

Guidelines on Climate Watches

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In recognizing the need for National Meteorological Services (NMSs) to improve their climate data and monitoring services, the Commission for Climatology (CCI) and the CCI Management Group placed a high priority on the distribution of guidelines for the NMSs.

Within the World Climate Data and Monitoring Programme, a meeting was held at the kind invitation of the USA (Silver Spring, Maryland, 26 to 29 January 2004) in which the CCI Expert Team to Develop Guidance on Climate Watches initiated the preparation of guidelines on their topic. The participants were either members of the Expert Team (ET) of CCI, or were invited experts. The ET was established in 2003, within the CCI Open Programme Area Group (OPAG) on Monitoring and Analysis of Climate Variability and Change.

The Guidelines on Climate Watches are meant to be easy to read and refer to, well illustrated, and not bulky. They provide information and assistance on how to organize and implement climate services, and present processes and technological solutions that attempt to address the special situation and needs of smaller NMSs, which have limited resources.

The review of the Guidelines was the most recent activity that was done within the CCI OPAG structure that was adopted by the thirteenth session of CCI, so that all CCI Members were given an opportunity to review and comment, as well as to see the progress being made in the OPAGs. It was drafted by the CCI Expert Team, circulated for additional contributions and comment among the members of the CCI Expert Team, and posted to the OPAG’s web site for review and comment by the members of CCI.

It should be kept in mind that this Technical Document, like the other technical documents published under the WMO World Climate Data and Monitoring Programme (WCDMP) series, is intended to provide guidance in the form of best practices that can be used by Members. Because of the diversity of NMSs with respect to size and stage of technological development along with the variability of weather types and climate, some practices may not have significant utility for a specific Member. However, this document does cover a wide range of guidance that should provide some form of assistance to every Member.

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Guidelines on Climate Watches

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1. Introduction

In recent decades, climate extremes and climate variability have resulted in increasingly noticeable impacts on societies in countries throughout the world. WMO CCI-XIII noted the importance of reducing vulnerability to disasters stemming from climate anomalies. In its thirteenth session (Geneva, November 2001), CCI stated that "... the Management Group and the OPAGs would seek... to enable the delivery to end-users, through the NMHSs, increasingly accurate and reliable warnings and monitoring products of extreme events related to climate and the related environment throughout the world, and ensure that they would reach their target audience in a timely and useful manner." [Commission for Climatology, Abridged Final Report with Resolutions and Recommendations of the Thirteenth Session, Geneva, Nov. 21-30, 2001, WMO TD-No. 938.]

The 14th session of the WMO Congress recognized that climate system monitoring and climate change detection are increasingly important inputs to high priority activities such as early warning and disaster prevention planning. It addressed the implementation of a climate alert system to inform Members of pending significant climate anomalies. It noted the linkage of this activity with Strategy 1 of the Sixth Long-Term Plan (6LTP). Congress stressed the critical importance of eliminating confusion and of minimizing duplication in the provision of operational products and services related to warning services. It requested the president of CCI to liaise with CBS on the definition and guidelines for climate alert systems, and the resulting Guidelines reflect that collaboration.

This Technical Document describes the current status of Climate Watches, the concept of Climate Watch, and guidelines for establishing, operating and evaluating Climate Watches. The main goal of a Climate Watch is to provide information about significant anomalies for the forthcoming season(s) that may have substantial impacts on a regional scale. Some examples of

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Climate Watches are included in this report. These Guidelines are intended to provide guidance in the form of good practices that can be used by Members.

The formation of a Climate Watch System sits comfortably within the framework of the WMO World Climate Applications and Services Programme. From WMO (Guide to Climatological Practices, in draft form), Section 1.5.2 “The World Climate Applications and Services Programme (WCASP) encourages and assists Members in the use of climate information to meet the needs of governments, industries and the public. The long-term objectives of the Programme, with some current activities, are as follows:

- To help Members develop climate services with special emphasis on national sustainable development and on devising methods of adapting to, and mitigating, the adverse impacts of climate and its variations;
- To promote awareness of the potential benefits of climate services in human endeavour with particular emphasis on public safety and welfare;
- To encourage the development of practical methods and techniques and to provide easy access to the methods and techniques for the application of climate information and prediction products.

2. Rationale and background

Persistent departures (anomalies) from long-term average climatic conditions can have significant societal impacts. For example, drier-than-average conditions can lead to drought, which can affect agriculture and water resource management, leading to crop loss, restricted water usage, and perhaps a reduction in energy generation. On the other hand, excessively wet conditions increase the likelihood of flooding that could endanger people's lives and destroy infrastructure in the affected region. The impacts of such anomalies are usually larger in developing countries, which are often poorly prepared to effectively cope with adverse climatic conditions.

Governments typically react to climatic extreme events through "crisis management" rather than through the formulation and implementation of anticipatory measures commonly referred to as "risk management". A typical reason mentioned by decision makers for the lack of such risk management policies, has been the lack of means to predict climate conditions (e.g., precipitation and temperature) with sufficient skill and lead-time. However, in selected regions of the world, this situation has changed dramatically due to recent advances in the capacity to predict climate anomalies linked to large-scale phenomena.

Since the early 1980s major advances have been made in our understanding of the causes of interannual climate variability and in our ability to observe, monitor and predict the state of the climate. A great deal of attention has been focused on monitoring and predicting the El Niño/Southern Oscillation (ENSO) cycle, which has pronounced effects on patterns of temperature, precipitation and tropical cyclone activity for large areas of the world. Since the ENSO cycle is closely monitored in real-time and its evolution is fairly well understood, there is an opportunity to anticipate associated climate departures several months in advance.

Another phenomenon that has received a great deal of attention during the last 25 years is the tropical Madden-Julian Oscillation (MJO). Like the ENSO cycle, the MJO affects temperature, precipitation and tropical cyclone activity over a large region of the world, but on a much shorter time scale (30-60 days). Thus, at times the MJO can have a major impact on agriculture in certain tropical and subtropical regions that have relatively short rainy seasons. In this case, there is an opportunity to anticipate temperature and precipitation departures 2-4 weeks in advance.

In order for countries to make the transition from "crisis management" policies to "risk assessment/ risk management" policies, it is important that information on the state of the climate be provided to relevant decision-making organizations, such as government, agricultural agencies, emergency management services, and water resource management agencies.

A "Climate Watch" can serve as a mechanism to heighten awareness in the user community that a significant climate anomaly exists or might develop and that preparedness measures should be initiated. NMHSs in several countries have developed and operationalized Weather Watches

(e.g., for tornadoes, hurricanes, severe storms, etc.) that have been assisting societies to improve their preparedness and reduce their vulnerability to weather extremes. Given the advances in climate prediction and climate monitoring during the last two decades, and in the framework of establishing risk assessment and risk management policies, it is now feasible for Members to issue Climate Watches to help reduce socioeconomic vulnerability by improving preparedness procedures for adverse climatic conditions.

In the present document, a Climate Watch is an advisory with the following characteristics:

- Issued to heighten awareness in the user community concerning a particular state of the climate system;
- Disseminated to serve as a mechanism for initiating preparedness activities by users and/or a series of events that affect user decision making;
- Based on real-time monitoring (current status) of conditions and on climate outlooks;
- Issued by individual NMHSs, perhaps in coordination with other NMHSs or regional Climate Centers in the region or beyond;
- Developed as a result of continuous and iterative collaboration with users;

3. Assessment of current activities and capacity

a. Current dissemination of climate information in bulletin form related to Climate Watches

Since the early 1980s, many countries (e.g., USA, Australia, Japan, China, Peru, Brazil, and UK) have developed real-time operational activities to monitor and assess the state of the climate and to disseminate the information to interested users. Initially, the information was disseminated as printed bulletins, which took as much as a month to get to subscribers. During the last decade online versions for some of the bulletins have become available on the Internet, which has allowed for a near real-time dissemination of climate information.

Most of the climate bulletins include information on the state of the ENSO cycle, which is a major cause of interannual climate variability. Some countries now issue climate advisories or watches concerning the extreme phases of the ENSO cycle (El Niño and La Niña). [For example, NOAA has for many years issued ENSO Advisories or ENSO Diagnostic Discussions, and the Australian Bureau of Meteorology has established a three-stage alert system for El Niño, which it uses in its internal assessment to gauge the level of confidence that meteorologists and oceanographers have in detecting a developing El Niño event. (see appendix 2)].

Many countries have developed statistical and dynamical climate prediction techniques for the ENSO cycle. Discussions concerning those predictions are included in some of the climate bulletins and on several websites. Some centers provide free e-mail notification when products are updated. Some centers disseminate regional temperature and precipitation climate outlooks based on those climate prediction techniques. For example, the International Research Institute (IRI) for Climate Prediction, through its website, provides information regarding the state of the ENSO cycle, and outlooks for tropical Pacific SST anomalies and related global temperature and precipitation anomalies, which are based on several statistical and dynamical prediction techniques. The NOAA/Climate Prediction Center (CPC) publishes the monthly Climate Diagnostics Bulletin (CDB), which includes an assessment (Forecast Forum) of the latest ENSO forecasts. CPC also produces a monthly ENSO Diagnostic Discussion, that assesses the current state of the ENSO cycle and an outlook as to what can be expected during the next one or two seasons. The CDB and ENSO Diagnostic Discussion are available on the Internet.

