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COMMISSION FOR CLIMATOLOGY ITEM 6.2
MANAGEMENT GROUP MEETING

GENEVA, Switzerland 18-21 May 2010

CLIMATE MONITORING AND ASSESSMENT
DEFINITION OF CLIMATE EXTREME EVENTS

(Omar Baddour)

6.2.4.1 CCl developed in 2005 a guidelines-document on climate watches which was followed by a series of regional workshops for improving climate monitoring including implementation of climate watch systems in the regions. Based on the first two workshops held in RA-III in 2008 and RA-II in 2009, it was noted that standard data base should be developed by WMO on climate extreme events and adoption of common definitions relevant to some climate extremes and their scale and intensity is also required so that information is compared seamlessly amongst NMHSs in the same region. For example when an NMHS provides a climate advisory on a heat wave there should be a standard definition of what a heat wave means in terms of Tmax and Tmin in the given area and region. Also we could assign a scale qualifying the severity of the heat wave based for example on daily temperature maximum and minimum, humidity and the geographical extend. Same applies for other extremes such as cold waves, wind storms, etc.

6.2.4.2. Furthermore, considering the efforts of the Joint CCl/Clivar/JCOMM Expert Team on Climate Change Detection and Indices (ETCCDI) and the important steps which have been achieved in developing and assessing climate change and providing a good comparison platform for worldwide climate extreme assessment, nevertheless the need for assessing in parallel climate change based on extreme event observations and monitoring (from phenomenological point of view) has become a necessity to achieve more detailed description of climate change influence on weather and climate related extremes. In this regards, the intended work would complement the ETCCDI efforts in climate change detection and monitoring based on empirical craterisation of climate extremes.

MG group reviewed the CCl agreed deliverables of OPACE-2 with particular mention of the provision of guidelines on methodologies and standards for defining extreme weather and climate events that are of major societal impacts and assessing their attribution and return periods in the changing climate such as for heat waves, cold waves, extremes precipitations anomalies and wind storms, etc.; and provision of project proposal for developing standards for creating global, regional and national data bases on extreme weather and climate events. It decided to establish a Task Team on Climate Extreme Events (TT-CEE) with the following Terms of Reference:

(1) Review the existing work and studies, including by WMO communities and others which relate to climate extreme events, their definitions, geographical distribution, space and time scales, intensity, etc;

(2) Evaluate the gaps in and the need for developing common definition related to climate extreme events with particular focus on cold waves, heat waves and severe precipitation and storms events (not including those related to tropical cyclones),

(3) Provide guidance to the Members on methodologies and standards for defining extreme weather and climate events and assessing their attribution and return periods

(4) Provide an advise on developing an inter-operable data base for climate extreme events with focus on regional and national levels;

(5) Liaise with other commissions, programs, co-sponsored programs and regional and international projects and agencies to develop linkages and partnership on this subject;

