

# **WORLD METEOROLOGICAL ORGANIZATION**



**World Climate Programme (WCP)**

**Climate Coordination Activities (CCA)**

## **POSITION PAPER**

**WMO'S ROLE IN GLOBAL CLIMATE CHANGE ISSUES  
WITH A FOCUS ON DEVELOPMENT AND SCIENCE  
BASED DECISION MAKING**

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# POSITION PAPER

## WMO's Role in Global Climate Change Issues with a focus on Development and Science based Decision Making

### Executive summary

The World Meteorological Organization (WMO) is the UN system's authoritative voice on the state and behaviour of the Earth's atmosphere including its interaction with the oceans, the climate and water resources. Its leading role in the coordination of international climate issues dates back to 1929 when the International Meteorological Organization established a Commission for Climatology. It was WMO that, in 1976, issued the first authoritative statement on the accumulation of carbon dioxide in the atmosphere and the potential impacts on climate. As a result in 1988, WMO and UNEP<sup>1</sup> jointly established the IPCC<sup>2</sup>, which has been critical in providing regular assessments of climate science, potential impact of climate change and of policy options, including mitigation and adaptation to climate variability and change. Furthermore, WMO in cooperation with UNEP, FAO, UNESCO and its IOC<sup>3</sup>, and ICSU<sup>4</sup> established the GCOS<sup>5</sup> to ensure systematic observation for climate change studies. WMO considers UNFCCC and other legal instruments such as the Kyoto Protocol to be the basis for future climate change debate and actions. Through a global partnership in capacity building, training, education and public awareness at all levels; WMO provides active support to the achievement of the UN MDGs<sup>6</sup> such as eradicating extreme poverty and hunger and ensuring environmental sustainability. Scientific evidence strongly suggests that the consequences of climate change are grave and have an adverse effect on societies, particularly in developing countries. It is therefore essential that decision-makers are able to formulate their policies based on the latest unbiased, scientific data such as that provided by WMO and its Members - the National Meteorological and Hydrological Services. On the other hand, WMO's joint programmes such as the WCRP<sup>7</sup> play a crucial role in narrowing uncertainties, particularly in the determination of the rate of climate change, the impacts on regional scales where society and environment are most vulnerable and the occurrence of extremes and sea level rise.

### Introduction

1. WMO provides world leadership in expertise and international cooperation in weather, climate, hydrology and water resources, and related environmental issues, and thereby contributes to the safety and well being of people throughout the world and to the economic benefit of all nations.
2. WMO initiatives have significantly enhanced the understanding of the complex Earth climate system. These include the identification and analysis of critical environmental phenomena, such as increase in greenhouse gases and related global warming, climate variability and change, natural disasters, air and water pollution, depletion of the ozone layer, acid rain, and by bringing to the world's attention their status and their potential dangers. WMO's leading role in the coordination of international climate issues dates back to 1929 when the International Meteorological Organization established a Commission for Climatology.
3. WMO's strategies have been designed to respond to a number of challenges related to weather, climate and water issues. Climate change and its impacts, one of the most serious problems facing global sustainable development, is of great concern to humanity and is being

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<sup>1</sup> United Nations Environment Programme (UNEP)

<sup>2</sup> Intergovernmental Panel on Climate Change (IPCC)

<sup>3</sup> Intergovernmental Oceanographic Commission (IOC)

<sup>4</sup> International Council for Science (ICSU)

<sup>5</sup> Global Climate Observing System (GCOS)

<sup>6</sup> Millennium Development Goals (MDGs)

<sup>7</sup> World Climate Research Programme (WCRP)

addressed by several global, regional and national organizations and institutions. Even if mitigation actions such as greenhouse gas emission reductions can help slow the rate of climate change, it is widely acknowledged that human activity is modifying the climate, with the increased possibility of extreme changes. Adaptation through a range of technical, regulatory, and behavioural changes, is one of the mechanisms available to society for dealing with climate change. WMO, in collaboration with its Member States comprising a global network of NMHSs<sup>8</sup>, plays a crucial role in weather and climate observation, monitoring, scientific understanding of climate processes, and the development of clear, precise and user-targeted information and climate predictions. By providing sector-specific climate services, including advice, tools and expertise, WMO and its Members work towards meeting the needs and requirements of adaptation strategies as well as decision-making.

