

WORLD METEOROLOGICAL ORGANIZATION



WMO PARTICIPATION IN THE NAIROBI PROGRAMME OF WORK

*Specific topic:
Climate risks and extreme events*

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Introduction

In response to the UNFCCC Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change, WMO submitted a "Concept paper: on the role of WMO and National Meteorological and Hydrometeorological Services (NMHSs) in the Implementation of the Nairobi Work programme", in November 2006. This note can be considered as a complement to the "concept paper" and addresses more specifically the focus area "climate risks and extreme events".

A number of WMO programmes or co-sponsored programmes contribute significantly to the present focus area, whereas IPCC, co-sponsored by UNEP, has just released the first part of its Fourth Assessment Report including a number of updated information on observed and predicted evolution of climate-related extreme events. The World Climate Programme is dealing with the general issue of climate data. It has developed the mechanism of "climate watches" for the observation and record of climate extremes, the Climate Information and Prediction Services (CLIPS) project for the provision of climate information, products, predictions and services adapted to the needs of users, and is dealing with climate risk management and impacts in a number of domains, with a large part given to agriculture and more recently health issues. The Hydrology and Water Resources Department develops a whole range of actions related to climate related risks in hydrology, the Natural Disaster Prevention and Mitigation Programme (DPM) strengthens the international collaboration in disaster risk management, the Tropical Cyclones Project assists Members in all forecast and risk-management aspects in relation to tropical cyclones, the Global Climate Observing System (GCOS, co-sponsored by ICSU, IOC and UNEP) defines the optimal strategy for climate monitoring including extreme events, the WMO Space Programme contributes more specifically to the coordination of space-based observations, the World Climate Research Programme (WCRP, co-sponsored by ICSU and by the IOC of UNESCO) is developing a specific research strategy on climate extremes.

The present note is articulated along the five items under the present focus area as part of the Nairobi Work Programme. However the answer to one specific item can sometimes be of interest to one or several other items, or refer to activities more directly related to other focus areas.

(a) Experience with assessment and management of current and future climate-related risks and impacts, including those related to extreme events and in specific sectors

The assessment of current climate-related risks and impacts, including those related to extreme events, and their observed year to year evolution is a major activity for WMO, in close coordination with NMHSs: this includes efforts to observe and make available adequate data, to ensure specific watches for extreme events and assessments of their occurrence worldwide, and to develop information and prediction services. WMO is also directly concerned with the impact of those events in a number of domains, in close association with the user communities, more specifically in hydrology and water resources issues, as well as agriculture and more recently health. With the establishment of its new DPM programme, WMO is developing with NMHSs a comprehensive strategy on risk management for natural hazards.

Observations and data

Lack of adequate and reliable climate data is considered to be a major constraint in developing an accurate understanding of the current and future climate variability and change, particularly in the developing and least developed countries. NMHSs, through the WMO, coordinate their efforts in capacity building, training, research and development to address this gap and provide reliable climate observations, which can be transformed into useful products for stakeholders to make use in the development of their adaptation strategies. NMHSs contribute significantly through the development and use of Modern Climate Data Management Systems (CDMSs) and through 'rescue' of historical records that are at risk of deterioration, in order to secure complete and safe long-term climate records. Through its various programmes WMO provides a platform for a coordinated global framework for obtaining climate data needed for climate change detection and its impacts on vulnerable sectors, research, policy information and national economic development.

GCOS will outline its contribution to the Nairobi Work Programme under the topic "data and observations" (for the due date of 21 September 2007). The main thrust of GCOS is to enable high quality, long-term climate observations at all scales, and it is acknowledged by potential users of climate information that healthy observing systems at global, regional, and national levels are of fundamental importance for the development of climate services and effective climate risk management that will be required for adaptation to climate variability and change, and more generally for sustainable development. Having adequate global networks is critical to begin consideration of adaptation. The monitoring, detection and attribution of changes in climate extremes requires daily, or preferably hourly, resolution data. However, the compilation, provision, and update of a globally complete and readily available full resolution daily dataset are very difficult tasks, in part, because not all NMHSs have the capacity or mandate to freely distribute the daily data that they collect. The GCOS Implementation Plan recommends that, when requested for the purposes of impact studies and extreme events, daily and/or hourly observations of the climate variables should be provided to the appropriate international Data Centre.

WMO, under its "Space Programme" and the Coordination Group for Meteorological Satellites (CGMS), in accordance with a request from the WMO Commission for Basic Systems at its extraordinary session in November 2006, have undertaken to review the baseline of the space-based global observing system with two particular objectives:

- To optimize it through global cooperation and ensuring data quality, consistency and accessibility
- To address the need for sustained observations of climate parameters.

This initiative will be further developed under Area N°2, data and observations. It should be however pointed out that, through integrating in a common approach the observing systems for climate monitoring and for operational weather warning and prediction, all timescales from Nowcasting to long-term climate trends are covered, as required for the assessment of climate risks and extreme events.

In the area of extreme events and related risks, WMO has agreed, through its DPM Programme, to inform WMO Members of the existence and purpose of the International Charter on Space and Major Disasters and its utilization of civil protection agencies as national focal points, and that the DPM Office should inform the International Charter on Space and Major Disasters Executive Secretariat on issues relevant to the Charter as they emerge. The International Charter on Space and Major Disasters, initiated in 2000 by French National Centre for Space Studies (CNES) and European Space Agency (ESA) and now signed by most major space agencies, offers a unified system of space data acquisition and timely delivery to those affected by natural or man-made disasters through Authorized Users. An Authorized User can now call a single number to request the mobilization of the space and associated ground resources of the member agencies to obtain data and information on a disaster occurrence. Data acquisition and delivery takes place on

an emergency basis. The Charter was activated more than a hundred times since its implementation, mainly for two types of disasters: hydro-meteorological (hurricanes, floods, etc.) or seismic (earthquake, tsunamis, etc.). The activation process is well established, effective, timely and efficient. It relies on civil protection agencies as national focal points. However, the analysis of activations also highlights that the utility of Charter products could be further enhanced if NMHSs work with the civil protection agencies to provide value-added products based on combining the high-resolution satellite images provided by the Charter with various hydro-meteorological forecast output.

Climate Watches and climate monitoring

Weather extreme events such as hurricanes, thunderstorms, tornadoes, etc. require weather watches for which most NMHSs issue early warnings and undertake special monitoring. In a similar manner, 'climate watches' deal with climatic extremes like heavy monsoons, flooding, cold waves, heat waves, droughts, etc., which require long-term monitoring with historical observations and its integration into the context of global climate patterns. By incorporating recent climate analysis as well as outlooks, climate watches serve as advisories and forewarnings of climate anomalies, therefore enable continuous and timely climate related risk assessment and management to avoid damages to life and property. The necessary mechanisms have already been put in place in some parts of the world, e.g. the North American Drought Monitor, the ICPAC (Inter-Governmental Authority on Development Climate Prediction and Applications Center) and SADC (Southern African Development Community) Drought Monitoring Centers in Africa. WMO works with NMHSs and many institutions in the world to issue regional climate watch bulletins. Through its programmes, the World Climate Data Management Programme (WCDMP) and DPM in collaboration with the Commission for Climatology (CCI) and NMHSs, WMO has planned for the coming four years period 2008-2011 to establish and implement climate watch systems at national levels. The main focus for these efforts is to improve preparedness and reduce socio-economic vulnerability to climate hazards in developing and least developed countries. Through DPM Program, other agencies are expected to be part of the implementation process of climate watches including resource mobilization, partnership for an integrated early warning system as well as the outreach of the decision makers at regional and national levels.

