev@mecom.ru

WMO SECRETARIAT

7bis, Avenue de la Paix
CP 2300
CH-1211 GENEVA 2

Mrs Leslie MALONE
Scientific Officer
World Climate Applications and CLIPS Division
World Climate Programme Department
Tel: 41 22 730 8220
Fax: 41 22 730 8042
Email: LMalone@wmo.int

The Socialist Republic of Viet Nam

Dr Thang NGUYEN VAN
Director of Center for Meteorology and
Climatology
Institute of Meteorology and Hydrology
Ministry of Natural Resources and Environment
of Viet Nam
5/62, Nguyen Chi Thanh Road,
Dong Da District
HANOI
Tel: 84 4 835 9415
Fax: 84 4 835 5993
Email: nvthang62@hotmail.com
nvthang@vktv.edu.vn

Local Coordinator

Dr Shinji NAKAGAWA
Japan Meteorological Agency
Head, Office of International Affairs
Planning Division
Administration Department
Tel: 81 3 3211 4966
Fax: 81 3 3211 2032
Email: inad-jma@hq.kishou.go.jp
s_nakagawa@met.kishou.go.jp

Mr Fumio WATANABE
Japan Meteorological Agency
Head of Tokyo Climate Center
Climate Prediction Division
Climate and Marine Department
1-3-4 Otemachi, Chiyoda-ku
100-8122 TOKYO
Tel: 81 3 3212 8341 (Ext: 3166)
Fax: 81 3 3211 8406
Email: fumio.watanabe@met.kishou.go.jp

**Extract of paragraphs on Regional Climate Centres from the
Abridged Final Summaries of EC-LIII, EC-LIV, CG-XIV and EC-LVI**

EC-LIII (2001)

4.1.31 The Council was pleased to receive the report from the Intercommission Task Team on Regional Climate Centres. The Council expressed its sincere appreciation for the quality of the work undertaken by the Intercommission Task Team and, while recognizing that an important foundation had been laid, commented that more detailed preparation still needed to be made. Future work was needed to secure the leading role of NMHSs in the delivery of services in order to ensure that the development of climate services within NMHSs of developing countries was not held back, and that there was close collaboration between relevant WMO commissions and between WMO and all other bodies involved. The Council noted that the report included the Statement of User Requirements for Seasonal to Interannual Operational Prediction and Forecast Products, prepared by CCI, and a proposed list of RCC functions. The Council requested that CCI keep the Statement of User Requirements under review.

4.1.32 Noting that the concept of RCCs was widely supported within the contributing commissions, the Council confirmed that establishment of such Centres was desirable, where appropriate, to assist NMHSs to interpret and apply seasonal to interannual forecasts. The Council further confirmed that the list of RCC functions developed by the Task Team was comprehensive and that, depending on regional requirements, individual Centres might not necessarily be required to handle all functions. Furthermore, the Council recognized that the needs for establishing those Centres and the structure of such Centres, might vary between and across regions. Individual regions might require more than a single Centre. The option of virtual centres created by networking existing organizations was also recommended for consideration. Accordingly, the Council strongly endorsed the involvement of regional associations in further activities directed at the establishment of RCCs. The Council was pleased to note the offers made by China and the Islamic Republic of Iran to host RCCs. The Council also noted that there were already existing relevant activities for operational delivery of global forecast products for climate by many national and regional Meteorological Services as identified by the Intercommission Task Team.

4.1.33 The Council confirmed that the creation of RCCs should follow the established procedures for the designation of RSMCs and that that process should involve all relevant commissions in order to discriminate clearly the additional activities of the Centres from those of existing GDPS RSMCs. The demonstration of capabilities of proposed Centres fell into the remits of both CBS and CCI.

4.1.34 The Council noted that commitments to providing operational seasonal to interannual forecasts would need to be sought from producing centres. In a first developmental stage, the Council agreed that a limited number of forecast producers with global capabilities should be approached, including both numerical and empirical producers. The Council noted that the Intercommission Task Team proposed that the following centres be approached in the first instance: the Bureau of Meteorology (Australia), the Centre for Weather Prediction and Climate Studies (Brazil), the Meteorological Service of Canada, Météo-France, the Japan Meteorological Agency, the South African Weather Bureau, the Meteorological Office (United Kingdom), the Climate Prediction Center (United States), ECMWF and the International Research Institute for Climate Prediction (United States). The Council was pleased to note that the Max Planck Institute for Meteorology in Germany had agreed to serve as a producing centre. Recognizing that seasonal to interannual forecast capabilities existed in a substantial and growing number of centres, the Council strongly recommended that neither the initial limited list of producers, nor any subsequent

expanded list, be exclusive of any organization that wished to participate provided that they could fulfill the stated requirements.

4.1.35 Considering the extent of further cross-Programme coordination necessary to establish RCCs, the Council agreed that the work of the Intercommission Task Team on Regional Climate Centres would be extended until its forty-fourth session. Accordingly, the Council adopted Resolution 7 (EC-LIII).