4. It was WMO that, in 1976, issued the first authoritative statement on the accumulation of carbon dioxide in the atmosphere and the potential impacts on climate. This was a key trigger that focused the attention of policy makers to the potential threat of climate change and its impacts for generations to come. As a result in 1988, WMO and UNEP jointly established the IPCC, which has been critical in providing regular assessments of climate science, potential impact of climate change and of policy options. WMO and its affiliated programmes have been the principal provider of the scientific and technical information that underpins the IPCC's assessments. The IPCC assessment, of which the AR4<sup>9</sup> has recently been released, provides a reference scientific framework as a basis for contemporary climate change discussions.

5. WMO in cooperation with UNEP, FAO, UNESCO and its IOC, and ICSU organized the First World Climate Conference in 1979 and the Second World Climate Conference in 1990. The Conferences were important milestones in the development of climate as a 21<sup>st</sup> century issue of international importance, which led to building awareness, reaching consensus and triggering actions. First World Climate Conference (FWCC) led to the establishment of the WCRP originally jointly with ICSU (and later with IOC). The Second World Climate Conference (SWCC) called for the establishment of a climate convention, adding momentum to international efforts that resulted in the development of the UNFCCC<sup>10</sup> in 1992. The SWCC also led to the establishment of the GCOS and to recommendations on future WCP activities.

6. WMO considers UNFCCC and other legal instruments such as the Kyoto Protocol to be the basis for future climate change debate and actions. WMO emphasizes the importance of linkages between the UNFCCC to other international agreements and conventions. WMO recognizes that future climate change policies would require the consideration of climate change, energy, socio economic issues and sustainable development. As far as adverse impacts of climate change are concerned, WMO emphasises the need to make reference to the relationship between climate change and natural disasters (floods, droughts, heat waves, etc.) and supports adaptation practices supplemented by mitigation. WMO welcomes the COP-12 initiative, which adopted the 'Nairobi Programme of Work on Impacts, Vulnerability and Adaptation to Climate Change' and officially recognized the role of WMO and NMHSs in the programme. To this effect, WMO Members feel committed to take a proactive role in planning national and regional programmes on adaptation to climate variability and change and participate in the implementation of the Nairobi Programme of Work based on the modalities and deliverables identified in the WMO Concept Paper.

7. WMO also actively supports other UN climate-related Conventions such as the UNCCD<sup>11</sup>, UNCBD<sup>12</sup>, the Vienna Convention on the Protection of the Ozone Layer and its Montreal Protocol and Amendments. The UN General Assembly declared 2006 as the IYDD<sup>13</sup> and WMO actively cooperated with UNCCD in the implementation of IYDD. WMO contributes actively to the activities

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<sup>8</sup> National Meteorological and Hydrological Services (NMHSs)

<sup>9</sup> Fourth Assessment Report (AR4)

<sup>10</sup> UN Framework Convention on Climate Change (UNFCCC)

<sup>11</sup> United Nations Convention on Combat Desertification (UNCCD)

<sup>12</sup> United Nations Convention on Biodiversity (UNCBD)

<sup>13</sup> International Year on Deserts and Desertification (IYDD)

of AHTEG<sup>14</sup> on biological diversity and climate change, on understanding the linkages between biodiversity and climate change. The year 2008 has also been declared the International Year of Planet Earth in which WMO has begun and will continue to cooperate with UNESCO and the IUGS<sup>15</sup> in its implementation.

8. WMO, through a global partnership in capacity building, training, education and public awareness at all levels, contributes to mobilizing support for international action to address climate change. It provides active support towards the achievement of the MDGs such as eradicating extreme poverty and hunger and ensuring environmental sustainability through a vast reservoir of expertise and knowledge, among its Members states, Programmes, Technical Commissions, partner institutions and organizations. Regional Climate Outlook Forums initiated and supported by the WCP<sup>16</sup> of WMO in different parts of the world, for example, provide an effective mechanism for capacity building at the regional level, particularly in developing countries.