Through the CCI and in cooperation with Members, WMO has been issuing Annual Statements on the Status of the Global Climate since the last 13 years. These Statements document the extreme weather and climate events in the regional context, and provide a historical perspective on the variability and trends of surface temperatures that have occurred since the nineteenth century. It has also developed through CCI a plan to monitor climate extremes on national, regional and global level, and has assigned a special rapporteur on climate extremes. The WMO Commission for Climatology, WCRP and the Joint Commission for Oceanography and Maritime Meteorology (JCOMM) jointly run an Expert Team for Climate Change Detection, Monitoring and Indices (ETCCMDI), which develops and publicizes indices and indicators of climate change and variability using daily climatological data, including particularly indices of daily to seasonal extremes (cf. Annex 1). Software developed at this occasion enables all interested parties to calculate indices the same way, so that their analyses fit seamlessly into the global picture. Part of the efforts of the Expert Team includes planning and organization of climate extremes seminars and hands on training workshops to compute climate extreme indices in various countries in the world: six of such seminars/workshops were organized in Africa, South America, Asia and Middle east to cover as much as possible the existing gaps in developing countries. These workshops provided an optimal opportunity to produce peer-reviewed papers contributing to the IPCC studies (cf. Annex 2). The Expert Team recently set a plan for the period 2006-2009, including the coordination of important science issues in relation with indices, the identification of new indices related to heat stress and drought, and marine indices from the surface and subsurface ocean.

Climate Information and Prediction Services

The 12th World Meteorological Congress (1995) considered that the provision of climate information and predictions would improve economic and social decision making, and that this would support sustainable development, and established a Climate Information and Prediction Services (CLIPS) project within the World Climate Applications and Services Programme. This is an end-to-end approach linking research, data, analysis, products including climate predictions, and services, through to end users in key socio-economic sectors such as renewable energy, health, tourism, water resource management, agriculture and urban management. Capacity-building including training is a key aspect of CLIPS implementation, and a number of training workshops were held by WMO across the world to create local capacities in developing and delivering user-targeted climate information. The global network of CLIPS Focal Points assists in national and regional coordination and information sharing in climate activities.

As part of the CLIPS project activities, WMO has actively supported the development of consensus-based approach to climate prediction, both at the global and regional levels. With the help of the leading experts around the world, WMO regularly prepares and issues El Niño/La Niña Updates. These products reflect a global consensus on the present and expected evolution of ENSO-related conditions and, with the national-scale advice and support of National Meteorological and Hydrological Services (NMHSs), help users in anticipating regional impacts associated with major ENSO-related anomalies. Depending on the nature of regional impacts of El Niño/La Niña, these updates provide handles for early warning of extreme climatic events such as droughts and floods. WMO has also formulated a plan to develop a global atlas of El Niño/La Niña impacts to help in identifying regions affected by such global-scale climatic anomalies and assess the associated risks, and another to promote demonstrations and implementation of Heat Health warning Systems (HHWS) in several regions where deadly heatwaves are serious and frequent extreme events of consequence. Resource mobilization is a major constraint in undertaking such projects, and WMO is exploring several potential resources in this regard.

Regional Climate Outlook Forums (RCOFs) are one vehicle for development of user-driven products and services, which were successful in various regions in attracting the interest and support of sectoral user groups in development and dissemination of seasonal climate predictions and related products. RCOFs constitute an important vehicle in developing countries for providing advanced information on the future climate information for the next season and beyond, and for developing a consensus product from amongst the multiple available individual predictions. RCOFs are regularly convened twice a year in the sub-regions Western Africa, Greater Horn of Africa, Southern Africa, Southeastern South America, West Coast of South America and Central America, and once a year in Asia. The RCOFs have also developed partnerships with the core sectors like agriculture, health, water, etc. with active media participation.

Risk Management

WMO and the National Meteorological and Hydrological Services (NMHSs) contribute to different stages of disaster risk reduction, including prevention, preparedness, response and recovery and reconstruction, through monitoring, detecting, analysing, forecasting, and the development and issuance of warnings for weather-, water- and climate-related hazards. In recognition of the critical role of NMHSs and WMO in disaster risk reduction, Congress XIV (May 2003) through its Resolution 29 decided to establish WMO Natural Disaster Prevention and Mitigation (DPM) Programme with the vision to enhance the contributions of National Meteorological and Hydrological Services, in a more cost-effective, systematic and sustainable manner, towards the protection of lives, livelihoods and property.

Traditionally, disaster risk management in majority of countries has focused on post-disaster emergency response and relief activities. Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disaster (HFA), which was adopted by 168 nations during the second World Conference for Disaster Reduction (WCDR, Kobe, Japan,

January 2005), aims to shift the disaster risk reduction paradigm from the traditional post disaster response to a more comprehensive approach involving prevention, preparedness and contingency planning as well as emergency response and recovery. HFA is the basic framework for implementation of disaster risk reduction capacities at national, regional and international levels. On the basis of this new paradigm, climate information could play a critical role in supporting preventive and preparedness strategies in disaster risk management.

As part of their commitment to satisfy the needs of their users concerning weather and climate information, the NMHSs and WMO maintain permanent relations with the various sectors impacted by climate-related events, and provide the meteorological and hydrological information necessary to assess the impacts in sectors such as marine, aviation, agriculture, health, water, energy and civil engineering. In an effort to put a clear focus on risk management with regard to floods, drought and integrated water resources management, WMO prepared for the Fourth World Water Forum held from 16 to 22 March 2006 in Mexico City, Mexico, the Baseline and Thematic Documents on Risk Management. Likewise, WMO – in collaboration with ISDR – authored the chapter on “Managing Risks – Securing the Gains of Development” for the second edition of the UN-wide World Water Development Report.

As a step to further enhance this activity, the International WMO Conference on "Living with Climate Variability and Change: Understanding the Uncertainties and Managing the Risks ", held at Espoo, Finland, 17-21 July 2006, set up some principles to serve as a basis for action. This conference was unique in the sense that the user sectors took the lead to review opportunities and constraints in integrating climate risks and uncertainties into the mainstreams of decision-making where sensitivity to climate variability and change is but one among many factors to consider. The focus was on risk assessment and decision-processes in real-world contexts, and the conference came up with the “Espoo Statement” (<http://www.livingwithclimate.fi>). It recommended that collaborative mechanisms be developed that facilitate needs and requirements driven activities in climate-related risk management, and that they be used to improve the quality of climate-related risk management to the benefit of all.