During 1999 to 2001, The Asian Pacific Network (APN) supported a project on *ENSO and the Warm pool in the western Pacific Ocean*, with participation from Australia, China, Indonesia, Japan, Malaysia, Philippines and Vietnam. A related web page containing monitoring and prediction information on the ENSO cycle was established through this collaborative effort.

Through cooperation between the WMO and the IRI, as a contribution to the United Nations Interagency Task Force on Natural Disaster Reduction, with contributions from many meteorological services and regional centers and organizations, an “El Niño Update” has been officially issued since 1997. Through this update the WMO made significant progress in developing and issuing an international El Niño watch.

Although major progress has been made in distributing specific El Niño watch information, there is a need for Climate Watches that focus on related impacts for specific regions and/or countries. Climate Watches (e.g., El Niño, drought, heat wave, cold wave, floods) would be a means of synthesizing the large volume of monitoring and prediction information, which would then serve as the basis for making critical socioeconomic decisions. Every country has something to gain by developing a national Climate Watch system or contributing to a regional Climate Watch system.

The WMO's Climate Information and Prediction Services (CLIPS) project and the African Centre of Meteorological Applications for Development (ACMAD) have been jointly improving the Climate Watch Africa bulletin. It provides information on a wide variety of climatic issues in a user-friendly way. This cooperative effort exemplifies the kind of international networking among climate centres that is one of the tenets of CLIPS. Climate Watch Africa is transmitted on the Meteorological Data Distribution service of Meteosat and more than 30 national Meteorological and Hydrological Services (NMHSs) have access to it.

Drought is an example of a regional-scale extreme climatic event, which is a long-lasting and slow-developing climate disaster that contributes to socioeconomic losses in many countries. Compared to El Niño, a drought watch would be more appropriate on a country or regional basis. In some developed countries, drought has been monitored for several years, for example, in the USA via the US Drought Monitor. The Monitor is a multi-agency product, which uses a variety of indices, such as the Palmer Drought Severity Index (PDSI), soil moisture, weekly stream flow, Standardized Precipitation Index (SPI) and Satellite Vegetation Health Index, to monitor drought conditions. The Drought Monitor is disseminated on the Internet. Some other countries rely mainly on rainfall and rainfall deficiency to assess drought conditions. In some African countries, rainfall anomalies are used as the criteria to declare a drought. In China, the National Climate Centre employs an improved Z-Index (Wang and Zhai 2003) together with temperature and precipitation data to assess drought conditions. Monitoring statements and some outlook information are distributed to the government departments, such as the State Council, Ministry of Agriculture, Ministry of Water Conservation, etc. When a drought is developing, the National Climate Centre of China usually issues a "Drought Climate Bulletin". Electronic information has been accessible on the Intranet within the China Meteorological Administration (CMA) since 1997.

Attempts to distribute watch information on other climate extremes have also been explored by several organizations and institutions. For instance, heat waves, which are closely associated with human health issues, have been the focus of activities within the CLIPS program.

b. Analysis of levels of capacity for obtaining, developing, interpreting, and disseminating climate information

In different countries, the levels of capacity for obtaining, developing, interpreting, and

disseminating climate information are very different. Generally, they can be roughly divided into three levels. In some developed countries, such as the USA, Australia and some European countries, near real-time data from the GTS are operationally obtained, processed and analysed through assimilation systems and diagnostics techniques to provide climate monitoring or prediction information. Many countries rely on processed and analysed data from these developed countries to generate the products for their own country and region or they can rely on the climate information provided directly by the developed countries. This situation is especially true for El Niño Watch. However, some countries lack the capacity to access, develop and disseminate climate information. A quick survey from existing documents shows that not all NMHSs have the capacity to produce climate information required to issue Climate Watches. A WMO report in the year 2000 stated that in early 1999, 70% of the NMHSs had access to the Internet. Most likely the percentage has increased since 1999; yet it is unlikely that 100% of the countries have Internet access at the present (2004).

To properly interpret climate information a country must have trained professionals. The Climate Information and Prediction Services (CLIPS) and the Regional Climate Outlook Fora (RCOF) have made great efforts to train personnel in some African countries. The RCOF were set up by the NMHSs to produce rainfall outlooks for specific regions. The Drought Monitoring Centres (DMCs) in Nairobi, Kenya and Harare, Zimbabwe and the African Centre of Meteorological Applications for Development (ACMAD) in Niamey, Niger are actively involved in producing rainfall forecasts for their respective regions. These centres are actually using information distributed by Global Processing Centers (GPCs, see e.g. appendix 2).

The International Research Centre on El Niño (CIIFEN) in Guayaquil, Ecuador also uses climate information from the GPCs, as the basis for issuing El Niño Outlooks for the South American Region. CIIFEN also contributes to the RCOF in that part of the world.

For a forecast to be a success, it has to reach the user community in a timely manner in order to influence decision-making. Pilot projects were carried out in the Southern African Development Community (SADC) countries (namely South Africa and Zimbabwe) to determine how farmers were responding to the rainfall outlook issued at the beginning of the rainy season. It was found that not everyone takes advantage of this information. Studies also found that the preferred means of receiving climate information is through radio and newspapers. In Australia, farmers would prefer the Internet, while in remote African villages the RANET (Radio internet) is most appropriate (Walker et al, 2001). Thus, the best vehicle for disseminating climate information varies greatly from country to country, and from region to region.

c. Summary

Great progress has been made in providing climate-monitoring information, especially in regards to the ENSO cycle. However, further progress is necessary in order to meet the needs of decision makers dealing with socioeconomic vulnerability that results from climate anomalies and extremes. For the developing countries where the economies and societies are more prone

to climate disasters, Climate Watches for regional climate anomalies and events could serve to alert decision makers and thereby help to mitigate the effects of adverse conditions. However, those countries often lack 1) the capacity to obtain timely climate information, 2) the expertise to interpret climate information, and 3) techniques to develop and distribute climate information in an efficient and timely manner. Therefore, a strong capacity-building effort should be made in the developing countries in order to create the necessary infrastructure to support the development and dissemination of Climate Watches, which ultimately will be beneficial to the user community in minimizing the adverse effects of climate variability.

4. Elements of a Climate Watch

In general, as part of a Climate Watch system, the NMHS would continuously monitor and assess the state of the climate, evaluate available climate forecasts, and, when conditions warrant, issue formal climate watches to alert end users. End users would then be in a position to undertake actions to mitigate the climate-related impacts.

A particular state of the climate may produce both beneficial and detrimental societal impacts. For example, regional drought may be detrimental for farmers yet provide a boost for tourism. Similarly, above normal rainfall may provide benefits to some farmers yet may bring increased community health risks from malaria or similar vector-borne diseases. To avoid confusion, these guidelines on the issuance of a Climate Watch focus on adverse climate-related impacts. This mirrors the weather warning system where warnings are only issued upon the expectation of weather that may be hazardous to life and property.

In a similar way, completely opposite states of a climate may necessitate issuing a Climate Watch. For example, excessive rainfall over a period of months may saturate soils, leading to higher-than-average probabilities for flooding, land erosion and mudslides; while rainfall deficits may lead to crop failures, famine and economic loss. It is expected that both situations will lead to issuing some form of a Climate Watch due to their potentially adverse environmental and societal impacts.

While there appears no need at this time to have a dual or three “stage” system of Climate Watches, akin to the Watches, Warnings and Alert systems for hurricanes, as climate monitoring and forecast technologies improve a stage system may become appropriate.

It is important to distinguish the difference between a Climate Watch System and a climate monitoring system. The objective of a Climate Watch is to enable an end user to take some action to minimize the effects of an expected adverse climate-related impact, rather than simply reacting to an observed climate anomaly. A Climate Watch System should also be seen as an addition to a NMHSs climate forecasting system and to RCOF. A Climate Watch will use climate forecasts and outlooks generated by RCOF, but should be thought of as being a proactive alert of impending unfavourable climate anomalies specifically focused on the end user. The Climate Watch best practices described in this document are not intended to replace the RCOF or other climate forecasting activities that NMHSs are already involved in. NMHSs participating in RCOF should consider how the results of the RCOF in their region should be integrated into the Climate Watches issued by the NMHSs and/or associated regional climate institutions. A Climate Watch System adds value to climate monitoring and forecasting within the NMHS in the form of providing necessary and specific information on potential climate anomalies to end users.