9. WMO has recently begun planning with other UN Agencies and Governments for the WCC-3<sup>17</sup>. WMO believes that such a mechanism can contribute to already established initiatives like the UK-led post Gleneagles dialogue on climate change. In addition, the International Conference would help developing countries and regions leverage existing expertise and knowledge for their decision-support systems and tools that are relevant to their local needs.

10. WMO has stressed the urgent need for governments to provide adequate support for National Meteorological and Hydrological Services, to ensure that they utilize the latest technologies and current scientific knowledge. These will further improve the accuracy of climate information and prediction services that they offer to communities, policy makers and users. In this regard, partnerships across disciplines and institutions at national and international levels are essential and actively fostered.

### **Observation and Monitoring**

11. WMO manages an IOS<sup>18</sup>, which comprises of unique complex networks in space, in the atmosphere, on land and at sea, operated by its Member States. The network records and reports on weather, climate and natural environment and makes a substantial contribution to the delivery of increasingly accurate and reliable information on weather, water, climate and the environment worldwide.

12. Data collected through WMO's GOS<sup>19</sup> gives a clear indication that globally averaged surface temperatures have increased since the beginning of instrumental records in 1861. Over the 20th century, this increase was about 0.74°C; however, the linear warming trend over the last 50 years is nearly twice that for the last 100 years. Moreover, analyses of indirect data for the Northern Hemisphere indicate that the late 20th century warmth was unprecedented for at least the past millennium.

13. Over the same period, the 1990s was the warmest decade, 1998 the warmest year with 2005, the second warmest. Should atmospheric concentrations of greenhouse gases double compared to pre-industrial levels, the projected temperature rise by the end of the present century would likely be around 3°C.

14. Scientific evidence strongly suggests that the consequences of climate change are grave and have an adverse effect on societies, particularly in developing countries. It is therefore essential that decision-makers are able to formulate their policies based on the latest unbiased,

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<sup>14</sup> Ad Hoc Technical Expert Group (AHTEG)

<sup>15</sup> International Union of Geological Sciences (IUGS)

<sup>16</sup> World Climate Programme (WCP)

<sup>17</sup> World Climate Conference-3 (WCC-3)

<sup>18</sup> Integrated Global Observing System (WMO-IOS)

<sup>19</sup> Global Observing System (GOS)

scientific data such as that provided by WMO and its Members - the National Meteorological and Hydrological Services.

15. WMO along with UNEP, IOC of UNESCO and ICSU established the GCOS in 1992 to ensure that the observations and information needed to address climate-related issues are obtained and made available to all potential users. 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 and change, and for supporting research toward improved understanding, modelling and prediction of the climate system. It addresses the total climate system including physical, chemical and biological properties, and atmospheric, oceanic, hydrologic, cryospheric and terrestrial processes.

16. GCOS builds upon, and works in partnership with, other existing and developing observing systems such as the WWW<sup>20</sup>, the GOOS<sup>21</sup>, the World Hydrological Cycle Observing System, the Global Terrestrial Observing System, and the Global Observing System and Global Atmospheric Watch of the World Meteorological Organization. A major achievement of GCOS was completion in October 2004 of the "Implementation Plan for the GCOS 10-year Implementation Plan" in support of the UNFCCC. It specifies the actions required to implement a comprehensive observing system that would characterise the state and variability of the global climate system and respond to the various needs expressed by UNFCCC. GCOS is actively involved in the recently established Group on Earth Observation, as the main contributor to the climate societal benefit area and also a potential contributor to other domains.

17. The GAW<sup>22</sup> component of WMO focuses upon the role of atmospheric chemistry in global change and the need to include scientific data and information in the formulation of national and international policy. It consists of a partnership of managers, scientists and technical experts from 80 countries. NMHSs have the responsibility to monitor the concentration of greenhouse gases in the atmosphere. In March 2006, WMO released the first of a series of Annual Greenhouse Gas Bulletins. These bulletins represent the consensus of a consortium of networks operating since 1975. The data are reported by participating countries and archived and distributed by the World Data Centre for Greenhouse Gases at the Japan Meteorological Agency.

