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FOR LONG-RANGE FORECASTING

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**INPUT TO ICTT ON CC ON THE ESTABLISHMENT OF APPROPRIATE OPERATIONAL
INFRASTRUCTURE FOR THE PRODUCTION AND EXCHANGE OF LRF**

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Summary and purpose of document

The function of NMHSs and RCCs in the dissemination of monitoring and prediction products.

Action proposed

The Team is invited to make recommendations based on the proposals submitted in this document.

1. INTRODUCTION

This preparatory paper provides some background and ideas for consideration and discussion.

Some guiding principles for the operational framework are that operational infrastructure should:

- Be structured and function so that the NMHSs and RCCs play a central role in the flow of information and in the dissemination of monitoring and prediction products. But this role should not be exclusive or restrictive since other relevant national organizations need to be included where they have a statutory or authoritative role in the observing, analysis, and prediction and/or application activities. The potential for the NMHSs to provide the technical and scientific support to the user communities must be harnessed in order to provide the highest quality LRF services in each country.
- Allow for and contribute to an active and continuing LRF research activity (observing technologies, modeling and prediction, and applications).
- Ensure access to information by all NHMSs and RCCs on a non-discriminatory basis and be constructed within the guidelines laid out in WMO Resolution 40.
- Utilize where possible the WMO/WWW Basic Systems- GOS, GTS and GDPS- and require that the WMO/WWW Basic Systems accommodate the requirements of the LRF monitoring, prediction and application components.
- Utilize the WMO/WCP/ CLIPS project in a way that complements and extends the activities of the WMO Basic Systems and builds the application component of the LRF services.
- Apply to general climate anomaly identification and prediction (i.e. not limited to El Nino/ La Nina cases for example).
- Facilitate the acquisition and exchange of data and information required by the WCP/WCDMP, CLIPS, GCOS etc.
- Facilitate the partnership building among the Constituent Bodies and Programs of WMO and among cooperating agencies (e.g. ICSU, FAO, WHO, UNEP, UNDP etc.)
- Make provisions to ensure that adequate documentation and guidance information accompanies the LRF products so that users may understand, interpret, and effectively use them within the confidence levels attached to the products.
- Allow for the dissemination of LRF products through all appropriate telecommunication means including WWW/GTS, satellite broadcasts, the Internet etc. The framework should specify the required standards (formats, data representation specifications, meta-data requirements etc.) that providers must follow.

2. Regional Climate Centres

Cg-XIII and EC-LII have agreed that the best approach to enhancing regional capabilities is to improve the efficiency of existing structures to handle the development of climate services, with additional functions being added to these structures as necessary. The ICTT on RCCs recognised that Cg-XIII had agreed that the role of the NMHSs should be fundamental in the delivery of services within their own countries. However the ICTT noted that climate activities are undertaken by organisations other than the NMHS in some countries.

However, there is a need for RCCs, and that this need varies between and across WMO Regions, that further development will require close coordination with RAs. There are important organisations with critical skills and resources not directly linked to the WMO WWW structure and that these should be entrained into a common infrastructure as far as possible. The first priority is to establish a WMO structure providing essential services to NMHSs. Development of RCCs should take advantage of existing structures, in particular the WWW structure, as far as possible. RCCs should play an important function in buffering information produced by global prediction centres for onward provision to the NMHSs. A key role of RCCs should be in expressing the quality of products and recommended that any exchange of forecast products should always be accompanied by verification information. At the same time the RCCs should be able to provide guidance in terms of state-of-the-art material that is also considered as experimental by many producing centres.

The ICTT on RCCs consulted the designation procedure for RSMCs as prescribed in the Manual on the Global Data Processing System (WMO No.-485) and agreed that this appears to have the inherent flexibility necessary for designation of RCCs. It was recognised that the designation process covers the identification of new centres and the broadening of activities of existing centres. Given the specific and partially unique requirements of RCCs it was recommended that the designation process be undertaken in consultation with an agreed list of possible functions of such Centres. Existing examples of RCCs include both centralised and distributed functionalities, the latter being met by a network of existing centres (a virtual centre) each contributing within their resources. The suggested functions are listed in Appendix 1.

3. Requirements

The infrastructure needs to include the network of WMO Centres with functionality in Analysis and Prediction and activities on both the global and regional scales. These and other Centres operated by individual WMO Member States or groups of Member States would undertake data assimilation and processing functions and provide out put products to support climate services activities operating at the national level.

The infrastructure should address a wide range of products of quite different content, methods of production, and intended use. These include:

- (1) Climate Monitoring and Diagnostic Products comprised of current analyses based on data and evaluated with respect to the historical record.

(2) Objective Numerical Prediction Products obtained as output from ocean and/or atmosphere models. Rapid progress is being made toward coupled ocean-atmosphere model systems.

(3) SI Forecast and Outlook Products based on the objective predictions, statistical relationships and subjective weighting of various inputs.