It must be stressed that a Climate Watch System should be developed as a result of initial, and ongoing, consultation with end users. Thus, an important step in the establishment of a Climate Watch System is for the NMHS to engage the user community as partners in formulating and

developing the system.

a. Necessary structure needed to form a Climate Watch System



Photograph: Mike Rayner/'The Age'

Expected outputs from a Climate Watch System include:

- An Initial Climate Watch – outlining the expected climate anomaly (see Section 4.5 for content);
- Climate Watch Update(s) at regular or agreed upon intervals – issued to keep the end user informed about the progress of the Climate Watch. For example, it may include information on the most recent long-range forecasts, or updated information on climate anomalies. Updates may be issued at monthly intervals or at intervals agreed upon in partnership with the end user;
- A Final Climate Watch – confirming that the Climate Watch has expired and that the likelihood of risks, associated with the climate anomaly, has diminished significantly.

The process of developing a Climate Watch System may vary from one NMHS to another, although in general it involves the following:

- Developing ongoing climate monitoring activities;
- Scientific assessment of regional climate anomalies, including their relationship to large-scale climate variability;
- Developing a long-range forecasting system or using publicly available long-range forecasts provided by Global Producers of Long Range Forecasts (GPLRF: appendix 2) or Regional Climate Centers;
- Consulting with prospective end users on the development of indices, criteria and policies for issuing Climate Watches;
- Developing a system for promulgating the Climate Watches in consultation with the user community;
- Evaluating the Climate Watches and their effectiveness in meeting the needs of the users.

While global monitoring is perhaps sufficient for assessments of the state of the large-scale climate system, it is imperative that the NMHS develop a nation-based monitoring activity which observes climate elements needed at a spatial resolution that is appropriate for the monitoring of climate and for the issuing of Climate Watches (see Guidelines on Climate Observation Networks and Systems, WMO-TD No. 1185, WMO, Guide to Climatological Practices, in draft form, WMO) and which also serves as ground truth for remotely-sensed (satellite) observations. Such ground based observing systems, combined with local knowledge, enables climate monitoring on a scale necessary for a Climate Watch System.

It is important to establish a computer-based dataset consisting of monthly, seasonal and annual summaries of temperature, precipitation and other climate elements. This will allow for monitoring the state of the climate system and detecting conditions that might lead to extreme events. Also, a suitable climatology needs to be established so that a given observation may be evaluated against a historical average.

It should be noted that the best strategy for designing a Climate Watch System that effectively meets the needs of the users is for the NMHS to engage the user community early in the process as partners in formulating and developing the system. A strong partnership with the user community is most critical in the development of the aspects of the Climate Watch System that directly touch the users: the indices and criteria, promulgation system, and evaluation plan. However, since monitoring, and long-range forecasting activities ultimately aim to serve the needs of the user community, it is advisable to partner with the user community from the beginning.

i. Data and observations

It is the responsibility of the NMHS, or similar organization, to gather observations and perform analyses of the data. It is also the responsibility of the NMHS to liaise with intermediary users on appropriate climate elements to observe for Climate Watch purposes. It is desirable that the NMHS have a network of observational stations that measure the most commonly used climate elements, which include air temperature (daily maximum and minimum), precipitation, humidity, atmospheric circulation (wind velocity) and atmospheric pressure (GCOS, 2003).

It is important for the NMHS to have an understanding of the current and recent past climate state of the region in question, and that the observational dataset be as homogeneous and robust as possible. It is also important to record metadata so that it is known how observations were made (see Guide to Meteorological Instruments and Methods of Observation (6th edition), WMO-No. 8, WMO). The method in which the climate element is observed and the data analysis technique must be scientifically defensible.

For the purposes of guaranteeing that the user community is informed of all relevant information there is a need to verify forecasts and to make verification statistics of forecasts publicly available.

After the Climate Watch has been issued there is a need to continue climate monitoring in order to update the user community on the latest information and if necessary issue a Climate Watch Update or a Final Climate Watch.

There is also a need to monitor the effectiveness of Climate Watch criteria over a period of time. This includes monitoring false alarms and hit rates. This can easily be completed using a standard contingency table (see Standardized Verification System (SVS) for Long-Range Forecasts (LRF), WMO). Similarly, there is a need to continually monitor the quality and appropriateness of observations associated with criteria that go into a Climate Watch.

For further information on climatological practices see Guide to Climatological Practices, in draft form, WMO.

ii. Climate monitoring

To be in a position to issue Climate Watches it is important for the NMHS to monitor local climate and to establish a readily accessible climate database, which will enable current climate situations to be placed in historical context.

It is important for the NMHS to monitor the local climate situation before, during and after the Climate Watch has been issued.

- Before issuing a Climate Watch there is a need to know the current climate state and the magnitude of deviations from climatology.
- During the period of the Climate Watch it may be necessary to provide updated information to the end users concerning the evolution of the climate departures and any changes in the climate outlooks. This may involve the issuing of a Climate Watch Review at set stages after the initial Climate Watch.
- After the period of the Climate Watch has passed there is a need to monitor the potential for further climate anomalies.

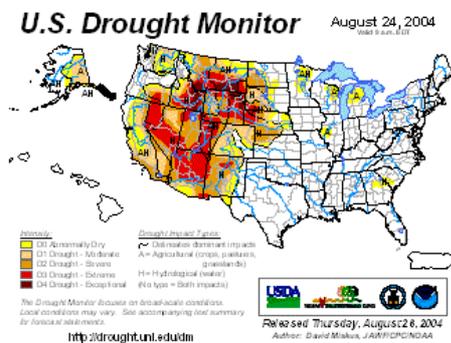
There is also a need for the NMHS to monitor relevant large-scale climate phenomena such as the ENSO cycle (El Niño and La Niña), NAO (North Atlantic Oscillation) and MJO (Madden-Julian Oscillation). This may be accomplished through information provided by WMO and Global Producing Centres of Seasonal to Interannual Forecasts (GPCs) and monitoring bulletins – see contacts in Appendix 2. The monitoring of large-scale climate systems may provide information on much of the climate variability within a region. In addition, the NMHS should continuously monitor available forecasts provided by the Global Producers of Long Range Forecasts (GPLRF).

Further information about climate monitoring is contained in the Guidelines on Climate Observation Networks and Systems, WMO-TD No. 1185, WMO.



iii. Climate analysis

Once a climate monitoring system is developed there is a need for diagnosis and analysis. This includes a comparison of the current climate conditions to historical observations, and interpreting the findings and noting the similarities and differences. Climate monitoring also involves placing regional climate conditions into context with large-scale climate phenomena, such as ENSO. It is important that the NMHS have an understanding of how ENSO and other large-scale climate phenomena impact local climate conditions.



iv. Long-range forecasting

There is a necessity to understand and use some form of long-range forecasting in conducting a Climate Watch System. The forecasting can take the form of:

- Relating large-scale phenomena, such as the ENSO cycle, to localised climate variability (e.g., some form of downscaling);
- A statistical analysis of historical climate data;
- Use of global or regional climate models available on the web;
- Development of dynamical long-range forecasting systems.

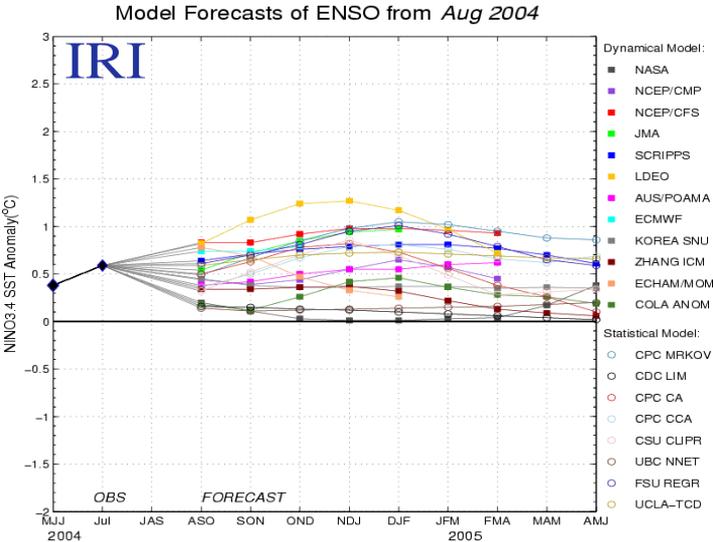
In NMHSs where it is not possible to conduct localised long-range forecasts it may be possible to use global forecasts of precipitation and temperatures that are readily available (see Appendix 2 for web resources). These are made available via the WMO GDPFS (Global Data Processing and Forecasting Systems) and several NMHSs.

In cases where there are human resources available to run long-range forecasting systems but not for development of such systems there is the possibility of “technology transfer”. This may involve using statistical forecast systems developed by other countries and tailoring those systems to the local conditions and training NMHS staff. An example of this is the AusAID project where prediction software developed in Australia is being used by several South Pacific countries (see page 48ff ABoM, 2003) or the Climate Prediction Tool (CPT) developed by the IRI for statistical downscaling of climate forecasts.

Climate forecasts are inherently probabilistic in nature. For example, seasonal rainfall outlooks are often provided in terms of probabilities of falling within tercile ranges (above average, normal, or below average). Some form of verification of forecasts must also be conducted, which would enable skill to be attached to the forecast.

As with analysis of climate data, there is a necessity to monitor climate forecasts before, during, and after a Climate Watch has been issued.