EC-LIV (2002)

4.1.2.9 The Council was pleased to receive the report from the Intercommission Task Team on RCCs. The Council expressed its sincere appreciation for the quality of the work undertaken by the Task Team and, while recognizing that an important foundation had been laid, commented that more detailed preparation still needed to be made as a preparation for the establishment of RCCs. Future work was needed to secure the leading role of NMHSs in the delivery of services, to ensure that the development of climate services within the NMHSs of developing countries was not held back and that there was close collaboration between relevant WMO commissions and between WMO and all other bodies involved.

4.1.2.10 Noting that the concept of RCCs was widely supported within the contributing commissions, the Council reiterated its support for the establishment of such Centres without undermining the role of NMHSs in their provision of seasonal to interannual forecasts.

4.1.2.11 The Council stressed the importance of ensuring that the RCC concept was further developed within an integrated framework of global, regional and national meteorological and related service provision so that it did not lead to any artificial division in the continuum of weather and climate services. In re-emphasizing that climate service provision was an integral part of the meteorological service role of NMSs and that the WMO system of Regional/Specialized Meteorological Centres for supporting the work of NMSs was well established, the Council further stressed that the definition of the functions, operating procedures and terminology for the issue of climate products should be carried out in close coordination with CBS, in respect of both its basic systems and public weather service responsibilities. The Council confirmed that the designation of RCCs should follow established procedures for the designation of RSMCs in order to take full account of the climate-related functions being carried out by existing GDPS RSMCs. The Council encouraged CCI, CBS and the regional associations to coordinate carefully the designation and implementation of the RCCs as soon as possible.

4.1.2.12 The Council noted the report of the second meeting (25–28 March 2002) of the Intercommission Task Team on RCCs, recognized that sufficient requirements had been proposed as functions for RCCs and acknowledged that it was now time to proceed to the establishment of the network of RCCs. The Council further noted that, based on the work of the Task Team, the regional associations should consider the issue of designating those Centres.

4.1.2.13 The Council noted and concurred with the recommendations of the Task Team. Specifically, the Council concurred that as the regional associations proposed RCCs and their functions, they should be flexible in determining the functions based on individual regional needs. However, the Council reminded the regional associations that they should consider the entire suite of climate services necessary as they determined which services were necessary within the Region. The Council noted the importance of the various functions that needed to be performed, including the continuation and expansion of the Climate Outlook Forums, climate predictions and general capacity building within the Regions.

4.1.2.14 The Council considered that in some Regions, a virtual RCC might meet the needs of the regional associations, while in others, an RCC more focused on a single institution might be required. That would be determined on a Region-by-Region basis.

4.1.2.15 The Council noted that JMA had established the Tokyo Climate Centre to provide services for Japan. However, it further noted that some of the functions of that Centre might support the NMHSs within the Asia/Pacific area on climate information services, in particular the services on seasonal and interannual forecasts. In that connection, the Meeting of National Meteorological and Hydrological Service Directors on Advanced Climate Services in the Asia/Pacific Region was scheduled to be held in Tokyo in July 2002.

4.1.2.16 The Council concurred with the Task Team and strongly supported the need for a workshop of global producers of seasonal to interannual forecasts, including GDPS centres and institutions outside of WMO that were committed to make those products available on an operational basis. The meeting, to be coordinated by CBS, would give the state of commitments of those Centres in determining which products they were willing to make available. It would also provide an opportunity to agree on standards, formats and arrangements to make the products available on an operational basis, as well as the establishment of the operational schedule necessary for supporting the RCCs.

4.1.2.17 The Council commended the members of the Task Team for the excellent work accomplished and, especially, to the chairperson, Mr S. Mildner, and the president of CCI, Mr Y. Boodhoo.

4.1.2.18 The Council concurred with the Task Team that the work associated with the terms of reference was completed. The Council further recognized that should the need arise for further consideration of the matter, adequate structures existed within CCI and CBS for appropriate follow-up actions. The Council further concurred that through the presidents of the regional associations and the technical commissions concerned, the programme implementation of regional associations should now consider the specific RCC functionalities within each Region and begin the establishment of the RCC network.

CG-XIV (2003)

3.2.0.10 Noting the requests of Thirteenth Congress as well as the fifty-second and fifty-third sessions of the Executive Council, Congress expressed its appreciation to the CCI for the excellent work completed by the Intercommission Task Team on Regional Climate Centres. Congress concurred with the recommendations of that Task Team and encouraged the regional associations, in collaboration with the Long-Range Forecast (LRF) Global Producing Centres (GPCs), to carefully and efficiently consider the needs and requirements of RCCs, and to develop the appropriate terms of reference prior to initiating the process needed to establish RCCs, with the guidance of CCI and CBS. Congress took note of the offers made by Members to host RCCs. Congress urged CCI to develop guidelines and procedures to assist the regional associations in the implementation of the RCC's.