(6) Report to OPACE-2 co-chairs

MG decided to nominate the following members of the Task Team

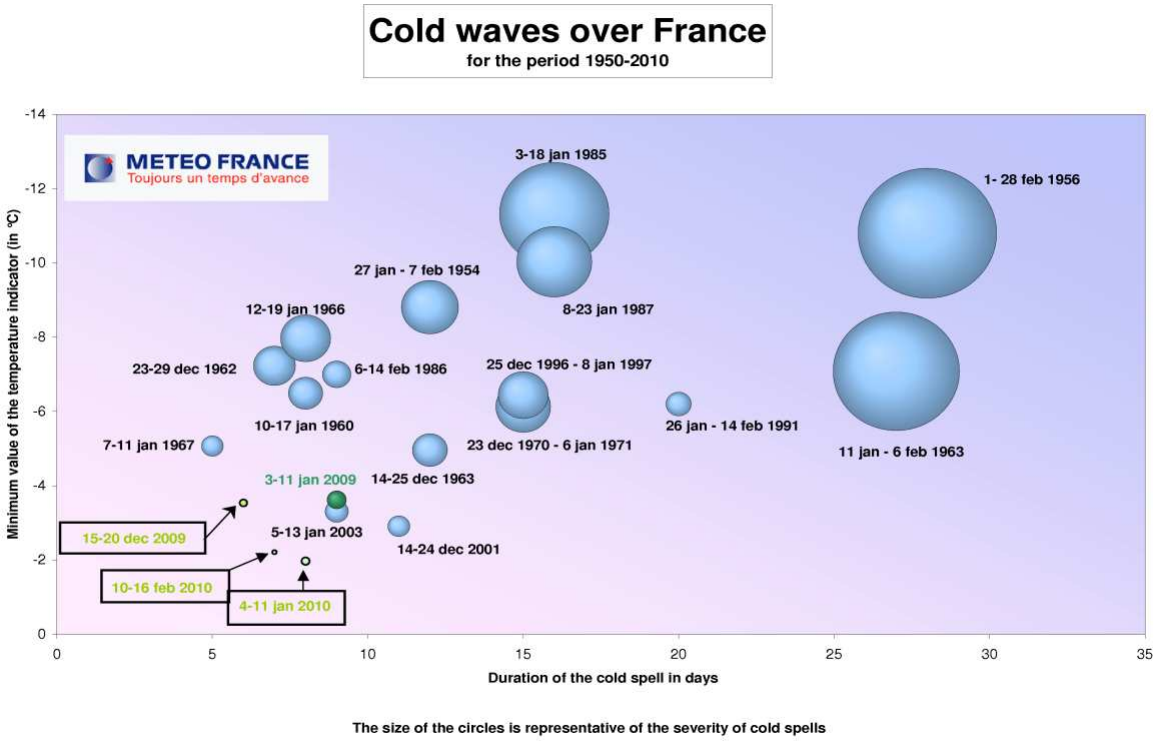
Chair : ……
Co-Chair: ……
(1) ……
(2) ……
(3) ……
(4) ……
(5) ……
(6) ……

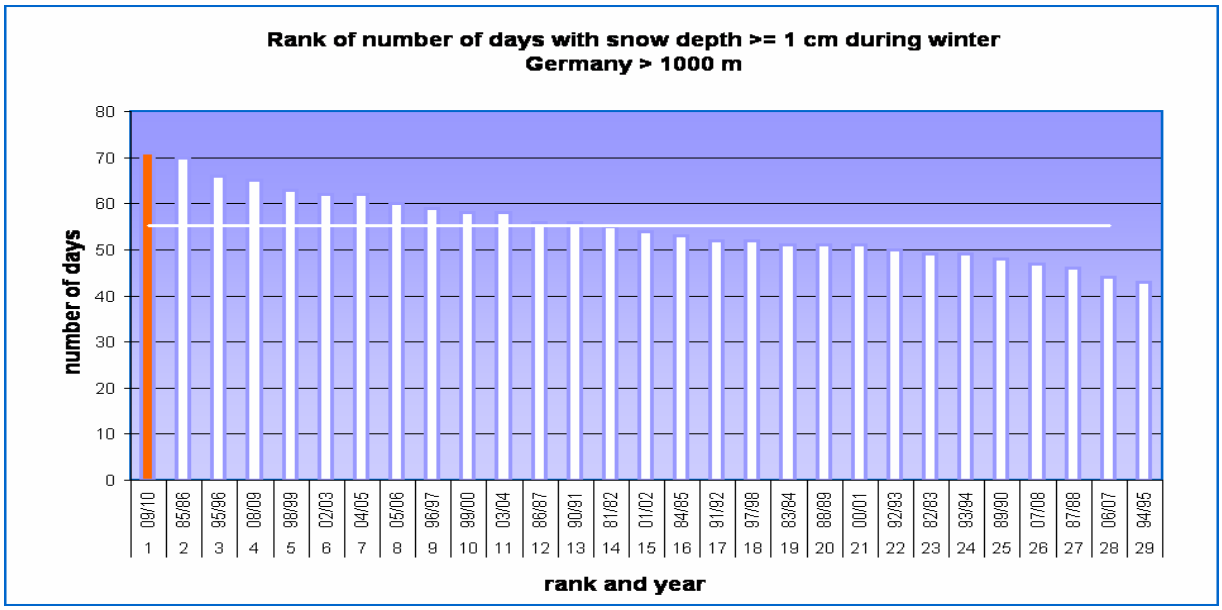
MG welcomed the proposal by China and decided to seek ways for assisting in implementing the proposed project with the aim of benefiting other Members from the outcome of this project and develop similar ones in other regions.