The infrastructure should accommodate institutional players on the global, regional and national scales. The suggested institutions are RCCs and NMHSs and may include academic research institutions as well as governmental institutions. The institutions should be able to demonstrate greater operational stability and long term commitment.

4. Global SI Forecasting

The following initial list of centres capable of providing global outputs on an operational basis are:

- Bureau of Meteorology, Melbourne, Australia;
- Centro do Previsão de Tempo e Estudos Climáticos, Cachoeira Paulista, Brazil;
- Meteorological Service of Canada, Montreal, Canada;
- Météo-France, Toulouse, France;
- Japan Meteorological Agency, Tokyo, Japan;
- South African Weather Bureau, Pretoria, South Africa;
- Met Office, Bracknell, United Kingdom;
- Climate Prediction Center, Washington, United States of America;
- European Centre for Medium-Range Weather Forecasts, Reading, United Kingdom;
- International Research Institute for Climate Prediction, New York, United States of America.

Current services are based on a variety of data sources, methodologies and models. What is already available requires to be catalogued. These centres produce model output.

5. Regional Climate Centre SI Activities

RCC scientists, in collaboration and consultation with regional NHMSs climate analysts should draw together regional climate guidance. The list of following details the types of analysis for each monthly cycle:

A. Observations

1. The Southern Oscillation. Preparation of background material on the Southern Oscillation, its state, and how this affects regional climate.
2. Global Climate Diagnostics. Global climate diagnostics beprepared to assess the main features determining the regional climate in the coming season. Factors examined could include the state of the Southern Oscillation, North Atlantic Oscillation, and trends and projections in these, sea surface temperature patterns in the various ocean basins with likely impacts on the regional climate, and the larger scale climate circulation of the tropics and hemisphere concerned.

B. Forecasts

1. ENSO forecasts. Forecasts of trends in ENSO are examined to assess the development of ENSO for the coming months.
2. Global forecasts. Output from global climate forecasting models be analysed for the region concerned for guidance on sea level pressure trends, temperature and rainfall.
3. Analogue selection. Atmospheric circulation and sea surface temperature patterns for the the region from the past be modeled for matches with the current season. Selected analogues provide useful forecasting guidance for the current season.
4. Statistical forecasts. Statistical models be run to derive regional climate guidance.

C. Expert Assessment

1. Background climatology. Background climatology on seasonal climate patterns and ENSO be provided by the RCC and combined with the observations and forecasts to provide an expert assessment of probable climate outcomes for the region.
2. Regional Teleconference. The guidance is distributed to regional NHMSs. A regional teleconference, coordinated by by the RCC, occurs between climate centres in the region to prepare the final guidance.
3. Climate outlook. A general regional climate outlook is prepared by the RCC, which outlines the main climate patterns expected for the three month periods.

D. Delivery and Reception

1. Practically all SI products presently available are communicated over the Internet. For products like the Objective Numerical Prediction products from ECMWF, U.K. Met. Office and IRI, the mechanism of utilizing password protection has been implemented with the provider controlling the administration of the passwords.
2. In the foreseeable future a mixture of delivery and reception systems is suggested. As the GTS develops more Internet-like capabilities more SI product delivery can migrate there. At the present time the Internet, (e-mail and bulletins posted on websites) supplemented with telefax and mail must remain the primary carrier for SI products. It is anticipated that soon Internet access will be possible for all NMHSs. The CLIPS Pilot Project component is one vehicle among others for providing technical assistance.

ANNEX 1

List of Regional Climate Centre functions

The requirements of NMHSs for RCC functions will vary from Region to Region, and may comprise only a subset of the following list. The required activities may be undertaken within a single centre or distributed amongst NMHSs.

Operational Activities:

- Interpretation and assessment of relevant output products from global prediction centres;
- Generation of tailored products to meet NMHS needs including seasonal outlooks etc.;
- Product verification, including the necessary exchange of basic data;
- Product distribution.

Coordination Functions:

- Strengthen collaboration between NMHS on related observing, communication and computing networks including data collection and exchange;
- Development of systems to facilitate harmonisation and assistance in the use of SI Forecast products;
- Assist in coordination with end users, including the organisation of workshops and other forums on users' needs;
- Assist NMHSs in the development of a media and public awareness strategy relating to SI Forecasts;
- To represent the needs of associated NMHSs.

Data Services:

- Rescue of climate data sets;
- Provision of climate data base and archiving services;
- Assist in the development and maintenance of software modules for standard applications;
- Advising on data quality management.

Training and Capacity building:

- Training of 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.

Research and Development:

- Develop a climate Research and Development agenda and coordinate it with other RCCs in the Region;
 - To arrange for studies of climate variability, predictability and impact in the Region;
 - To develop consensus practices to handle conflicting information for the Region;
 - Develop validation procedures relating to SI Forecast products in coordination with other centres;
 - Develop and validate regional models, methods of downscaling and interpretation of global output products;
 - Undertake application research, and assist in the specification and development of sector specific products;
 - Arrange for studies of the economic value of climate information.
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