Also see Section 4.4.3 within the Guide to Climatological Practices, in draft form, WMO, for information on how to best utilize on-line climate services.



b. Issuing organization

The responsibility for climate monitoring is generally that of a National Meteorological and Hydrological Service (NMHS) and, since the necessary meteorological and climatological expertise resides there, it is advised that the NMHS manage and coordinate the Climate Watch

process. This is advisable for a number of important reasons.

- There is a need to have a clear understanding of the current state of the climate. This is important both in ongoing monitoring of the climate and in guidance associated with defining when to issue a Climate Watch.
- There is a need to have an understanding of how the large-scale climate affects local climate conditions.
- There is a need for a thorough understanding of the climate forecasting systems that may be utilized in a Climate Watch System.
- Having the NMHS involved in Climate Watches enables governments and other end users to best manage climate risk on a national and local scale.

However, in many countries various user sectors (e.g. water resource management and agriculture) also maintain weather observation systems. The NMHS should strive to work with these user groups and whenever possible integrate data from them into the climate analyses.

It is also the responsibility of the NMHS to conduct reviews of the Climate Watch process. The review should include the relevance of indices associated with the Climate Watch, the distribution process, and an evaluation of how well the Climate Watch system is meeting the requirements of the end users.

The aim of the Climate Watch System is to provide information about forecasted climate anomalies that are relevant to end users and that will allow end users to take action to reduce risk associated with those climate anomalies. For this to be the case a partnership needs to be established between the NMHS and appropriate user communities, particularly during the development stage of the Climate Watch System. The aim of this relationship is to develop criteria for issuing Climate Watches, to educate users in relevant areas of climate monitoring, analysis and forecasting, and to work with them to develop appropriate communication tools, forecast products, and evaluation plans. It is important that there are designated contact persons in the NMHS who can provide the user community with information relevant to the Climate Watch System.

It is also important to maintain contact after the Climate Watch has been issued. “A highly important role of climate specialists within a Meteorological and Hydrological Service is to ensure that the climatological information provided or available to national or regional planners is properly understood, and that any risks associated with the use of the information are also understood” (Guide to Climatological Practices, in draft form, WMO).

After the initial development stage of the Climate Watch System there is a need for ongoing consultancy. This enables: success or otherwise of the Climate Watch System to be monitored; education in improved monitoring or analysis techniques; exchange of recent research results on climate variability and climate-related risks, and an ongoing evaluation and improvement of the Climate Watch System.

In summary, a strong partnership between the NMHS and the user community is important for the successful development and operation of a Climate Watch System, as well as for its progress and evolution over time.

c. The user community

It is the responsibility of the NMHS to identify critical sets of prospective end users and appropriate intermediaries. Users of climate information are individuals or organizations whose interests are affected by climate anomalies and who consider climate information when making decisions (IRI, 2001). A user, or “end user,” may be an individual decision maker (such as a farmer), a government agency, or an organization that is aware of vulnerability to climate and has the knowledge and ability to act on climate information. Rather than receiving climate information directly from the technical experts who produce it, most end users access climate information via intermediaries who interpret and transform the technical information into a form that is more suitable for the end users (IRI, 2001). Intermediaries may be meteorological officers, climate scientists, extension workers, government policy advisers, consultant engineers, media, journalists, local leaders, etc. And they commonly act on behalf of or influence a large number of people.

In other words, user intermediaries are individuals or bodies (organizations – either government or otherwise) that provide guidance to a climate-sensitive community sector in order to enable that community to make better decisions. An end user is the climate-sensitive community themselves (e.g. farmers, herders, business owners, etc.). For example in Australia the user intermediaries for the farming sector may include the Bureau of Rural Services (BRS), Australian Bureau of Agricultural and Resource Economics (ABARE) and state departments of primary industry. In Africa the Drought Monitoring Centre may be classed as a user intermediary. These organizations have responsibility for dealing with the farming community.

In addition to end users and user intermediaries, a third group of users known as user stakeholders may contribute to the development and operation of Climate Watch Systems. User stakeholders are “organizations which have the interest of the users at heart and a stake in the effectiveness of the processes aimed at meeting those interests,” such as aid agencies, international organizations concerned with development or governance, non-governmental organizations (NGOs), and community-based organizations (IRI, 2001). User stakeholders may be able to contribute to the Climate Watch System by raising awareness, empowering the end users, lobbying, analyzing and disseminating information, and supporting meetings, training seminars, and other capacity building activities. The role played by user stakeholders will differ from country to country, so some NMHSs may wish to partner directly with users stakeholders, while others will elect to work through intermediaries.

Finally, the media are a particular group of user intermediaries that deserve special mention. Radio, television, print, Internet, and other media have the capacity to communicate Climate Watches to a vast array of end users. However, targeted efforts to communicate tailored climate

information tend to be more effective (and less prone to exaggeration and misinterpretation) than broad communication of general information. Hence, the effectiveness of members of the media as intermediaries will depend upon their abilities to understand and interpret Climate Watches for their audiences. And these abilities, in turn, will depend upon the training they have received, and their relationships with the NMHS and intermediaries from affected sectors.

Identifying and partnering with appropriate user intermediaries is normally a better strategy than attempting to work directly with end users because 1) there are too many end users for NMHSs to reach directly, 2) end users commonly require interpretation of technical climate information, 3) intermediaries can provide NMHSs with extensive insight into end user needs and circumstances, and 4) NMHSs can benefit from infrastructure and activities of intermediaries. Therefore, it is important to begin partnering with user intermediaries early in the development of a Climate Watch System.

It is envisaged that initial contact with prospective user intermediaries can be undertaken either by group information sessions held by the NMHS, or that representatives from the NMHS go to meetings that are held by individual user intermediaries.

It is important to have a contact point, set person or position within each intermediary organization, in order to make sure that this organization receives the Climate Watch. It is not enough to post the Climate Watch to a web site and expect that the intermediaries and end users will read it – the NMHS must be proactive in making sure the intermediaries receive notification that a Climate Watch has been issued.

Ongoing interaction between the NMHS and the user community is important. It is important that the user intermediaries and ultimately the end users understand the skill associated with the forecast system, any weakness in the observing system, and the terminology associated with the Climate Watch. It is also important to regularly evaluate whether the Climate Watch System is addressing the end user's needs. Thus, periodic feedback from the user intermediaries should be requested and evaluated. The NMHSs and user intermediaries should agree upon a plan for collecting and evaluating user feedback as part of the design of the Climate Watch System.

Climate Watches are to be issued in a timely manner to allow end users sufficient time to incorporate them into their decision-making processes. For example, if a drought Climate Watch is to be issued, farmers need access to this information before they've made decisions about planting, crop management and harvesting. Responsibility for secondary distribution of Climate Watches (e.g., from Bureau of Rural Services to the farming community) may be effectively delegated to an appropriate intermediary. A periodically evaluated contact protocol for the dissemination of the Climate Watch must be established between the NMHS and the user intermediaries.

Climate Watches are to be developed in close collaboration with the user community. Setting goals and selecting criteria should be the first issues addressed by the NMHS and intermediaries. This may involve research by either or both parties into appropriate criteria

(climate elements) and threshold conditions for issuing Climate Watches. In some cases, especially those involving health-related risk, there may be a need for further study and research to establish whether climate surveillance is appropriate. That is, there is a need to establish a direct causal link between a particular climate anomaly and the situation being monitored. For example, it has been shown that climate surveillance is useful in predicting outbreaks of Murray Valley encephalitis in Western Australia, but there is less evidence to suggest the same relationship exists between climate and outbreaks of Murray Valley encephalitis in far southeastern Australia (Spencer et al., 2001).

Examples of user intermediaries and end user communities are contained in the Appendix 3.

d. Criteria

Watches may incorporate information from recent climate analysis as well as outlooks from long-range forecasts. Climate Watches should only be issued when there is an enhanced probability that a climate anomaly may happen and where there might be serious consequences to some stakeholder. Given the prerequisite that the Climate Watch must be as accurate as practicably possible, the period over which an initial Climate Watch is valid should be stated. As with weather warnings, a Climate Watch should only be issued when there is an enhanced probability of a significant climate anomaly. Hence, there is a need to establish appropriate criteria for a Climate Watch to be issued.

It may be necessary to issue a final statement when there is a return to “normal” conditions, or a high likelihood of a return to normal conditions. Once again, there is a need to consult with intermediary users on what may constitute a return to normal conditions. It may also be necessary to issue a Climate Watch on a regular basis in order to update the intermediary users on the current situation and outlook. Updates should only be issued, however, after an initial Climate Watch has been issued. For example, an Initial Climate Watch, issued on the 19th of June, may suggest that a Climate Watch Update will be issued in one month (on the 19th July). Climate Watch Updates may need to be issued on a monthly basis until the Climate Watch anomaly has passed, at which time a Final Climate Watch should be issued. Climate Watch Updates should not be issued on an ongoing or routine basis unless an Initial Climate Watch has been issued and ongoing updates are needed.