These mechanisms could promote:

- Evaluation of current climate-related risk management in all relevant sectors
- Better assessments of the value of climate-related risk management
- Establishment of data sets necessary to inform decision making
- Research to improve climate-related risk management
- Development of decision-support tools
- Capacity building in climate-related risk management
- On-going evaluation of outcomes
- The use of suitable financial mechanisms in support of climate-related risk management.

Impact in Hydrology and Water Resources

WMO's climate related hydrological activities are initiated/implemented through the World Climate programme – Water Component (WCP-Water) that is chaired by a member of the Advisory Working Group of the Technical Commission for Hydrology (CHy). Main thrust relates to facilitating the development of science-based tools to detect signals of climate trends and change in hydrological time-series and to foster the actual use of climate information by water managers. Priority is on the use of climate information with regard to variability and trends primarily for water resources assessment including decision making with regard to planning, operation and management of water resources infrastructure with a focus on adaptation choices.

The impact of climate variability and change on water resources depends not only on changes in the volume, timing, and quality of streamflow and recharge but also on system characteristics, changing pressures on the system, how management of the system evolves, and what adaptations to climate change are implemented. In the framework of the WCP-Water, WMO

is promoting the implementation of several demonstration projects on the impact of climate variability and change on water resources in specific regions, by providing seed funding for the creation of multidisciplinary teams that would demonstrate in practical terms the application of methodologies to regionalize Global Climate Models and study the impacts of climate variability and change specifically on the scale of regional and large basins water resources. Furthermore, efforts are under way to enhance the utility of RCOFs in water resources management. National Meteorological Services are encouraged to upgrade their climate prediction capability in such a form that it can be utilized by National Hydrological Services in providing climate-oriented predictions for improved water resources management including providing information that allows to dealing with extreme hydrometeorological events outside the range already experienced by countries/regions. One of the major reasons why predictive climate information is at present not fully utilized by water managers is the lack of a generally agreed conceptual framework for the use of climate predictions/scenarios. Milestones to address these issues are the conclusions of an expert meeting between climate specialists and water managers held in WMO Secretariat, Geneva, December 2006

Most studies in this domain relate to present climate and climate variability. It is expected that they can be extended to future climatic conditions, following improvements in climate predictability. The following are examples of on going projects:

- Hydrological sensitivity to climate conditions
(Expert meeting on hydrological Sensitivity to Climate Conditions, WMO/TD-No. 1242, Geneva, August 2004)
- Stream-gauging stations appropriate for climate studies
(see: <http://www.wmo.int/web/homs/Hydroclimate/hydroclimate.html>)
- Project concept: “Bringing climate Information to Water Managers”, December 2006, to be published after review

Impacts in Agriculture

The Commission for Agricultural Meteorology (CAgM) of WMO has always been paying a lot of attention to climate related risks and impacts, including those related to extreme events, in the agriculture sector. Several working groups established by CAgM over the years and their reports have been published by WMO (see *Annex 3*).

CAgM established an Expert Team on the Reduction of the Impact of Natural Disasters and Mitigation of Extreme Events in Agriculture, Forestry and Fisheries, which held a meeting in Beijing, China in February 2004. The proceedings of this Expert Team Meeting was published as a book entitled “Natural Disasters and Extreme Events in Agriculture” by Springer in 2005.

In many parts of the world climate change and extreme climatic events such as severe droughts, floods, storms, tropical cyclones, heat-waves, freezes and extreme winds are one of the biggest production risk and uncertainty factors impacting agricultural systems performance and management. Coping with agro-meteorological risk and uncertainties is the process of assessing agro-meteorological risks and uncertainties and then developing strategies to cope with these risks. To address these issues, WMO, in collaboration with a number of co-sponsors organized an International Workshop on Agro-meteorological Risk Management: Challenges and Opportunities from 25 to 27 October 2006 in New Delhi, India. The workshop, hosted by the India Meteorological Department (IMD) and the Ministry of Science and Technology and Earth Sciences of the Government of India, was attended by 188 participants from 78 countries. In the workshop sessions, firstly weather and climate events and risks to farming from droughts, floods, cyclones and high winds, and extreme temperatures were identified and characterized.

Papers on approaches to dealing with risks highlighted preparedness planning, risk assessments and improved early warning systems, which can lessen the vulnerability of society to

weather and climate risks. Enterprise diversification, contract hedging, crop insurance, weather derivatives and weather index insurance play a key role in developing agricultural risk management strategies. A special session examined the use of crop insurance strategies and schemes to reduce the vulnerability of the farming communities to risks posed by weather and climate extremes.

A number of strategies were identified to cope with risks. These include the use of seasonal forecasts in agriculture, forestry and land management to assist alleviation of food shortages, drought and desertification. The use of integrated agricultural management and crop simulation models with climate forecasting systems give the highest benefits. Strategies to improve water management and increase the efficient use of water include crop diversification and better irrigation. Especially important is the application of local indigenous knowledge. A combination of locally adapted traditional farming technologies, seasonal weather forecasts and warning methods were important for improving yields and incomes. Challenges to coping strategies were many and identified in several papers. Particularly important is the impact of climate variability and change on the frequency and magnitude of extreme events. Lack of systematic data collected from disasters impedes future preparedness, as does the need for the timely delivery of weather and climate information to enable effective decision making. Finally a range of policy options to cope with such risks were presented. These included contingency planning, use of crop simulation modelling, and use of agro-meteorological services. Proceedings of the workshop will be published by Springer.

Impacts on health

There is an excellent and longstanding collaboration between WMO and World Health Organization (WHO), which was recently reinforced through a series of workshops on climate change and health held in different sub-regions of the world. The WMO Commission for Climatology Expert Team on Climate and Health, in partnership with the WHO is in advanced stages of developing theoretical framework and guidance for HHWS, for publication in 2007. The Expert Team agreed to develop a position paper on the utility of climate prediction to health decisions and to develop an on-line virtual library of relevant research on this topic.

(b) Ability, gaps, needs, opportunities, barriers and constrains to predicting climate variability, impacts and extreme events across regions and hazards

Research on climate predictability

This issue is the object of particular attention by WCRP. There is a general consensus within the climate research community that any change in the mean climate is likely to feature significant changes in frequency or severity of extreme climate events and that this would have profound impacts on nature and society. It is thus very important to analyze and model extreme events. Indeed, the recent Report of the Steering Committee for the “International Symposium on the Stabilisation of Greenhouse Concentrations – Avoiding Dangerous Climate Change” (Exeter, UK, 1-3 February 2005) emphasizes that in assessing the consequences of increased levels of greenhouse gases “we should not focus on temperature change alone but, on anticipated shifts in climate variability, for example, with increase in the frequency and severity of extreme events”. It notes that many climate impacts, particularly the most dangerous ones, will be associated with an increased frequency or intensity of extreme events and identifies this as an important area for further work since many impacts studies do not explicitly take the effects of extremes into account, although it is well known that such extremes pose significant risks to human well being. It quotes the heat wave that affected Europe in 2003 as an example.