Annex A

Example of a climate extreme event assessment relevant to the recent 2009/2010 NH cold wave.

1. Upper figure shows major cold waves in France in 1950-2010, X axis: duration of the cold spell in days, Y axis: minimum value of the temperature indicator (average of daily mean temperatures measured in 30 meteorological stations evenly distributed over France; in ℃). The diameter of circles symbolizes the intensity of cold waves; the largest are the most severe ones. Only major cold waves are plotted, except the recent cold waves of 2009 and 2010 with the aim of comparison. Source: Meteo France. Lower figure shows number of days with a snow depth >= 1 cm in the winter months December 2009 – February 2010 in Germany, averaged over all elevations > 1000 m above mean sea level. Source: DWD, Germany.





Annex B

China proposal on Monitoring and Assessment of Extreme Weather and Climate Events in Asia, Beijing Climate Centre, China Meteorological Administration

Project leader: Dr. Xiao Ziniu, Director General of BCC
Contact person: Dr. Ren Fumin, BCC, fmren@163.com

1. The Beijing Climate Centre (BCC) at CMA proposes to conduct a project to establish a centre for monitoring and assessment of extreme weather and climate events in Asia. These events are mainly associated with the multi-scale Asian monsoons and result in very high-cost impacts to the society due to the disasters they often cause. BCC proposes to establish a unified database and monitoring platform so that it can help organizing and disseminating real- and post-time monitoring and assessment information on extreme weather and climate events in Asia, thus contributing to the goal of research on high impact monsoon weather for disaster reduction of WMO programs, including the WCP and the WWRP-TMR.

1. Background

1.1 Asia, with 60% of the world's population most of which is in the developing countries, suffers more extensively than any other regions from natural disasters due to extreme weather and climate events. These include droughts, floods, heat waves, cold spells, snow storms, tropical cyclones, etc., which are mostly manifestations of variability and anomalies of the Asian summer and winter monsoons. In the past few decades, high intensity and high frequency extreme weather and climate events have been occurring at an alarming rate with the increase of extensive damages including property and life losses, which are the results of the rapid economical development and the influence of climate variations as evidenced by the occurring of record breaking events.

1.2 There are plenty of examples of damages occurred during the Asian summer monsoon. For example, from 2001 to 2005, the average annual death toll in South Asia due to heat wave alone reached 622, with the death exceeding 1,000 in both 2002 and 2003. The maximum temperature of heat wave events reached 50℃ every year in these five years, and reached 53℃ in 2003 that caused 1,700 deaths. In the summer of 2006, high temperature and drought in Chongqing, China caused severe damages when the maximum temperature reached 44.5℃, breaking the century-old historical record. In 1998, severe floods occurred in the Yangtze River basin, the Songhuajiang River basin and the Nenjiang River basin in China. In 2007, serious flood in the Huaihe River basin in China created the second highest water level in the history.