If there is no current Climate Watch then it may be appropriate to post a message with wording similar to “There is no current Climate Watch”. This assures the user and intermediaries that the current climate assessment does not warrant the issuing of a Climate Watch.

e. Content and format

The content and format of a Climate Watch statement for a particular country or region should be developed in conjunction with the appropriate user intermediaries. Guidelines for issuing weather warnings, however, can provide a good starting point for what should be included in a Climate Watch statement.

The information in a standard Climate Watch should include:

- a standard heading;
- issuing authority;
- time and date of issue;
- areas for which the advice is current (the appropriate regions);
- period during which the Climate Watch is valid;
- where appropriate, an indication of the reason for the Climate Watch, which may include graphical information;
- relevant skill of long range forecasts;
- possible follow on effects of the climate anomaly; and
- the date at which the next update will be issued.

Complete actual examples of an Initial Climate Watch, a Climate Watch Update, and a Final Climate Watch are given in Appendices 5, 6, and 7, respectively. These illustrative examples are provided as a framework for discussions. The particular content and format adopted by each NMHS should be tailored to the needs of each country or region, as determined in consultation with user community intermediaries.

f. Dissemination of the Climate Watch

The dissemination plan designed by the NMHS and its partner intermediaries (including members of the media) should balance the need for effective targeting of Climate Watches with the mandate to protect the lives and property of all citizens. Such a dissemination plan might combine public release of the Climate Watch (supported by media training and capacity building) with targeted dissemination via the networks of user intermediaries, such that further dissemination of a Climate Watch beyond that of the intermediary user, for example to the farming community, is the responsibility of the agricultural intermediary. It is advised that Climate Watches also be displayed on a publicly available web site, further facilitating the distribution process.

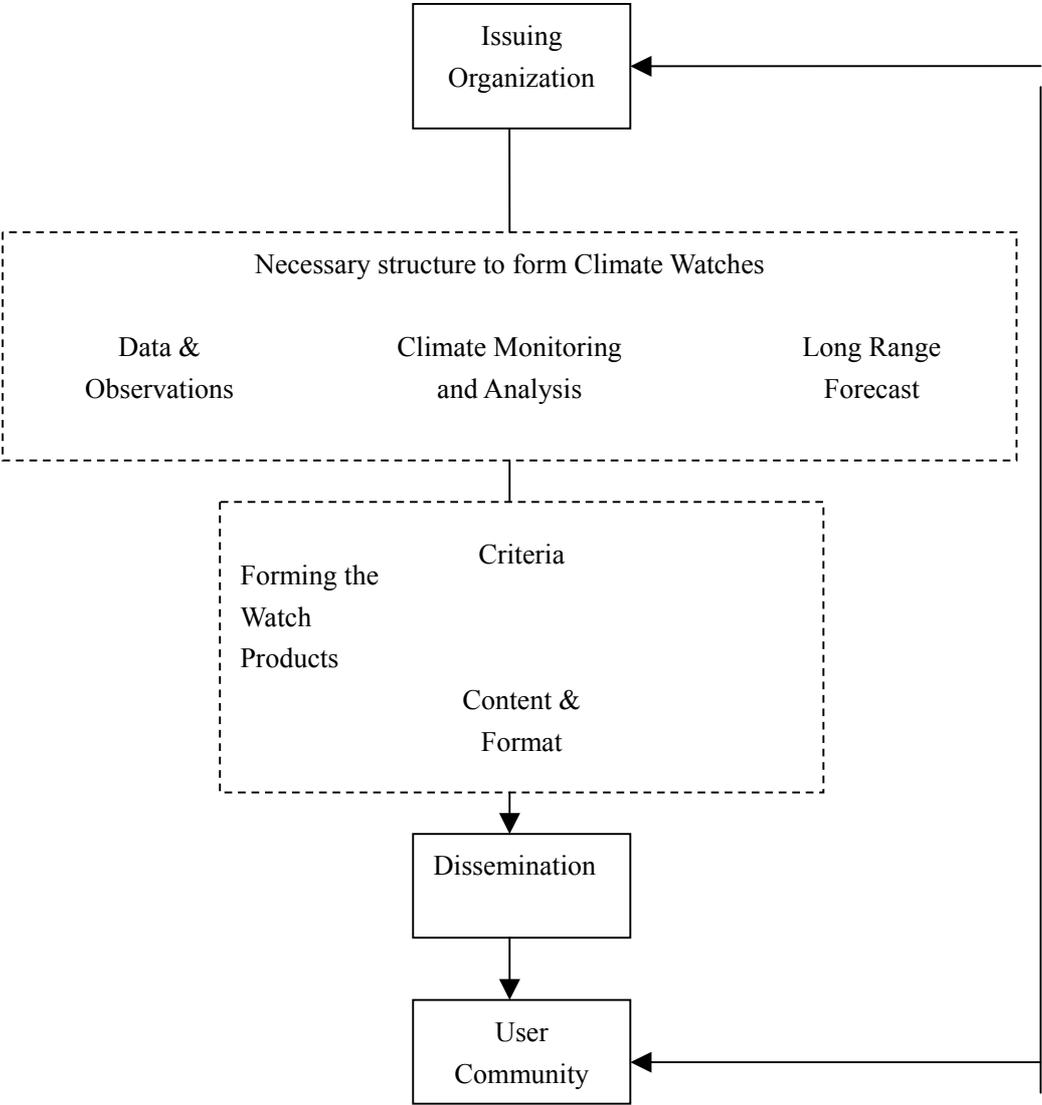
In a similar way to weather warnings, there is a need for the NMHS to be proactive in the distribution of the Climate Watch. This includes making sure that the user community receives the Climate Watch: at least the initial Climate Watch should involve person to person contact between the NMHS and intermediaries, while subsequent updated Climate Watches issued on a set date could be sent by fax or email. The initial contact could, for example, be made via a telephone call with a follow-up fax/email and updating a Climate Watch web page. For this to work smoothly there must be both a user intermediary contact person and a NMHS contact person responsible for the Climate Watch. Every effort must be made to make sure that the Climate Watch statement is delivered to the correct person.

As mentioned above, there is a need for the Climate Watch to be issued in a timely manner so

that the end user can take advantage of forewarning of a climate anomaly. For this to happen there is a need for the NMHS to disseminate the Climate Watch as soon as practical.

There is a need for ongoing monitoring of the effectiveness of the dissemination process, based upon evaluation criteria that are designed from the onset in partnership with user intermediaries.

A schematic structure for the Climate Watch System



5. Establishing, operating, and evaluating national Climate Watches

The purpose of a Climate Watch is to alert climate sensitive sectors and communities within a nation of an increased probability for some climate anomaly that will potentially have an influence over the NMHS's areas of responsibility and interest. Thus, it is important for the success of Climate Watches that the appropriate user communities and their needs are identified early in the process. In the absence of any other guidance, Climate Watches will be issued based on climatological criteria, e.g., analogous to Tropical Storm watches that are issued on the basis of observed and forecasted wind speeds and central pressures. However, if the Climate Watches are to be effective they must address the concerns of the user communities.

NMHSs should not be intimidated by the challenge of reconciling evolving scientific capabilities with the wide range of needs expressed by a multifaceted user community. As organizers of RCOF have discovered, though "it is important to identify user needs, it is not very useful to start with users' ideal requirements as the climate forecasts inevitably cannot match the specifics of the ideal cases owing to the forecasts broad time and space scales and other limitations. Instead it is better to ask how the available information can assist in a user's decision making and how it might be tailored to be more effective in this role." (IRI, 2001) This can only be done by establishing contact, nurturing interactions, and satisfying user concerns as best as the science allows.

Interactions with the users of Climate Watch information represent an ongoing process that is intrinsic to operating and evaluating national Climate Watches. The following recommendations may be helpful in forging fruitful partnerships with the user community:

- Involve user intermediaries early in the planning process so that the Climate Watch System can be designed around user needs.
- Approach user intermediaries as partners; NMHSs can learn as much from their users as their users can learn from them.
- Build upon existing relationships with the user community, e.g. networks or constituency groups that the NMHS is already working with in climate forecasting and applications, Regional Climate Outlook Forums, or other meteorological and climatological activities.
- If important economic or social sectors that are affected by climate anomalies are left out, bring in new partners by reaching out to government agencies, non-governmental organizations, companies, associations, researchers, and regional or international organizations which work in the sector(s).
- Be creative in devising ways to meet the needs of users who may be difficult to reach or disadvantaged as a result of poverty, gender, age, ethnicity, or other factors.
- Consider the scale of the Climate Watches when developing ideas about potential end users and intermediaries. If Climate Watches will be issued on regional or national scales, the users most able to take advantage of that information will most likely be those that function on regional or national levels, e.g. government agencies, food security organizations, water and electricity suppliers, etc.

a. Establishment of national Climate Watches

The nature of global climate monitoring and prediction requires significant resources, including state of the art computers, communications and a number of highly trained professional staff. Thus it is likely that the routine production of global seasonal climate analyses and forecasts will continue to be performed only at a few Centers e.g. ECMWF, JMA, NCEP, UKMO, IRI and CMA/NCC. However, these global seasonal analyses and forecasts are not, in themselves capable of supporting national Climate Watches. The products from the large Centers are only one of the initial links in a long chain of tailored climate information and forecast products that need to feed into a Climate Watch.