The Fourth Assessment Report of the IPCC contains quite elaborate statements regarding already observed and expected changes in climate extremes, the latter based on analyses of the outputs of a WCRP model archive specifically developed for AR4. A workshop planned jointly between IPCC, GCOS and WCRP in October 2007 will consider the climate

research challenges and observing system implications from the IPCC Fourth Assessment, the topic of climate extremes being one of those challenges.

A working paper entitled “climate extremes-what WCRP should be doing” will be presented in March 2007 to its governing body, the Joint Scientific Committee, and more precise recommendations for a work-plan in this domain should be available after this date. A WCRP-sponsored workshop designed to formulate a coordinated international strategy for the study of climate extremes is tentatively proposed for the beginning of 2008.

The objectives, tentatively set for WCRP, are as follows:

- To summarize, compare and assess definition(s) of climate extremes and develop a common language amongst researchers and end users;
- To design an inter-comparison framework through which both observations, climate model representations of extremes and projections of climate can be assessed and by which changes in climate extremes can be better evaluated;
- To accelerate progress on the prediction of climate extremes with a focus on developing capabilities and products which facilitate practical applications for stakeholders and regions around the world;
- To assess the observational and dataset framework for study of global extremes;
- To determine how extremes are changing and varying and why (including their relationship to mean variables, physical factors, shape of pdf etc).

The issue of “extremes” in the hydrological cycle has been the object of particular attention by the “Global Energy and Water cycle Experiment” (GEWEX) project of WCRP, which has established in 2005 a working group aimed at a better understanding of hydrological extremes, and of the feedback mechanisms which give rise to extended wet and dry periods. With the help of a unique data set produced as part of the “Coordinated Energy and water cycle Observation Project (CEOP)”, it addresses issues such as trends in the occurrence of extreme events, the predictability of extremes and the role of extremes in the climate system.

Major impediments for water managers to use climate information are scales and uncertainties and the reliability of climate signals in currently available observations. There is need to improve on spatial and temporal downscaling of climate information to the catchment scale and also to quantify and ultimately reduce uncertainties in climate predictions.

Support to regional and national climate prediction initiatives

WMO, through its World Climate Applications Programme, supports the development of climate prediction capabilities at the regional and national levels. Most of the extreme climate events, by nature, operate on small space and time scales, and therefore high-resolution climate models and other sophisticated downscaling strategies are essential for their prediction. While the technologies for such strategies does exist, many developing countries and almost all least developed countries do not have the required human and infrastructural resources to take up such activities. It is important to work towards local ownership of such capacities to develop sustained prediction capacities and their expected impacts.

WMO is also developing the concept of Regional Climate Centres (RCCs), which can provide regionally focused climate prediction products using state-of-art climate models to the developing and least developed countries, by optimizing the available resources. However, local expertise and adequate infrastructure at the national level are still needed to adapt such predictions to the national/sector context. WMO is developing a comprehensive CLIPS curriculum, which can be integrated into the national and regional training programmes to address this need.

Lack of adequate model skills at the regional level and uncertainties in the model predictions continue to be major challenges. While modelling research is making rapid strides to address these issues, approaches to make optimal use of the available information by integrating the uncertainties in decision making need to be promoted. As an example of this approach, WMO has sponsored a workshop on “Development of Regional Capacity for the Generation and Use of Regional Climate Change Scenarios in Africa” in Nairobi, Kenya, March 2007. The workshop is organized by ICPAC for ten countries in the Greater Horn of Africa to enable them to undertake effective climate change adaptation studies as well as assessments of the impacts.

Impact on Agriculture and forestry

Climate variability affects all economic sectors, but agricultural and forestry sectors are perhaps two of the most vulnerable and sensitive activities to such climate fluctuations. Climate change and variability, drought and other climate-related extremes have a direct influence on the quantity and quality of agricultural production and in many cases, adversely affect it, especially in developing countries, where technology generation, innovation and adoption are too slow to counteract the adverse effects of varying environmental conditions. For example, inappropriate management of agro-ecosystems, compounded by severe climatic events such as recurrent droughts in West Africa, have tended to make the drylands increasingly vulnerable and prone to rapid degradation and hence desertification. Even in the high rainfall areas, increased probability of extreme events can cause increased nutrient losses due to excessive runoff and water logging. Projected climate change can influence pest and disease dynamics with subsequent crop losses. Improved adaptation of food production, particularly in areas where climate variability is large, holds the key to improving food security for the global population.

Agriculture and forestry are currently not optimally managed with respect to today’s natural climate variability because of the nature of policies, practices and technologies currently in vogue. Decreasing the vulnerability of agriculture and forestry to natural climate variability through a more informed choice of policies, practices and technologies will, in many cases, reduce the long-term vulnerability of these systems to climate change. For example, the introduction of seasonal climate forecasts into management decisions can reduce the vulnerability of agriculture to floods and droughts caused by the ENSO phenomena.

It is with this background that WMO had organized the International Workshop on Reducing Vulnerability of Agriculture and Forestry to Climate Variability and Climate Change in conjunction with the 13th Session of the Commission for Agricultural Meteorology of WMO. The workshop reviewed the latest assessments of the science of climate variability and climate change, and their likely impacts on agriculture and forestry in different agro-ecological regions during the 21st century. It also surveyed and presented a range of adaptation options for agriculture and forestry and recommended appropriate adaptation strategies required to reduce vulnerability of agriculture and forestry to climate variability and climate change (cf. proceedings referred to in Annex 3)

Disaster Prevention and Mitigation

With the potential link between climate variability and climate change to the changing patterns of extreme events, climate related products and services such as climatological databases and customized seasonal to inter-annual climate forecasts can contribute significantly to disaster prevention and preparedness:

- (i) Climatological databases of hydro-meteorological hazards are needed for hazard analysis and mapping, which is a critical input for risk assessment and medium to long-term sectoral planning for reduction of risks. Furthermore, Climatological and real-time data are critical for development of new Risk Transfer Markets and design of risk transfer financial tools (e.g., weather derivatives, Cat Bonds, crop insurance) that enable distribution of risks;

- (ii) Seasonal to inter-annual climate forecasts, are now providing valuable sources of information for drought warning. Climate Watch Products bring outcomes of these models together with other relevant information to produce products that can be used more directly in decision-making. However, there is need for extension of these probabilistic models to resolve hazards that occur at shorter time and spatial scales (floods, tropical cyclones, etc). These models are critical for development of warning systems with longer lead-times, which can be critical for medium-term prevention and preparedness strategies.
- (iii) Furthermore, a number of key research questions relevant to climate and risk management decision-making remain unanswered. For example, the linkage between climate change and ENSO, PDO and NAO cycles, and subsequently, the linkages between ENSO, PDO and NAO with the changing patterns of hydro-meteorological hazards (floods, tropical cyclones, droughts, heat waves, etc.). Furthermore, the current climate models do not resolve temporally or spatially hazards, with exception of droughts. Progress in these areas is critical in development of probabilistic models, and information products that would be used in medium to long-term preventive strategies.