18. Lack of adequate and reliable comprehensive global 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's WCDMP<sup>23</sup>, 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 use in the development of their adaptation strategies. Long-term, high-quality and reliable climate instrumental time series are key information required for undertaking robust and consistent assessments in order to better understand, detect, predict and respond to global climate variability and change. WMO, in cooperation with ICSU sponsors, established WDCs<sup>24</sup> to archive and distribute data collected from observational networks. These centres serve the whole scientific community by assembling, scrutinizing, organizing and disseminating data and information. In this regard, WMO through modern CDMSs<sup>25</sup> aims at providing to NMHSs the complete technological and know how package which includes training on major topics in Data Management and related IT knowledge as well as the provision of technical support including high performance hardware and software sets to implement a robust climate data management infrastructure. These facilities assist Members in mainstreaming climate data into climate change adaptation. Within this framework climate extreme indices constitute a practical tool

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<sup>20</sup> World Weather Watch (WWW)

<sup>21</sup> Global Ocean Observing System (GOOS)

<sup>22</sup> Global Atmosphere Watch (GAW)

<sup>23</sup> World Climate Data and Monitoring Program (WCDMP)

<sup>24</sup> World Data Centers (WDCs)

<sup>25</sup> Climate Data Management Systems (CDMSs)

for summarizing climate variability and changes at global, regional and national levels and they offer the possibility for application in various sectors particularly in agriculture, water resources, health, and energy.

19. WMO aims at providing its Member countries, especially in developing and Least Developed Countries with the most complete technological and know how package, including training on Data Management and related IT knowledge. These contribute to their capacity building and enable them to be full partners in the UNFCCC Nairobi Work Program on Impacts, Adaptation and Vulnerability to Climate change. International efforts in prospecting simple indices reflecting climate extremes have led to the definition of 27 indices summarizing temperature and precipitation extremes using daily climatological data. Under the supervision of the WCDMP, leading experts have developed software allowing quality control and homogeneity test and adjustment for large data sets as well as the computation of the indices.

20. NMHSs can contribute significantly through the development and use of modern CDMSs and through 'rescue' of historical records that are at risk of deterioration, in order to secure complete and safe long-term climate records. Improved climate observations are vital to address climate related issues. The WCDMP 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.

21. WMO has been issuing Annual Statements on the Status of the Global Climate for 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 climate, particularly surface temperatures that have occurred since the nineteenth century. WMO is also 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.

## **Climate Research**

22. Integrating new observations, advanced computational and research facilities and scientific breakthroughs is essential to progress in the inherently global task of advancing understanding of the processes that determine our climate. The WCRP, sponsored by WMO, the ICSU, and the IOC of UNESCO, is uniquely positioned to draw on the totality of climate-related systems, facilities and intellectual capabilities of more than 188 countries.

23. Results from WCP and WCRP research provide a large part of the material assessed periodically by Working Group I of the IPCC in their advice to the UNFCCC. WCP and WCRP scientists and projects contribute significantly to the collection and assembling of climate observations, model development, coordination of climate model simulations and the understanding of the climate system necessary for the detection and attribution of past climate change, and the provision of climate information, including projections of future change based on various emission scenarios. These modelling activities organised and coordinated by the WCRP have been the basis for the IPCC AR4 (and past assessments), being published in 2007.

24. The WCRP CMIP3<sup>26</sup> is about 10 times larger than previous databases for climate model output. CMIP3 is by far the largest undertaking of its kind to date, resulting in over 200 papers in scientific journals already and many more in preparation. This information provides freely available climate change projections already being accessed by over 1000 end-users establishing the basis for any adaptation plans. This impressive archive allows nations to plan effectively for climate change.

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<sup>26</sup> Coupled Model Intercomparison Project 3 (CMIP3)

25. WMO believes that adaptation to variability and change requires accurate understanding of climate projections and an intimate knowledge of the skill of predictions of specific variables in particular regions. WCRP plays a crucial role in both increasing the skill and estimating the uncertainties of these predictions and in the detection and attribution of changes in the physical climate system.