Climate Watches should be based on observations of current (monthly, seasonal) climate anomalies and/or forecasts of the expected likelihood of future anomalies. State of the art climate models and empirical methods can generally produce probabilistic forecasts of monthly to seasonal temperature and precipitation anomalies, although skills tend to be slightly higher for the seasonal forecasts. As climate prediction becomes more mature Climate Watches may evolve to include other variables in addition to temperature and precipitation as well as other temporal scales of interest to the user communities.

Climate Watches should be established through a formal process that engages the user communities in development of the Watches. In order to establish an effective system for Climate Watches the NMHS will need to evaluate its capabilities and limitations to produce Climate Watches as realistically as possible. This includes assessments of its abilities to provide:

- 1) Timely observations of current climate conditions for their areas of responsibility
- 2) Adequate historical climate data for placing the observations into historical context
- 3) Timely, user relevant, analyses of current climate anomalies
- 4) Access to current global climate forecasts and the technical capabilities to interpret and downscale them to their region
- 5) Probabilistic climate forecast products that are understandable by the user community
- 6) Continuously updated records of past forecasts and analyses of past forecast performance
- 7) Methods for the routine dissemination of climate information to user groups and sectors and
- 8) An active program of collaboration and feedback with the user community to guide the design and determine the effectiveness of the Watches.

Once an evaluation of these abilities has been performed the NMHS will be in a position to initiate development of Climate Watches. If some aspects of needed technical capacity are lacking, the NMHS will need to develop its capacities. The NMHS may also wish to issue Climate Watches in collaboration with global climate Centers or Regional Climate Centers.

b. Building capacity for establishing Climate Watches

Building capacity for Climate Watches has two major components. The first involves those activities required to ensure that NMHS personnel have the capabilities to operate Climate Watches as well as capabilities required to ensure that the Watches are effectively communicated to and used by the communities that will benefit from the Watches. Compared to the almost century-long experience in day-to-day weather forecasting operational climate prediction is relatively new. Given the recent rapid developments in production of seasonal climate outlooks many NMHSs do not currently have staff with adequate training and experience in interpreting monthly and seasonal climate anomalies or their prediction. This training need is being partially addressed through the WMO CLIPS Program. Training in climate prediction and interpretation of forecast products is also addressed in many national programs, e.g. the African and South American Desk programs at the National Centers of Environmental Prediction (NCEP) NWS/NOAA. Brief descriptions of climate skill and climate training requirements can also be found in WMO/ IDB ATN/JF-6579-RG. It is essential that the NMHS have a sufficient number of staff with the appropriate training and experience in climate prediction. In some cases NMHSs may consider developing Watches in conjunction with Regional Climate Centers or with other NMHSs in a region.

The second aspect of capacity building requires interactions with the user community. These interactions have a twofold purpose. On the one hand, they help to build the capacity of NMHS staff members to understand and respond to the critical issues facing the users. Communication and interpretation of climate information is as important as its production. On the other hand, capacity building requires efforts to inform the user communities about the capabilities and shortcomings of climate prediction. Building capacity in the user community requires a dedicated and sustained effort that is best achieved by regular interaction and partnership with the users as well as a vigorous outreach program to help identify additional users of climate information. A critical part of capacity building is involving those communities as partners in the development of the Climate Watch goals, criteria, dissemination plans, and feedback systems.

c. Operation of national Climate Watches

If users are to benefit from an operational Climate Watch then methods, mechanisms and management structures must be developed to build and maintain a strong, persistent, and dynamic interaction between users of the Climate Watch and the NMHS. This is critical to the operation of the Watch and to the setting of schedules, procedures, dissemination mechanisms, and evaluation plans, as well as to determining the climate variables of interest to the users. Some of these issues are addressed in Section IV of this Report.

Of particular importance is the dissemination of the Climate Watches. A Climate Watch must get to the appropriate users in a timely way and in a user-friendly format in order to be effective in the decision-making process. This requires considerable efforts in determining and implementing the appropriate means for dissemination of the climate information. In many

cases the NMHSs do not have easy and direct access to the end users of climate information. Thus, a Climate Watch must develop appropriate relationships along each link of the communication chain to the users. This requires close and continuing collaborations among the various users and providers of information.

In many cases the mechanisms for dissemination could rest within those NMHSs, who generally have a well-developed set of users. In other cases representatives of the ministries, or government agencies, who advise user communities, e.g., public health, agriculture, water resources, risk/hazard management, may be appropriate partners or intermediaries in the dissemination of Climate Watches, while in other cases Non-Government Organizations (NGOs) may need to be involved. The NMHS should work with the appropriate agencies and organizations, e.g., a Ministry of Agriculture, to insure that not only does the Watch information get to the appropriate Agency but that the Climate Watch is understood and is appropriate to the need of the end-user communities serviced by that Agency.

In many cases the user communities may help determine and facilitate the means to disseminate the Climate Watch. Dissemination may have some very sophisticated components, such as Internet and/or direct satellite downlinks but may also have a number of effective components that are less dependent on cutting edge technology, such as radio, newspapers, television news and educational programs, newsletters, local civic meetings, meeting reports, and educational materials. An effective Climate Watch will have developed these links and dissemination methods well in advance of a potentially significant climate anomaly, e.g., an ENSO episode. This means that a large part of the dissemination work requires further close collaborations with the various user sectors in addition to the development of the products.

In summary, the building of dissemination mechanisms and agreements is an integral and vital part of any Watch. The Climate Watch operational design should contain provisions for ensuring that these mechanisms and agreements are developed early in the process, in partnership with the user community, and exercised appropriately.

d. Evaluating Climate Watches

A Climate Watch should include mechanisms to evaluate the effectiveness of the Watch. While the formal verification of forecast products is an essential part of the evaluation process this process needs to move beyond statistical summaries to evaluation of the Watch's effectiveness in the user community. A highly skilled climate analysis or forecast reflected in a Climate Watch will only be effective if users are acting on this information. Thus the evaluation requires regular, organized interactions among all of the participants in the Watch, from the providers of the climate information, through the intermediary agencies and organizations, to the end users of this information.

One of the difficulties in determining the effectiveness of the Climate Watch is the development of evaluation criteria. It is highly desirable that criteria for evaluating the Watches be developed and agreed upon with the user communities in advance. It is likely that over the long run the

information and forecasts in the Watches will have a certain level of formal “reliability” and “skill” while observed climate anomalies in a region will have a full spectrum of impacts, some good, some bad, and some possibly disastrous. Even an ideal Climate Watch will not be capable of eliminating all of the negative effects of an anomaly but should help to mitigate the effects and may help planners identify sectors and regions of vulnerability.

At least a part of the formal evaluations of the Climate Watch must also deal directly with the inherent probabilistic nature of Climate forecasts. For instance a seasonal probability forecast for 55% wet, 30% average, and 15% dry conditions is not "wrong" if that particular season turns out dry but would be "wrong" if, in a large number of such forecasts the observed probabilities were substantially different from those forecast, say 35% wet, 35% average, and 30% dry. Such evaluations require that forecasts be saved and archived.

The evaluation of the seasonal forecasts should form only one part of the evaluation of the Climate Watch. The evaluation of the Watch should also encompass the effectiveness of its dissemination and its ability to help the users make informed decisions given a current climate anomaly and probabilistic forecast. Specific evaluation methodologies will need to be developed in partnership with the user community. They may include such things as whether the Climate Watch was received, further disseminated, considered subjectively, formally used as part of a decision mechanism or ignored, and what impacts those decisions had on the welfare of the user community.

The following lessons for effective evaluation and learning may be useful for NMHSs and their partners in designing Climate Watch evaluation plans: (Cash, 2003)

- Prioritize evaluation.
- Build evaluation in early through collective, negotiated setting of shared and unambiguous objectives, criteria for evaluation, methods of evaluation, and performance indicators.
- Evaluate often and iteratively; one-shot evaluations are usually ineffective.
- Evaluate system-wide. Appraisals of agenda setting, research, observation, tools, applications, communications, assessment, decision support, and funding mechanisms should cut across all levels of the system.
- Evaluate both internally and externally.

6. Conclusion

In order for countries to make the transition from “crisis management” policies to “risk assessment/ risk management” policies, it is important that information on the state of the climate system be provided to relevant decision-making organizations and user community intermediaries, such as government, agricultural agencies, emergency management services, and water resource management agencies.

A “Climate Watch” can serve as a mechanism to heighten awareness in the user community that

a significant climate anomaly exists or might develop and that preparedness measures should be initiated. NMHSs in several countries have developed and operationalized Weather Watches (e.g., for tornadoes, hurricanes, severe storms, etc.) that have been assisting societies to improve their preparedness and reduce their vulnerability to weather extremes. Given the advances in climate monitoring and long-range forecast during the last two decades, and in the framework of establishing risk assessment and risk management policies, it is now feasible for Members to issue Climate Watches to help reduce socioeconomic vulnerability by improving preparedness procedures for adverse climatic conditions.