To this end WMO has initiated identification of requirements for linking climate and disaster risk management decision processes, with the view to establish priorities for more coordinated activities in both research and application areas that would result in development of climate products and services that can be utilized by Members in enhancing capacities for climate related risk management. These activities will be built upon strong partnerships with other agencies such as IFRC, the World Bank, UNDP, UNEP, among others. In parallel to these activities, WMO is working to strengthen early warning system capacities of its Members for hydro-meteorological hazards and working towards enhanced integration of the NMHSs warnings in disaster preparedness and emergency response planning.

c) Contribution of traditional knowledge to understanding and managing climate-related risks

WMO has experience in two areas where traditional knowledge remains essential to manage climate-related risks: water related risks, and agriculture and forestry.

If one takes the example of water-related risks, traditional knowledge is related closely to presently used adaptation techniques for hydro-meteorological extremes, such as floods and flood management practices. These practices that are in use to cope with currently occurring extremes and singular events are the cornerstone for the improvement of knowledge and practices to adapt under conditions of climate change.

WMO also pays special attention to the traditional knowledge and techniques in the management of climate risks for agriculture, especially in the semi-arid and sub-humid regions of the world. Intercropping, relay cropping and crop mixtures have been traditionally used by the farmers in the semi-arid regions to cope with climate risks. Experts from CAgM have been studying the radiation use efficiency, water balance and water use efficiency in the intercropping, relay cropping and crop mixtures to better understand the scientific basis for the adoption of such systems and to make further improvements in these systems for improved agricultural productivity. The range of adaptation options for managed systems such as agriculture and forestry is generally increasing because of technological advances, thus opening the way for reducing the vulnerability of these systems to climate change. However, some regions of the world, particularly developing countries, have limited access to these technologies and appropriate information on how to implement them. Here successful traditional technologies used over the centuries should be maintained. Incorporation of climate change concerns into resource-use and development decisions and plans for regularly scheduled investments in infrastructure will facilitate adaptation.

More generally, WMO facilitates the assimilation of traditional knowledge into modern climate related risk management strategies, as illustrated by the Regional Climate Outlook Forums in their close liaison with end-users in the various communities.

d) Implications for sustainable development in relation to (a) and (c) above

Most of the sustainable development issues, as reflected in Agenda 21 and the Johannesburg Plan of Implementation of World Summit on Sustainable Development (WSSD), are directly related to Climate Change and Variability or influenced by climate related events. In this regard, WMO assists NMHSs of developing countries, including the Least Developed Countries, to mainstream their activities into sustainable development processes, in particular the policy debates and the formulation of National Sustainable Development Strategies (NSDS) at national and local levels.

Our developing appreciation during the 20th century of the fragility of the environment in which we live, including the sensitivity of the climate system to human impact, has thrown the political spotlight on a range of climate-related issues. The greenhouse effect and global warming, the destruction of the ozone layer, vulnerability to natural hazards, protection of land and water resources, and renewable energy are a few of the areas where WMO has prepared itself to play an important role. WMO puts emphasis on science, technology and applications of climate information that are important for sustainable use of the Earth's resources and the protection of the climate system.

Access to locally relevant climate information as well as capacity to package and interpret such information both by the climate providers and users is crucial for sustainable development. Development of user-targeted climate services is therefore most essential, for which training of climate experts as well as sector representatives needs to be taken up in a more intensive manner. Sustained and regular CLIPS training workshops and RCOF activities as well as implementation of effective Showcase projects, which need substantial extra-budgetary resources, strongly contribute to sustainable development.

Work done in WMO on assessment of climate change and impacts is key to the development of adaptation policies, strategies and plans, of direct relevance to sustainable development. Climate extreme indices constitute a practical tool for summarizing climate variability and changes at global, regional and national level and they offer the possibility for application in various sectors particularly in agriculture, water resources, health, and energy. NMHSs manage climate data and are in need to make use of these data to compute climate extremes and climate change indices. This knowledge has become accessible to all nations and provides a real opportunity for an international collaboration in monitoring and assessing regularly climate change and its impacts as well as contributing to various international efforts such as IPCC and UNFCCC.

Examples of important implications are in the areas of secured freshwater supplies and the management of floods and droughts all of these being basic pre-conditions for sustainable socio-economic societies of member countries. There is generally a need for institutional changes at the level of national meteorological and hydrological Services of member countries to improve their capabilities and services to provide critical information for decision-making under conditions of climate change.

In regards to agriculture, most of the activities of CAgM of WMO described in (a) to (c) are aimed at promoting sustainable activities, alleviate poverty and contribute to food security, especially in the developing countries. CAgM is organizing Roving Seminars on Weather, Climate and Farmers in different regions of the world to bring together farmers from several villages at a centralized location and appraise them of the important features of weather and climate in their cropping regions, especially those related to climate variability and climate change, and educate them about the need for applications of weather and climate information in their operational activities. Feedback from the farmers at these seminars will help refocus the efforts of agrometeorologists to provide improved products and information to the farming community.

(e) Promoting understanding of impacts of, and vulnerability to, climate change

WMO supports the development, dissemination and use of climate information and products, including capacity building in the domains related to climate variability, trends and impacts. It is working with the NMHSs to develop climate change detection tools and software to compute indices that reflect the best estimate of climate trends within the countries. Through capacity building activities based on up-to-date knowledge and software, WMO assists Developing Countries and Least Developed Countries to follow quantitative and objective approaches for their contributions to the IPCC process and reporting to the UNFCCC. Through its DPM Programme, it is also developing a specific policy with respect to natural disasters. Examples of such initiatives are described below.

Climate observation and information

The issue of prominent global data gaps in developing nations is a focal issue for GCOS. It has completed a series of 10 Regional Workshops in developing nations to highlight observing system needs in those regions. There is now an increasing realization in the development community that climate data are essential to meeting development goals. GCOS organized a workshop entitled “Climate Information for Development Needs: An Action Plan for Africa” in Addis Ababa from 18-21 April 2006, in collaboration with the UN Economic Commission for Africa. The workshop was aimed at achieving the mainstreaming of climate information and services into development decisions as a crucial component of reaching the Millennium Development Goals for Africa. The workshop has led to the development of a strategy and implementation programme for “Climate for Development in Africa” that is now being finalized for consideration by international development assistance agencies who are committed to the effective use of climate for development in Africa.

In the same domain of climate observation, WMO has requested the parties to the UNFCCC convention to establish a trust fund to fill gaps in the global climate monitoring network and to support capacity building of ground-based atmospheric observing systems recognized by GCOS. These include networks measuring the classical Essential Climate Variables as well as the chemical variables, such as greenhouse gases and aerosols.