1.3 The most dramatic extreme weather and climate events during the Asian summer monsoon are associated with tropical cyclones, and their effects are far beyond the tropics and extend deeply into the entire summer monsoon region. For example, a landfall typhoon caused rare torrential rain in Henan Province of China in August 1975. As a result, several reservoir dams breached, causing a death toll of at least 30,000 people. In addition, 102 kilometer railways between Beijing and Guangzhou were destroyed by flooding, causing a traffic break for 18 days. In 2004, the number of typhoons from the Northwest Pacific landed in Japan reached 10, far more than the former historical record of six. In 2005, the average intensity of typhoons from the Northwest Pacific landed in China also set a historical record. In 2006, tropical storm Bilis and super typhoon Saomai set many records in the history of China's typhoon disasters, among which super typhoon Saomai set the record of having the highest intensity of typhoons landed on the mainland. Recent most noteworthy extreme events involving tropical cyclones also include the event in June 2007, when Oman and Iran of the Arabic Gulf in the Indian Ocean were hit by the strongest storm (the intensity reaching category-5 hurricane) in record. In November of the same year, Bangladesh was hit by a super-strong tropical storm Sidr, resulting in more than 5,100 lives lost or missing.

In May 2008, during the onset of the summer monsoon, tropical cyclone Nargis from the North Indian Ocean, swept across the delta area of Burma, caused at least 130,000 deaths including lives missing.

1.4 Extreme weather and climate events during the Asian winter monsoon also cause serious damages. In early 2005, worst snowfall in two decades blanketed northwest Asia and killed hundreds of people in Tajikistan, Pakistan, India and Afghanistan. The resultant melting in early spring flooded large areas, with over 110,000 residents affected in the Xinjiang region of northwest China alone. The strong late winter cold surges caused damages all over Southeast Asia. In January, 2006, unusually cold weather appeared in the western part of Russia, and minimum temperature in Moscow set the lowest record of the same period since 1927; minimum temperature in some areas of Siberia was close to -60℃; nearly at the same time, continuous snowfall occurred in large areas of Hokkaido Island of Japan, and the depth of accumulated snow created the deepest record in history in many areas. At the beginning of 2008, a widespread ice storm rampaged in southern China that broke all records. In the winter of 2008/2009, all 12 provinces in northern China suffered from serious drought at the probability of once per 30-50 years. Tropical cyclone also struck during winter monsoon and transition seasons. In Bangladesh, tropical storms killed more than 300,000 people in November 1970 and nearly 140,000 people in April of 1991.

1.5 At present the most comprehensive work in the operational monitoring of global extreme weather and climate events is being carried out at the US NOAA Climate Prediction Centre (CPC) and National Climate Data Centre (NCDC). Although some Asian countries such as China, Japan and Korea have set up their own climate monitoring system, they are all done with different emphases, coverage, and formats, and are in various stages of development. A lot of information and descriptions on many extreme weather and climate events still come from news media reports, which lack consistency in formats, contents, coverage, and methodology for interpretation and assessments, and are difficult as data source for vigorous research.

2. Purpose

2.1 The purpose of this project is to develop a monitoring and assessments system and data centre for extreme weather and climate events in Asia that is systematic, comprehensive and consistent, and provide a data base that is as complete as possible with high space and time resolutions to monitor and archive extreme weather and climate events in Asia. The goal is to provide the highest quality data for assessment, analysis and research of extreme weather and climate events therefore contributing to the goal of improved forecast and disaster prevention as well as mitigation efforts.

2.2 Recent progresses at BCC in the development of infrastructure, facility and capability have now enabled BCC to launch this project, which will establish a comprehensive database and monitoring platform through effective cooperation among NMHSs and other operational services in Asia. The system will organize and disseminate both real- and post- time monitoring and assessment information on extreme weather and climate events to serve the needs of the NMHSs and other operational and research agencies in Asia. BCC will provide necessary infrastructure and human resources and work with cooperating agencies and organizations to ensure the success of this project. The database established and the associated assessments of individual events will be very valuable to the research of severe monsoon weather and climate impacts, thus contributing to the goal of research in high impact weather for disaster reduction and mitigation of relevant WMO programs. In this regard the project will also serve as a focus in BCC's dual role as the East Asian Monsoon Activity Centre.