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Appendix 1: Glossary of terms and acronyms

APN - Asian Pacific Network

ACMAD - African Centre of Meteorological Applications for Development

CCI – WMO Commission for Climatology

CDB - Climate Diagnostics Bulletin

CIIFEN - International Research Center on El Niño

CLIPS - Climate Information and Prediction Services

Climate element - A climatic element is defined as any one of the properties or conditions of the atmosphere, from ground level to the upper troposphere, which, when combined with other elements, describes the weather or climate at a given place for a given period of time. Every meteorological element that is observed may also be termed a climatic element. The most commonly used elements in climatology are air temperature (including maximum and minimum), precipitation (rainfall and snowfall), humidity, atmospheric motion (wind speed and direction) and atmospheric pressure.

Climatological normal - Period averages computed for a uniform and relatively long period comprising at least three consecutive ten-year periods. Climatological standard normals are averages computed for consecutive periods of 30 years as follows: 1 January 1901 to 31 December 1930, 1 January 1931 to 31 December 1960, etc.

Climate observation - An observation used to describe or understand the climate system, which may include measurements of physical, chemical and biological properties, representing atmospheric, oceanic, hydrologic, cryospheric and terrestrial processes. The attributes of continuity and homogeneity are generally given high priority.

Climate observation network - An inter-connecting arrangement of observation systems designed to provide meteorological or related observations suitable for climatological purposes over some defined area.

Climate observation system - An observation system (e.g. automatic weather station, radiosonde, buoy) designed to measure, and often record and transmit, meteorological or related observations suitable for climatological purposes.

Climate system - The climate system is the highly complex system consisting of five major components: the atmosphere, the hydrosphere, the cryosphere, the land surface and the biosphere, and the interactions between them. The climate system evolves in time under the influence of its own internal dynamics and due to external effects resulting from volcanic

eruptions, solar variations and human activities (e.g., air pollution and land-use change).

CMA – China Meteorological Administration

CPC - Climate Prediction Center

CPT – Climate Prediction Tool

DMC - Drought Monitoring Centre

End user - End users of climate information are individuals or organizations whose interests are affected by climate anomalies and who consider climate information when making decisions. The key characteristics of end users are that they are decision-makers that are aware of vulnerability to climate and have the knowledge and ability to act on climate information. (IRI, 2001)

ENSO - El Niño/ Southern Oscillation

ET – Expert Team

GCOS - The *Global Climate Observing System* was established in 1992 and is co-sponsored by the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC) of UNESCO, the United Nations Environment Programme (UNEP) and the International Council for Science (ICSU). GCOS is intended to be a long-term, user-driven operational system capable of providing the comprehensive observations required for monitoring the climate system, for detecting and attributing climate change, for assessing the impacts of climate variability including climate change, and for supporting research toward improved understanding, modelling and prediction of the climate system.

GDPFS - Global Data Processing and Forecasting Systems

GPC - Global Processing Centre

GPLRF – Global Producers of Long Range Forecasts

GSN - The GCOS Surface Network contains about a quarter of the 4000 stations within the World Weather Watch reference synoptic network and has been specifically designed to determine the variability, including extremes, of surface air temperature over land at global, hemispheric and continental scales. It is also used to make similar estimates for other variables.

GTS - Global Telecommunication System

GUAN - The *GCOS Upper Air Network* is a baseline network of about 150 stations selected from the full upper-air network on the basis of past performance and global representation. It

intends to provide reliable measurements of large-scale temperature variations for heights up to 5hPa in the free atmosphere for the detection of climate change. Other variables, such as humidity and wind speed and direction are also extremely valuable.

Intermediary – see User intermediary

IRI - International Research Institute for Climate Prediction

MJO - Madden-Julian Oscillation

NGOs - Non-Government Organizations

NMS - National Meteorological Service

NMHS - National Meteorological and Hydrological Service

NOAA - National Oceanic and Atmospheric Administration

OPAG - Open Programme Area Group

Ordinary Climatological Station - A climatological station where observations are made at least once daily, including readings of extreme temperatures and precipitation amount.

PDSI – Palmer Drought Severity Index

Principal Climatological Station - Operates a more extensive observation programme than an Ordinary Climatological Station. At a minimum such a station should make observations of the following elements: weather, wind, cloud amount, type of cloud, height of cloud base, visibility, humidity, temperature (including extremes), atmospheric pressure, precipitation, snow cover, sunshine and/or solar radiation, soil temperature at various depths.

RANET - An internet-based satellite radio network used for communicating weather, climate, and development information to remote and resource poor populations in Africa, Asia, and the Pacific Islands. <http://www.ranetproject.net/>

RCC - Regional Climate Centre

RCOF - Regional Climate Outlook Forum

RCS - A *Reference Climate Station* (or Reference Climatological Station) is a climatological station, the data of which are intended for the purpose of determining climatic trends. This requires long periods (not less than thirty years) of homogeneous records, where human-influenced environmental changes have been and/or are expected to remain at a minimum. Ideally the records should be of sufficient length to enable the identification of

secular [over time] changes of climate.

RBCN - The *Regional Basic Climatological Network* provides support to regional-scale climate monitoring by encouraging an increase in the international exchange of monthly climate station data (CLIMAT reports). Members are encouraged to include RCSs within their RBCN.

SADC - Southern African Development Community

SPI – Standardized Precipitation Index

User community – The user community is the broad group individuals and organizations which use climate information, are involved in interpreting climate information for use by other individuals or organizations, and/or advocate for improving the effectiveness of climate information. End users, user intermediaries, and user stakeholders are all part of the broader user community.

User intermediary – A user intermediary is an individual or organization (government or otherwise) that provides guidance to a climate-sensitive community sector in order to enable that community to make better decisions. Intermediaries interpret and transform the technical information into a form that is more suitable for the end users. (IRI, 2001)

User stakeholder – A user stakeholders is an organization which has the interest of the users at heart and a stake in the effectiveness of the processes aimed at meeting user interests. Examples include aid agencies, international organizations concerned with development or governance, non-governmental organizations (NGOs), and community-based organizations. (IRI, 2001).

WCASP - World Climate Applications and Services Programme

Appendix 2: Some Selected Web Resources

Background on ENSO

An extensive source of links to ENSO-related web sites

<http://www.coaps.fsu.edu/lib/elinolinlinks/>

Some educational sites:

<http://iri.columbia.edu/climate/ENSO/>

<http://www.elnino.noaa.gov/>

<http://www.pmel.noaa.gov/tao/elnino/nino-home.html>

Background on Climate Prediction

Report to the Nation:

<http://www.atmos.Washington.edu/gcg/RTN/rtnt.html>

A list of (mostly) easy to read books and articles:

<http://www.atmos.Washington.edu/gcg/RTN/RTN.bib.html>

ENSO and Climate Prediction:

<http://iri.columbia.edu/climate/ENSO/globalimpact/index.html>

Real-time ENSO information:

<http://iri.columbia.edu/climate/ENSO/currentinfo/>

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/

<http://iridl.ldeo.columbia.edu/maproom/.ENSO>

<http://www.pmel.noaa.gov/tao/jsdisplay/>

<http://bcc.cma.gov.cn/>

Latest SST and atmospheric indices:

<http://www.bom.gov.au/climate/current/soihtml.shtml>

<http://www.cpc.ncep.noaa.gov/data/indices>

ENSO Forecasts

<http://iri.columbia.edu/climate/ENSO/currentinfo/>

<http://www.ecmwf.int/products/forecasts/d/charts/seasonal/forecast/plumes/>

<http://bcc.cma.gov.cn/>

Real-time global SSTs

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_update/index.html

<http://www.bom.gov.au/climate/current/anomsst.shtml>

<http://www.cdc.noaa.gov/map/clim/sst.shtml>

<http://www.longpaddock.qld.gov.au/>

Global producers of Long Range Forecasts

(these are part of the infrastructure for LRF being developed by WMO: see reports at <http://www.wmo.ch/web/www/CBS-Reports/DPFS-index.html>)

Australian Bureau of Meteorology (WMC Melbourne)

<http://www.bom.gov.au/climate/ahead/>

<http://www.bom.gov.au/bmrc/clfor/cfstaff/matw/maproom/index.htm>

<http://www.bom.gov.au/bmrc/ocean/JAFOOS/POAMA>

European Centre for Medium-Range Weather Forecasts (ECMWF)

Forecasts: <http://www.ecmwf.int/products/forecasts/seasonal/>

Documentation: <http://www.ecmwf.int/products/forecasts/seasonal/documentation/>

Demeter dataset: <http://www.ecmwf.int/research/demeter/data>

World Meteorological Centre Moscow (WMC)

<http://hmc.hydromet.ru> (*Password for access is to be provided on request*)

Japan Meteorological Agency (JMA)

<http://cpd2.kishou.go.jp/tcc/>

Met Office (United Kingdom)

<http://www.metoffice.gov.uk/research/seasonal/> .