With respect to climate information, the above mentioned ETCCDMI Expert Team has developed a user-friendly analysis software adapted to the diagnosis of climate extremes, and has organized 5 capacity building workshops contributing to a global extremes indices paper as well as other peer reviewed papers which contributed to IPCC AR4. One of its objectives is to maintain plans for capacity building in developing countries, and to work closely with the joint WCRP IGBP “global change System for Analysis Research and Training” (START) programme through its “Monitoring Extreme Climate Events” group.

Its main objectives include:

- The development of a guidelines document on best practices for detection and calculation of climate extreme indices, to be published in all languages and distributed to all NMHS. This guiding document is meant to assist NMHSs in accomplishing their advisory role for their governments and policy makers on the local assessment of climate change;
- The establishment of a Mechanism to inform NMHSs of availability of software and subsequent updates to keep them in the same wavelength with leading institutions in the field;

- The development of a website on climate change, allowing public information on indices and downloading methods, software and documentation for computing climate extreme indices.

In the specific area of space observation, a Memorandum of Understanding was signed between the World Meteorological Organization (WMO) and the United Nations Institute for Training and Research Operational Programme on Satellite Applications (UNOSAT) on 25 October 2005. The goal of UNOSAT is to make high-resolution satellite imagery and geographic information easily accessible to the humanitarian community and to experts worldwide working to reduce disasters and plan sustainable development. To do this, UNOSAT acquires high-resolution satellite images from commercial providers. UNOSAT is a unique cooperation initiative between the UN, science and satellite industry that ensures low-cost and high quality solutions.

Impact of climate variability and change

The CCI intends to promote understanding of the climate impacts in a number of sectors, more specifically human health, energy, tourism, urban and building climatology, water and agriculture. WMO is developing strong partnerships with various UN and other international organizations in these activities, including scoping workshops, pilot projects and user liaison actions, with a regional approach. One example of such partnership is mentioned above in item a) and concerns the World Health Organization. The conclusions of the “Espoo Conference” mentioned above in a) can also be used as guidance in the domain of capacity building. The Espoo Statement noted that the practice of climate-related risk management is not widespread within many sectors and that there is a lack of awareness of climate-related risk management opportunities among numerous communities that would benefit from climate-related risk management. This requires multidisciplinary collaborations and the cross-disciplinary exchange of information and agreed on-going collaboration at national and regional scales between sectoral partners and climate information providers. Furthermore, the CCI is compiling an updated version of the WMO Guide for Climatological practices. The Guide will be translated into all working languages to assist countries in their daily climatological operations.

In hydrology, under WCP-Water, activities are under way to develop and implement demonstration projects in various countries to promote understanding of impacts of climate variability and change on water resources and hydro-meteorological extremes, assessing vulnerabilities and to facilitate the development of adequate coping and adaptation strategies.

In agricultural meteorology, CAgM established in 2002 an Open Area Programme Group (OPAG 3) on Climate Change/Variability and Natural Disasters in Agriculture. It has the responsibility to maintain an active and responsive overview of all the activities related to improve short-, medium- and long-term weather forecasting for agriculture; determining the impact of climate change/variability on climate forecasting; research on the impact of natural climate variability and the reduction of the impact of natural disasters on agriculture; and to help reduce the contributions of agricultural production to global warming. Experts in this programme area identified the following three potential pilot projects for implementation in different regions that would promote an understanding of the impacts of, and vulnerability to, climate change:

- 1) Assessment of Natural Disaster Impacts on Agriculture (ANADIA)
- 2) Climate Forecasts for User Communities in Agriculture
- 3) Contribution of Agriculture to the State of Climate (CONASTAC)

In view of the high complexity of communicating climate related information to non-professionals, as well as the multiplicity of end-users, OPAG 3 recommended the implementation of a number of actions that may significantly contribute to bridge the agricultural and climate science communities. These include:

- (a) Efforts to accommodate the needs of the various end-users wherever possible;
- (b) Timely production of forecast products;
- (c) Need for climate information producers to classify/categorise end-users in order to feed them better;
- (d) Regular provision of updated products and making them available to the broadest audience possible;
- (e) Need for climate information producers to provide information on the characteristics of season types in terms of length, dates of onset and cessation, frequency of dry spells, chances of flooding, storms, etc.;
- (f) Regular dissemination of weather information especially hazardous weather may help in confidence building;
- (g) Education of end-users to distinguish between short- and longer-term predictions and how these are compiled.

Such a strategy can probably also be applied to other end-user communities.

Natural disasters and risk-management

In the domain of natural disasters, it is the ambition of the WMO and the Millennium Development Goals (MDGs) to halve the loss of life associated with natural disasters of meteorological, hydrological and climatic origin over the next 15 years. As a result, WMO is working towards the development of new products, programmes and partnerships that provide/facilitate information with longer lead-times on the state of the climate and associated natural hazards. Through its DPM Programme, WMO ensures the optimization of its global infrastructure and the integration of its core scientific capabilities and expertise into all relevant phases of disaster risk management at the international, regional and national levels, particularly related to risk assessment and early warning systems. WMO and NMHSs have the capability to develop and deliver critical products and services to the entire disaster risk management decision process. These include the multidisciplinary science to understand the vulnerability of communities to weather-, climate- and water-related hazards and hazards information for planning of emergency response and disaster mitigation/prevention. These systems operate alongside educational and capacity-building services that help ensure nations can better meet national needs for hazard information.

Annex 1

Climate Change Indices, Definitions of the 27 core indices

1. FD, *Number of frost days*: Annual count of days when TN (daily minimum temperature) $< 0^{\circ}\text{C}$.
2. SU, *Number of summer days*: Annual count of days when TX (daily maximum temperature) $> 25^{\circ}\text{C}$.
3. ID, *Number of icing days*: Annual count of days when TX (daily maximum temperature) $< 0^{\circ}\text{C}$.
4. TR, *Number of tropical nights*: Annual count of days when TN (daily minimum temperature) $> 20^{\circ}\text{C}$.
5. GSL, *Growing season length*: Annual (1st Jan to 31st Dec in Northern Hemisphere (NH), 1st July to 30th
6. TX_x, *Monthly maximum value of daily maximum temperature*:
7. TN_x, *Monthly maximum value of daily minimum temperature*:
8. TX_n, *Monthly minimum value of daily maximum temperature*:
9. TN_n, *Monthly minimum value of daily minimum temperature*:
10. TN10p, *Percentage of days when TN $< 10^{\text{th}}$ percentile*:
11. TX10p, *Percentage of days when TX $< 10^{\text{th}}$ percentile*:
12. TN90p, *Percentage of days when TN $> 90^{\text{th}}$ percentile*:
13. TX90p, *Percentage of days when TX $> 90^{\text{th}}$ percentile*:
14. WSDI, *Warm spell duration index*: Annual count of days with at least 6 consecutive days when TX $> 90^{\text{th}}$ percentile
15. CSDI, *Cold spell duration index*: Annual count of days with at least 6 consecutive days when TN $< 10^{\text{th}}$ percentile
16. DTR, *Daily temperature range*: Monthly mean difference between TX and TN
17. Rx1day, *Monthly maximum 1-day precipitation*:
18. Rx5day, *Monthly maximum consecutive 5-day precipitation*:
19. SDII *Simple precipitation intensity index*:
20. R10mm *Annual count of days when PRCP $\geq 10\text{mm}$* :
21. R20mm *Annual count of days when PRCP $\geq 20\text{mm}$* :
22. Rnnmm *Annual count of days when PRCP $\geq n\text{mm}$, nn is a user defined threshold*:
- 23 CDD. *Maximum length of dry spell, maximum number of consecutive days with RR $< 1\text{mm}$* :
- 24 CWD. *Maximum length of wet spell, maximum number of consecutive days with RR $\geq 1\text{mm}$* :
25. R95pTOT. *Annual total PRCP when RR $> 95\text{p}$* .