3. The plan

3.1 The monitoring of extreme weather and climate events in Asia will include two main categories of data. The first category is the monitoring of the extremity of meteorological key elements in individual stations. At present, relevant monitoring techniques for this purpose are relatively mature, and various indexes have been adopted in the present preliminary monitoring work of global extreme weather and climate events at BCC. In this project, the application and methods will be further refined and enhanced as experience is accumulated and revised and new tools tested. The second category is the monitoring of case events which will be defined by a range of the relevant intensity of each type of events. The work in this aspect has not been launched at BCC yet; the main reason is that a suitable corresponding monitoring technical index system has not been identified. Therefore, research needs to be conducted on the monitoring technical index system for this category. The current status at BCC and future plans for each category are described below:

3.1 Refining and enhancing the monitoring system for extreme events based on data from individual stations

- **Current status**

3.1.1 Currently, the operation in monitoring for extreme weather and climate events within China by BCC includes the monitoring of droughts, sandstorms, high temperatures, rainstorms, floods, snowfalls, heavy fog and typhoons, all at daily intervals.

3.1.2 For the monitoring of the whole Asia and the world, BCC has set the preliminary thresholds of extreme events according to their definitions and developed graphics that can reflect extremely high and low temperatures, and extremely intense precipitations and droughts. At present, the graphics include mainly spatial distribution maps such as daily maximum, minimum and mean temperature, daily maximum temperature exceeding the threshold and its departure, daily minimum temperature under the threshold and its departure, and daily precipitation exceeding the threshold and its departure percentage. These graphics are for the purpose of projecting intuitively and effectively an image of the intensity in different regions reflected by extreme events. An example is given in Figure 1, which shows the distribution of the minimum temperature beyond the threshold in the extensive area from western Russia to Eastern Europe on January 20, 2006.

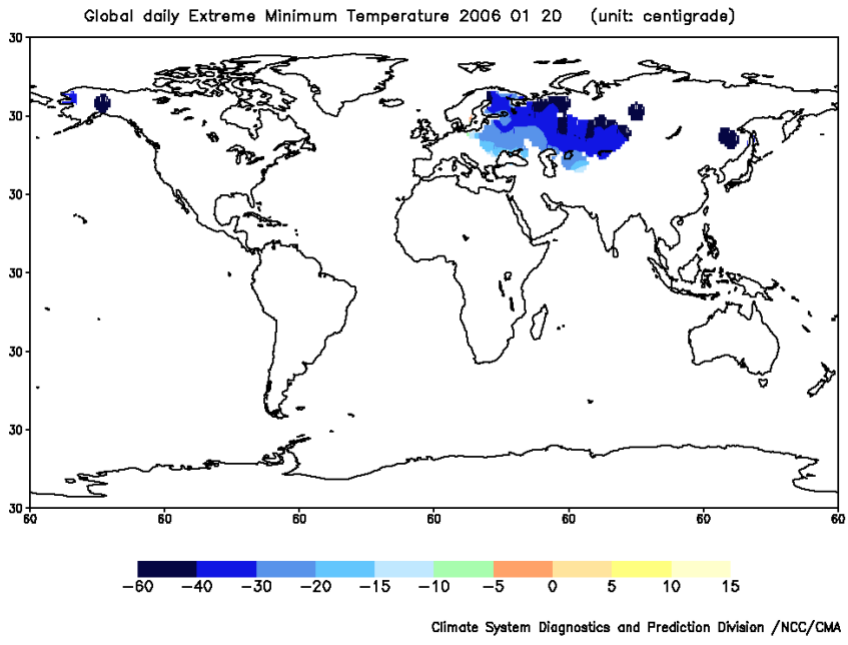


Figure 1: The distribution of minimum temperature (unit: ℃) below threshold value on January 20, 2006

• **Technical support for monitoring**

3.1.3 The development of the technologies for differentiating and monitoring extreme events based on meteorological elements of individual stations is relatively mature. For example, in 2004 the Expert Team on Climate Change Detection and Indices (ETCCDI) developed a set of index system on extreme climate events with the software available at the website http://cccma.seos.uvic.ca/ETCCDI/software.shtml. BCC/CMA recently developed additional indices after conducting research on monitoring index on several kinds of extreme events such as drought and high temperature. Each of these indices includes three parameters: absolute threshold index, extreme index based on percentile, and frequency (once-in-how-many-years) index based on probability distribution statistics.