EC-LVI (2004) (extracts on RCCs, including from the EC-AGCE)

Regional Climate Centres

4.1.27 The Council reiterated its support for the establishment of RCCs, where appropriate, in order to assist NMHSs to interpret and apply seasonal to interannual forecasts and to carry out regional climate services. The Council noted that the regional associations were responsible for

establishing RCCs, while recognizing the advice provided by the Executive Council Advisory Group on Climate and Environment (EC-AGCE). The Council urged those regional associations interested in RCCs to proceed quickly toward implementation. It was stated that the designation of RCCs had a process to follow established by the Ad Hoc Team of Experts discussed in general summary paragraph 4.1.29. Within Regions, establishment of trust funds to assist implementation and ensure sustainability of RCCs would be helpful.

4.1.28 The Council reaffirmed the fact that regional associations that implemented RCCs might also choose to follow established procedures for the designation of RSMCs and that the process should involve all relevant Commissions in order to discriminate clearly the additional activities of the Centres from those of existing GDPFS RSMCs. The demonstration of capabilities of proposed Centres fell into the remits of both CBS and CCI. The Council recognized the important relationship between climate and water and urged that CHy be included in the planning and implementation of RCCs.

4.1.29 The Council noted with appreciation that a CCI Ad Hoc Expert Team was convened in Geneva (27-28 November 2003) to develop guidelines for use by regional associations in describing requirements and procedures for implementing RCCs. The Council noted that there might still be a need in some Regions for continued expert support from WMO in establishing RCCs. Furthermore; the Council urged regional associations to make use of existing infrastructure and institutions in that process.

Executive Council Advisory Group on Climate and Environment

4.2.16 The Council appreciated the guidelines that had been developed for the implementation of the RCCs by the ad hoc expert group within CCI. However, the Advisory Group wished to advise the Executive Council of the importance of ensuring that:

- (a) The concept and modus operandi of the RCCs were fully integrated into the overall architecture of global environmental monitoring and provision of services;
- (b) The role of RCCs in supporting the national operational and services of NMHSs were built strongly into the proposed framework;
- (c) The various proposed functions of the RCCs in education and training, capacity-building, research and service provision were appropriately coordinated with the corresponding functions under other WMO-sponsored programmes;
- (d) Regional associations became fully engaged in the decisions on establishing RCCs to ensure that individual RCCs were designed to meet clearly articulated and recognized regional needs.

The Council concurred with the advice provided by the Advisory Group and requested that the Secretariat ensure that all regional associations, WMO Programmes and technical commissions were made aware of that advice and, as necessary, that those bodies worked in concert to ensure maximum benefit was derived for the NMHSs from the RCCs.

**Extract from the Manual on the Global Data Processing System (WMO No. 485)
- 1992 edition, Suppl. No. 4 (VIII.1997)
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 fulfil 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 GDPS:
 - (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.

List of functions and activities of RCC or RCC-FSE in RA II

1. Operational function

Activities:

- Provide interpretation and assessment of relevant output products from global prediction centres
- Generate and distribute tailored products to meet NMHS needs including seasonal outlooks etc.
- Undertake product verification, including hind cast verification of the tools, and the necessary exchange of basic data
- Provide climate analysis, monitoring
- Provide climate advisories in co-ordination with NMHS
- Climate Database Management

2. Co-ordination function

Activities:

- Strengthen collaboration between NMHS on related observing, communication and computing networks including data collection and exchange
- Develop systems to facilitate harmonisation and assistance in the use of Seasonal and Interannual (SI) Forecast products
- Assist in co-ordination with end users, including organisation of workshops and other forums on users' needs (Regional Climate Outlook Forum)
- Assist NMHSs in the development of a media and public awareness strategy relating to SI Forecasts
- Assist in co-ordination of research concerning the best means of communicating climate products and other information
- Foster the sharing and use of data and information from climate and other scientific disciplines
- Assist the introduction of climate information and predictions into early warning and disaster prevention systems
- Represent the needs of associated NMHSs in climate related matters
- Facilitate links to external climate community
- Internally co-ordinate all parts of the RCC collective
- Co-ordinate relevant training of RCC staff

3. Data services function

Activities:

- Assist in the rescue of climate data sets
- Provide climate database and archiving services
- Assist in the development and maintenance of software modules for standard applications
- Advise in data quality management

4. Training and capacity building function

Activities:

- Train NMHS staff in SI Forecasting methods and characteristics to assist NMHSs to strengthen their services
- Assist in the training of end-users on the application and impact of SI Forecast products
- Assist in the introduction of appropriate decision models for end-users, especially as related to probability forecasts
- Assist in technical capacity building on NMHS level

5. Research and development function

Activities:

- Study climate variability, predictability and impact in the Region
- Develop tools for objective climate analysis and prediction
- Promote research, development, and application of methodologies to harmonise and unify information from varied sources for regional and sub-regional products
- Develop verification procedures relating to SI Forecast products in co-ordination with other centres and WMO guidelines
- Develop and/or validate regional models and methods of downscaling of global output products
- Undertake application research, and assist in the specification and development of sector specific products
- Promote studies of the economic value of climate information.