26. R99pTOT. *Annual total PRCP when RR > 99p:*

27. PRCPTOT. *Annual total precipitation in wet days:*

References

- Karl, T.R., N. Nicholls, and A. Ghazi, 1999: CLIVAR/GCOS/WMO workshop on indices and indicators for climate extremes: Workshop summary. *Climatic Change*, **42**, 3-7.
- Peterson, T.C., and Coauthors: Report on the Activities of the Working Group on Climate Change Detection and Related Rapporteurs 1998-2001. WMO, Rep. WCDMP-47, WMO-TD 1071, Geneva, Switzerland, 143pp.

Annex 2

List of meetings relevant to Climate Applications and Services since 2004

Dates and Venue	Meeting / Workshop / Seminar
Date and place to be decided	Meeting of the CCI Expert Team on Research Needs (ET 3.1)
Date and place to be decided	CLIPS Training Workshop for Mediterranean parts of RA I (Africa) and RA VI (Europe)
Date and place to be decided	Meeting of the Expert Team on CLIPS Operations, Verification and Application Services
Date and place to be decided	Meeting of the CCI Expert Team, and Scoping Workshop, on Climate and Tourism
Date and place to be decided	Meeting of the Experts on Implementation and Demonstration of Heat-Health Warning Systems
Date and place to be decided	First Implementation-Coordination Team (ICT) Meeting of CCI
Date and place to be decided Honolulu? September?	Meeting of the CCI Expert Team on El Niño and La Niña, with Workshop on Common language for Communications and for scoping an atlas of ENSO Impacts
Date and place to be decided Costa Rica (September?)	WHO Workshop on Climate and Health
11-14 November 2007 Geneva, Switzerland	Fifteenth session of the CLIVAR Scientific Steering Group
1-5 October 2007 San Lorenzo de El Escorial, Spain	7th Annual Meeting of the European Meteorological Society (EMS) and the 8th European Conference on Applications of Meteorology (ECAM)
4-8 June 2007 Barcelona, Spain	WCRP Workshop on Seasonal Prediction
4 - 6 April 2007 Beijing, China	3rd Session of the Forum on Regional Climate Monitoring, Assessment and Prediction for Asia (FOCRA II)
22-23 March 2007 Bonn, Germany	Improving Public Health Responses to Extreme Weather/heat waves (Final EuroHEAT Meeting, WHO-Europe)
19-23 March 2007 Madrid, Spain	WMO International Conference on "Secure and Sustainable Living: Social and Economic Benefits of Weather, Climate and Water Services"
8-10 March 2007 Nairobi, Kenya	First Malaria Outlook for the Greater Horn of Africa
5 - 7 March 2007 Nairobi, Kenya	19th Climate Outlook Forum for the Greater Horn of Africa
5 - 9 March 2007 Lima, Peru	2nd Alexander von Humboldt International Conference - The Role of Geophysics in Natural Disaster Prevention
28 February - 2 March 2007 Geneva, Switzerland	Authors' Meeting to Develop Guidelines for Heat-health Warning Systems

Dates and Venue	Meeting / Workshop / Seminar
15 - 27 January 2007 Bangkok, Thailand	CLIPS Training Workshop for RA II (Eastern Asia)
11 - 14 December 2006 Amman, Jordan	WHO Workshop on Climate and Health
20 - 22 November 2006 London, UK	Meeting of the CCI Expert Team on Climate and Health
30 October -2 November 2006 Armenia, Colombia	6th Climate Outlook Forum for the Western Coast of South America (WCSA-6)
2 - 5 October 2007 Yerevan, Armenia	RA VI Training Seminar on Capacity Building in Climate-related Matters
27 - 28 September 2007 Asuncion, Paraguay	XXV Climate Outlook Forum for the Southeastern of South America
6-7 September 2006 Gaborone, Botswana	10th South African Region Climate Outlook Forum (SARCOF-10)
31 August-1 September 2006 Nairobi, Kenya	18 th Climate Outlook Forum for the Greater Horn of Africa (GHACOF-18)
14 August-1 September 2006 Nairobi, Kenya	Capacity Building Workshop for Downscaling Climate Prediction Products for Agriculture and Food Security
17-21 July 2006 Espoo, Finland	WMO Conference on Living with Climate Variability and Change: Understanding the uncertainties and managing the risks (with FMI, IRI and EU)
12-16 June 2006 Göteborg, Sweden	Sixth International Conference on Urban Climate
22-26 May 2006 Geneva, Switzerland	CCI Expert Team on the Guide to Climatological Practices
17-19 May 2006 Niamey, Niger	Seasonal Outlook Forum PRESA-O/09 for West Africa (PRESAO-AO/09)
15-17 May 2006 Montevideo, Uruguay	RA III Working Group on Climate Matters
26 - 27 April 2006 Porto Alegre, Brazil	XXIV Climate Outlook Forum for the Southeastern of South America
18 - 21 April 2006 Belize City, Belize	XVII Climate Outlook Forum of Central America
6 - 8 April 2006 Beijing, China	2nd Session of the Forum on Regional Climate Monitoring, Assessment and Prediction for Asia (FOCRA II)
3-7 April 2006 Geneva, Switzerland	Workshop on Forecasting Adverse Health Impacts in Africa
1-3 March 2006 Nairobi, Kenya	17 th Climate Outlook Forum for the Greater Horn of Africa (GHACOF-17)
22 - 24 February 2006 Dakar, Senegal	RA I Working Group on Climate Matters
13-14 February 2006 Geneva, Switzerland	Commission for Climatology Management Group Meeting