• **Future plan**

3.1.4 Currently key element products, such as frost, freezing, warm nights and hot days, etc are each treated as the same index used year-around without differentiation with respects to seasonality and weather system regimes. In 2009 this system will be improved by adopting multiple indices based on seasonal variations and time periods adjustable according to weather and climate regimes. Historical data and statistical methods and experiments will be used to find the best index and thresholds for each index.

3.1.5 In 2010, the real-time monitoring of daily variation time sequences will be enhanced. Asia will be divided into East Asia, Southeast Asia, South Asia, West Asia, Central Asia and Russia. Daily variation time series of individual stations in various areas will be provided aiming at different key elements. The data retrieval system of global station database will be established. Attentions will be made to ensure that the system will possess suitable and convenient procedures for data interface, which is important to meet the needs of various statistic tasks and to provide extremity historical series and assessment information for individual stations.

3.2 Development of monitoring system based on the cases of extreme events

• **Research on monitoring technology**

3.2.1 Historical data will be used to develop monitoring technology. From 2009 to 2010, the research will be aimed at the cases of five types of extreme weather and climate events i.e., droughts, floods, heat waves, cold spells, tropical storms/typhoons within China. This includes the study of their definition, temporal and spatial variations, index system (extreme intensity, impact coverage, persistence and comprehensive intensity), and such study will evaluate the suitability of different ways of indexing them with existing technologies and develop possible revisions and conducting experiments to find the most suitable methods.

3.2.2 From 2011 to 2013, the research will be aimed at the cases of five types of extreme weather and climate events i.e., droughts, floods, heat waves, cold spells, tropical storms/typhoons for the entire Asia. The same tasks of 2009-2010 for the area of China will be carried out for the expanded area of Asia, with additional consideration relative to possible different characteristics between sub-regions of Asia.

• **Future plan**

3.2.3 From 2009 to 2011, a case-based database of the above-mentioned five types of extreme weather and climate events within China will be constructed, which will provide such information as spatial and temporal distribution characteristics of extreme climate events i.e., droughts, floods, heat waves, cold spells, tropical storms/typhoons within China, and also

provide the inquiry, searching and downloading of relevant data and graphs. In the process of constructing the database the system will be able to realize the real-time monitoring and historical extremity assessment for all cases of the five types of extreme weather and climate events within China.

3.2.4 From 2011 to 2013, the work will be extended to the cases of all Asia. Namely, the study on their definition, temporal and spatial variation, index system (extreme intensity, impact coverage, persistence and comprehensive intensity) and corresponding monitoring technology will be carried out to construct the all-Asia database and establish an operational monitoring and assessment system that can be updated in real time or near real time.

3.3 Information sharing and service among Asian countries

3.3.1 International cooperation will be most crucial to develop the operational monitoring and assessment system and data centre of extreme weather and climate events in Asia and realize its potential as a valuable tool for research in high-impact monsoon weather and disaster reduction and mitigation. The cooperation will include data exchange, research, and technical training. The project will construct product websites and develop routines to strengthen service product exchanges among Asian countries. Based on the present website of BCC, the independent webpage for the monitoring and assessment operational products of extreme weather and climate events in Asia will be established to allow timely uploading and display of the above-mentioned monitoring and assessment products, and provide information and data services to meteorological services government departments of various countries, and relevant international agencies. Meanwhile, a user list for Asian countries will also be established to facilitate the timely exchange of relevant information.

3.3.2 In addition to regular interval meetings such as the annual FOCRAII which will provide opportunities for external inputs, BCC plans to organize a small advisory panel consisting of invited international experts for consultation on technical issues and to facilitate the international cooperation of the project.

4. Funding

4.1 BCC is currently conducting the monitoring and assessment system within China under both BCC's internal development funding and the research project funding from the Chinese government. Both types of fundings will be utilized to support this project.