26. Concerted efforts are being made by some of the NMHSs and leading international climate modeling groups, under the coordination of the WCRP, to develop Regional Climate Models so that they become capable of providing regional scale (typically 25 x 25 km, and higher resolution with appropriate computing facilities), climate information for impact studies, to facilitate their use within the modest computational infrastructure of the developing countries, and to provide training on this information as necessary. Global efforts can be spearheaded by WMO to bridge the existing gaps between developed and developing countries in their understanding of climate change impacts through capacity building and regular updates of occurrence of extreme events and associated damages. While downscaling using regional climate models is valuable, there is an urgent need for high-resolution global simulations to capture the global teleconnections that are an integral part of weather and climate. There is an urgent need to advance from climate projection with a space resolution of approximately 100 km, insufficient for adequately resolving cyclones, to cloud system-resolving models with resolutions of several kilometres. This will require the coordination of many scientists working together to build the next generation of climate prediction models and PetaFLOPS computers to run them on.

27. WCRP plays a crucial role in narrowing uncertainties, particularly in the determination of the rate of climate change, the impacts on regional scales where society and environment are most vulnerable and the occurrence of extremes and sea level rise. Reduction of these uncertainties requires the filling of significant gaps in observational programmes and understanding, and improved models for projection of climate change, both globally and regionally. This information is critical to enable individual nations to plan for and adapt to climate and global change.

### **Climate Services**

28. The CLIPS<sup>27</sup> Project of the WCASP<sup>28</sup> 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 the 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. RCOFs<sup>29</sup> are one of the vehicles for developing user-driven products and services, which were successful in various regions in attracting the interest and support of sectoral user groups and in developing and disseminating seasonal climate predictions and related products. These mechanisms can be effectively expanded to include regional climate change information products.

29. Recognising that response to climate variations and change requires the capability to appreciate and properly interpret research findings and to apply them to national planning initiatives, the WCRP is focused on supporting capacity building in developing and least developed countries. Through the WMO Climate Information and Prediction Services (CLIPS) project, WCP, WCRP and its CLIVAR project, aim to develop the capacity of the NMHSs by taking advantage of the recent advances in the science of climate and in the processing and delivery of climate information, and to pass on the benefits of the improved climate services to the user community.

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<sup>27</sup> Climate Information and Prediction Services (CLIPS)

<sup>28</sup> World Climate Applications and Services Programme (WCASP)

<sup>29</sup> Regional Climate Outlook Forums (RCOFs)

30. In addition, through the VACS<sup>30</sup>, WCRP-CLIVAR aims to develop appropriate research programmes for the various regions of Africa; build capacity throughout Africa in climate science through training workshops, conferences and other activities and provide scientific advice and guidance to ongoing and future research into the variability and prediction of Africa's climate.

31. 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 level. With the help of leading experts spread across 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 NMHSs, help users to anticipate the regional impacts associated with major ENSO-related anomalies. Depending on the nature of the regional impacts of El Niño/La Niña, these updates provide early warning of extreme climatic events such as droughts and floods. Joint WCP/CCI/DPM<sup>31</sup> efforts are being made to develop a worldwide inventory of ENSO impacts. A number of NMHSs and research agencies have the individual capacity to develop seasonal climate predictions for their country, region or the world. RCOFs constitute an important vehicle to provide advanced information on the future climate information for the next season and beyond for developing countries, and for developing a consensus product from available individual predictions. The RCOFs have also developed partnerships in the core sectors such as agriculture, health, water, etc. with active media participation.

32. WMO is also developing RCCs<sup>32</sup>, which can provide regionally focused climate prediction products using state-of-art climate models to developing and least developed countries, by optimizing available resources. However, local expertise and adequate infrastructure and organization at the national level are still needed to adapt these 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.

33. WMO proactively interacts with user sectors to review opportunities and constraints in integrating climate risks and uncertainties into decision-making activities where sensitivity to climate variability and change is one of many factors to consider. WMO recognizes that the major socio-economic sectors are sensitive to climate variability and change, and that the integration of climate information into decision-making would help support the development of effective climate-related risk management. While this requires multidisciplinary collaborations and partnerships, it is clear that strong climate programmes in NMHSs are essential to this process.

## **Climate Applications**

34. The impact of climate variability and change on water resources depends not only on changes in the volume, timing, and quality of stream flow 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. These 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.