Dates and Venue	Meeting / Workshop / Seminar
7-10 February 2006 Singapore	RA V Working Group on Climate Matters
7 February 2006 Geneva, Switzerland	Experts Meeting on Early Warning Systems
23-24 January 2006 Geneva, Switzerland	Ad Hoc Meeting of the LWCVC Core Group of the Scientific Organizing Committee (SOC)
5-7 December 2005 Santiago, Chile	5th Climate Outlook Forum for the Western Coast of South America (WCSA-5)
23-25 November 2005 Niamey, Niger	Workshop on Climate and Health: Climate and Environmental Information for Public Health Services in West Africa
7-18 November 2005 Kingston, Jamaica	IAI GAWTEC Training Institute on Climate and Health in the Americas
3-11 November 2005 Beijing, China	Commission for Climatology - fourteenth session
1-2 November 2005 Beijing, China	WMO Technical Conference on Climate as a Resource
October 2005 Montevideo, Uruguay	XXIII Climate Outlook Forum for the Southeastern of South America
3-7 October 2005 Nainital, India	Regional Workshop on Human Health Impacts from Climate Change and Variability in the Himalayas Region
19-23 September 2005 Toulouse, France	Expert Meeting on the Guide to Climatological Practices
16 September–28 October 2005 Oklahoma, USA	Fifth Training Workshop on Climate Prediction & Applications – Circum – Indian Ocean
7-8 September 2005 Harare, Zimbabwe	9th South African Region Climate Outlook Forum (SARCOF-9)
5-9 September 2005 Garmisch, Germany	17th International Congress of Biometeorology
31 August - 2 September 2005 Nairobi, Kenya	16th Climate Outlook Forum for the Greater Horn of Africa (GHACOF-16)
8-19 August 2005 Lima, Peru	CLIPS Training Workshop for Regional Association III
13-16 July 2005 Sao Paulo, Brazil	Regional Technical Meeting on CLIPS and Agrometeorological Applications for the MERCOSUR Countries
20-22 June 2005 Rome, Italy	Meeting on improving public health response to extreme weather
23-25 May 2005 Geneva, Switzerland	Meeting of the Expert Team on Urban Climatology including Training

Dates and Venue	Meeting / Workshop / Seminar
17 May -3 June 2005 Niamey, Niger	Seasonal Outlook Forum PRESA-O/08 for West Africa (PRESA-AO/08)
7 - 9 April 2005 Beijing, China	1st Session of the Forum on Regional Climate Monitoring - Assessment - Prediction for Asia (FOCRA II)
5 - 6 April 2005 Buenos Aires, Argentina	XXII Climate Outlook Forum for the Southeastern of South America
2-4 March 2005 Mombassa, Kenya	15th Climate Outlook Forum for the Greater Horn of Africa (GHACOF-15)
14-18 February 2005 Brasilia, Brazil	Training Workshop on Climate Early Warning Systems for Region III
2-4 February 2005 Tokyo, Japan	Meeting of the Expert Team on Verification
14-15 December 2004 Niamey, Niger	Consultative meeting on Climate and Health held at ACMAD
22-26 November 2004 Brazzaville, Congo	7th Technical Conference for Regional Association I
22-23 November 2004 Madrid, Spain	World Tourism Organization (WTO) UN Agencies Coordination Meeting on Tourism Matters.
15-17 November 2004 Guayaquil, Ecuador	4th Climate Outlook Forum for Western Coast of South America (WCSA-4)
10-12 November 2004 Nanyuki, Kenya	UNEP Design meeting for the fourth Global Environment Outlook (GEO-4)
9-12 November 2004 Guayaquil, Ecuador	Regional Association III Workshop on CLIPS and Its Application to the Health Sector
28 - 29 October 2004 Asuncion, Paraguay	XXI Climate Outlook Forum for the Southeastern of South America
25-27 October 2004 Tokyo, Japan	RA II Working Group on Climate related Matters including CLIPS (RA II-RCCs).
12-15 October 2004 Arusha, Tanzania	Meeting of Expert Team on CLIPS operations including Product Generation, with emphasis on countries in Need.
26 September - 7 October 2004 Doha, Qatar	CLIPS Focal Point Training Workshop for Western Regional Association II.
27-29 September 2004 Amsterdam, the Netherlands	International Conference 'Climate Change: a challenge or a threat for water management' and Meeting of the International Steering Committee of the Co-operative Programme on Water and Climate (CPWC)
14-15 September 2004 Nadi, Fiji	Climate and Health Workshop

Dates and Venue	Meeting / Workshop / Seminar
13-17 September 2004 Barcelona, Spain	World Urban Forum II
13-16 September 2004 Galapagos Islands, Ecuador	El Niño Early Warning for Sustainable Development in Pacific Rim Countries and Islands.
30 August - 02 September 2004 Harare, Zimbabwe	8th South African Region Climate Outlook Forum (SARCOF-8)
August 2004 Jeddah, Saudi Arabia	Seasonal Outlook Forum PRESA-NOR/02 for North Africa
23-27 August 2004 Nairobi, Kenya	14th Climate Outlook Forum for the Greater Horn of Africa (GHACOF-14)
27-29 July 2004 Geneva, Switzerland	African Climate Variations Workshop focusing on Eastern and Southern Africa
12-16 July 2004 Vientiane, Lao People's Democratic Republic	Workshop on Production of National Climate Monitoring Bulletins in the Indochina Region.
8-11 June 2004 Banjul, Gambia	Seasonal Outlook Forum PRESA-O/07 for West Africa
12 - 14 May 2004 Geneva, Switzerland	Meeting of Expert on End User Liaison
14 - 16 April 2004 Freiburg, Germany	Meeting of Experts to Develop Guidelines on Heat-Health Warning Systems
23-27 February 2004 Nairobi, Kenya	13th Climate Outlook Forum for the Greater Horn of Africa (GHACOF-13)
9 - 10 February 2004 Bratislava, Slovakia	Workshop on Extreme Weather Events and Public Health Responses

LIST OF WMO technical notes and publications

- 1) Technical Note No. 202. Report of CAgM Working Group. 2004. Management Strategies in Agriculture and Forestry for Mitigation of Greenhouse Gas Emissions and Adaptation to Climate Variability and Climate Change. WMO No. 969.
- 2) Technical Note No. 201. Das, H.P., Adamenko, T.I., Anaman, K.A., Gommès, R.G, and Johnson, G. 2003. Agrometeorology Related to Extreme Events. WMO No. 943, 137 pp.
- 3) Technical Note No. 200. Salinger, M.J., Desjardins, R.L., Janzen, H., Karing, P.H., Veerasamy, S., and Zipoli, G. 2000. Climate Variability, Agriculture and Forestry: Towards Sustainability. WMO No. 928, 41 pp.
- 4) Technical Note No. 199. Salinger, M.J., Desjardins, R., Jones, M.B., Sivakumar, M.V.K., Strommen, N.D., Veerasamy, S., Lianhai, W. 1997. Climate Variability, Agriculture and Forestry: An Update. WMO No. 841, 51 pp.
- 5) Technical Note No. 196. Climate Variability, Agriculture and Forestry. Report of the CAgM-IX Working Group on the study of Climate Effects on Agriculture including Forests, and of the Effects of Agriculture and Forest on Climate. 1994. WMO N° 802. 152 pp