Meteo-France

http://www.meteo.fr/special/CLIM/clim_model.html (*Model anomalies*)

International Research Institute (IRI)

<http://iri.columbia.edu/climate/forecast>

Center for Weather Forecasts and Climate Studies/National Institute for Space Research (CPTEC/INPE)

<http://www.cptec.inpe.br/clima>

Access to numerical model output can be provided, by sending an email to gclima@cptec.inpe.br, and a password will be provided.

Korean Meteorological Administration (KMA)

<http://www.kma.go.kr/kmas/kma/english/main.htm>

South African Weather Service (SAWS)

<http://www.weathersa.co.za/FcastProducts/LongRange/>

Meteorological Service of Canada (MSC)

<http://www.cccma.bc.ec.gc.ca/data/hfp/hfp.shtml>

http://weatheroffice.ec.gc.ca/saisons/index_e.html (*Seasonal forecasts information*)

National Climate Center of China Meteorological Administration (NCC/CMA)

<http://ncc.cma.gov.cn>

Climate Prediction Center (CPC/United States)

<http://www.cpc.ncep.noaa.gov/>

World Meteorological Organization (WMO/Switzerland)

<http://www.wmo.ch/web/www/DPS/EPS-HOME/eps-home.htm#Long-range> (*EPS/LRF producing centres*)

<http://www.wmo.ch/web/www/DPS/GDPS-Supplement5-AppI-4.html> (*Definitions of forecast ranges*)

<http://www.wmo.ch/web/www/DPS/LRF-verification-systems.html> (*Verification system for Long-range forecast*)

Appendix 3: Example of the user communities

Examples of end user communities and climate factors that influence those communities:

- **Health:** particularly in relation to rainfall during sensitive seasons. Note that in Australia malaria has been eradicated; however there are more than 70 viruses that may be spread by insects that can breed rapidly during unusually heavy rainy periods. (See page 70, ABoM, 2003).
- **Agriculture:** frosts, rainfall, heat - Farmers can prepare for diversification or change in normal cropping practices (e.g., during El Niño Peru crops may switch from cotton to rice since cotton is more susceptible to water logging; Australia uses chickpeas during drier years since they have a shorter growing season and later planting date than wheat so are able to withstand late frosts and drier conditions – examples from Couper-Johnston).
- **Food security:** rainfall and temperature – pre-positioning and timely delivery of aid
- **Emergency planners:** drought, floods, heat waves – contingency plans
- **Energy providers:** rainfall and water availability for hydroelectric energy production, temperature with regard to predicting demand
- **Water resources:** rainfall (and temperature), dam management, water allocation
- **Livestock:** rainfall, temperature – herd management, migration
- **Tourism:** rainfall, heat – occupancy rate projection, publicity
- **Transportation:** rainfall (and temperature) – river navigation, port and harbor mgt.
- **Urban design:** rainfall, temperature – infrastructure design, urban management
- **Fisheries management:** rainfall, temperature, ocean conditions – adjust fishing quotas or length of seasons
- **Fire authorities:** rainfall, temperature – undertake burnoffs
- **Households:** rainfall (and temperature) – managing discretionary spending and investments

Examples of user intermediaries: government bodies (e.g. agricultural agencies, emergency management services and water resource management agencies) meteorological officers, climate scientists, extension workers, government policy advisers, consultant engineers, media, journalists, opinion makers, and local leaders.

Examples of user stakeholders: aid agencies, national and international organizations concerned with development or governance, non-governmental organizations (NGOs), and community-based organizations.

Appendix 4: Outline of a Climate Watch

Standard heading

Issuing agent

Issuing office

Name of warning

Area affected by Climate Watch

Date and time issued

Period of validation

General statement of the Climate Watch

Situation bringing about the event

Information on update advice

NMS contact details

List of attachments

Appendix 5: Example of an Initial Climate Watch

INITIAL CLIMATE WATCH

Bureau of Meteorology
National Climate Centre

CLIMATE WATCH FOR RAINFALL DEFICIENCY

Climate Watch valid for southwest Queensland, northwest New South Wales.

Issued on 2 March 2004

Valid until 2 April 2004

Please be aware of expected severe rainfall deficiency over the area of southwest Queensland and northwest New South Wales. This region has experienced rainfall in the lowest decile range averaged over the last three months. The outlook for the next three months, derived from the Bureau of Meteorology's statistical forecast model, suggest that the chance of exceeding the median rainfall is 30% for this region. Outlook confidence for this forecast is particularly high, with a skill level above 65%.

These figures meet or exceed the criteria for a rainfall deficit Climate Watch for this region, being:

- Rainfall for the previous three months: decile one or lower.
- Chance of rainfall being greater than the median: 40% or lower.
- Forecast skill score: 55% or greater.

Climate situation: Sea surface temperatures in the central equatorial Pacific have increased over the previous two months. There is the strong chance that warm state ENSO conditions are likely to eventuate. Eight out of twelve computer models surveyed suggest the likelihood of El Niño by June 2004. There is a strong relationship between El Niño and low rainfall in this region for this time of the year.

This Climate Watch is expected to be updated on or before 2 April 2004.

For further information please contact Grant Beard (03) 9669 4527

Attachments:

- Regional map highlighting the area covered by this Climate Watch
- Rainfall decile map of Australia for the most recent three months
- Latest seasonal climate outlook
- Rainfall skill map covering the coming three months
- Map of recent weekly sea surface temperature anomalies for the Pacific
- Plumes of forecast Nino3.4 sea surface temperature anomalies

Appendix 6: Example of a Climate Watch Update

CLIMATE WATCH UPDATE FOR RAINFALL DEFICIENCY

This is an update of the Initial Climate Watch issued on the 2 March 2004.

The main conditions updated are:

- An increase in the area affected by the Climate Watch.
- Most recent forecast results suggest a continuation of a low probability in exceeding above median rainfall.

Climate Watch valid for southern Queensland, north and central New South Wales.

Issued on 2 April 2004

Valid until 2 May 2004

Please be aware of expected severe rainfall deficiency over the area of southern Queensland, and northern and central New South Wales. Over the past four months this region has experienced decile two rainfall, with decile three rainfall over the most recent three months. The outlook for the next three months, derived from the Bureau of Meteorology's statistical forecast model, suggest that the chance of exceeding the median rainfall is 40% for this region. Outlook confidence for this forecast is particularly high, with a skill level above 60%.

These figures meet or exceed the criteria for the continuation of a rainfall deficit Climate Watch for this region, being:

- Rainfall for the previous three months: decile six or lower.
- Chance of rainfall being greater than the median: 50% or lower.
- Forecast skill score: 50% or greater.

Climate situation: Sea surface temperatures in the central equatorial Pacific continue to be warmer than average. An El Niño has been declared. Seven out of twelve computer models surveyed suggest a continuation of El Niño conditions through to at least November 2004. There is a strong relationship between El Niño and low rainfall in this region for this time of the year.

This Climate Watch is expected to be updated on or before the 2 June 2004.

For further information please contact Grant Beard (03) 9669 4527

Attachments:

- Regional map highlighting the area covered by this Climate Watch
- Rainfall decile map of Australia for the most recent three months
- Latest seasonal climate outlook
- Rainfall skill map covering the coming three months
- Map of recent weekly sea surface temperature anomalies for the Pacific
- Plumes of forecast Nino3.4 sea surface temperature anomalies

Appendix 7: Example of a Final Climate Watch

FINAL CLIMATE WATCH

This is the cessation of the Initial Climate Watch issued on the 2 March 2004.

FINAL CLIMATE WATCH FOR RAINFALL DEFICIENCY

Initial Climate Watch valid for Climate Watch valid for southwest Queensland, northwest New South Wales, subsequently extended to cover the areas southern and eastern Queensland, north, central and eastern New South Wales.

Issued on 2 January 2005

Over the past three months the Climate Watch area has experienced decile eight rainfall. This followed good falls in late November and through much of December. The outlook for the next three months, derived from the Bureau of Meteorology's statistical forecast model, suggest that the chance of exceeding the median rainfall is 55% for this region. Outlook confidence for this forecast is particularly high, with a skill level above 60%.

These figures do not meet the criteria for continuing the rainfall deficit Climate Watch for this region, being:

- Rainfall for the previous three months: decile six or lower.
- Chance of rainfall being greater than the median: 50% or lower.
- Forecast skill score: 50% or greater.

Climate situation: Sea surface temperatures in the central equatorial Pacific have continued to cool in the last few weeks. The short-lived 2004 El Niño appears to be subsiding with an expected return to neutral ENSO conditions over coming months. All twelve computer models surveyed suggest a return to neutral ENSO conditions by March 2005.

For further information please contact Grant Beard (03) 9669 4527

Attachments:

- Regional map highlighting the area covered by the most recent Climate Watch
- Rainfall decile map of Australia for the most recent three months
- Latest seasonal climate outlook
- Rainfall skill map covering the coming three months
- Map of recent weekly sea surface temperature anomalies for the Pacific
- Plumes of forecast Nino3.4 sea surface temperature anomalies