35. WMO's Agricultural Meteorology Programme assists Members in provision of meteorological and related services to the agricultural community to help develop sustainable and economically viable agricultural systems, improve production and quality, reduce losses and risks,

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<sup>30</sup> Variability of the African Climate System (VACS)

<sup>31</sup> Disaster Prevention and Mitigation Programme (DPM)

<sup>32</sup> Regional Climate Centres (RCCs)



decrease costs, increase efficiency in the use of water, labour and energy, conserve natural resources and decrease pollution by agricultural chemicals or other agents that contribute to the degradation of the environment. WMO Member countries are facing the need to increase food production and water resources storage capacity to satisfy the aspiration of their ever-growing populations. While weather retains its inherent variability and other environmental hazards are spreading and intensifying, people are becoming aware of the potential economic contribution of meteorology to the efficient sustainable development of their countries.

36. Agriculture is typically the most important sector in the economy of developing countries, especially in the LDCs and SIDSs. Farmers practice subsistence agriculture and the productivity of the agricultural systems depend heavily on prevailing rainfall and temperature patterns. Climate variability, climate change and seasonal shifts in meteorological parameters strongly impact agricultural productivity, affecting the food security of many vulnerable developing countries. Such services are vital to the special needs of developing countries where agriculture is a critical socio-economic sector.

37. Weather and climate impacts on energy supply, demand and price are multi-faceted. Climate and weather data and products are being increasingly used by energy-related agencies in planning, design and operations. Tailored climate information can help enhance the exploitation of sustainable natural sources such as wind and solar energy, biomass, hydraulic, which are also environment-friendly. Weather extremes generally are much more frequent than seasonal extremes. Weather and climate information should be better integrated into the development of energy policies at various levels. Capacity building of both the climate and energy communities is of fundamental importance to improve communication of each other's needs and capabilities, so that well-planned analyses of the meteorological impacts on the energy sector can be made which can feed the development of effective tools to better manage risk in the energy sector. WMO regards climate as a resource, which offers great physical potentials for direct and indirect transformation into energy. It urges governments and the private sector to pursue energy efficiency measures particularly in the building sectors and wider use of renewable energies, (solar, wind Hydropower, etc.).

38. Tourism is currently one of the largest and fastest growing industries, and for a majority of nations it is one of the top sources of export or foreign exchange revenue. Climate change will not only impact tourism directly with changes in temperature, extreme weather events and other climatic factors, but it will have an indirect impact by transforming the natural environment that attracts tourists. WMO in partnership with the NMHSs and the international meteorological community is making an important contribution by providing relevant information to the tourism sector in order to reduce the adverse consequences of weather and climate extremes for tourism operators. At the same time WMO is joining with UNWTO<sup>33</sup> and the tourism sector to maximize the benefits of favourable weather conditions and changes in climate. In this way both organizations are raising awareness levels about the sensitivity of tourism to weather and climate variability and change, including extremes. They are also providing guidance on how key actors in the tourism system might best respond in order to reduce risks and maximize benefits.

39. WMO has a long-standing partnership with the WHO<sup>34</sup>, and others in climate applications to health. WMO, in collaboration with WHO, is in advanced stages of publishing Guidance on HHWS<sup>35</sup> to help nations cope with the health consequences of deadly heatwaves. Joint WCP/CCI/DPM efforts are being made to develop demonstration projects on HHWS, to facilitate relevant training and implementation of HHWS in regions vulnerable to heatwaves, in which some countries have already evinced interest. WMO is also actively promoting a close coordination of RCOFs and MALOFs<sup>36</sup> in Africa, for real-time applications of climate information in Malaria control.

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<sup>33</sup> UN World Tourism Organization (UNWTO)

<sup>34</sup> World Health Organization (WHO)

<sup>35</sup> Heat-Health Warning Systems (HHWS)

<sup>36</sup> Malaria Outlook Forums (MALOFs)

Additionally, AREP/THORPEX and GCOS have taken up several initiatives on climate and health in Africa. The CCI ad hoc ET is also in the process of developing a position paper on the utility of climate prediction to health decisions and an on-line virtual library of relevant research on this topic. Such efforts can feed into multi-hazard Early Warning Systems with climate and health applications to other vulnerable regions.

40 WMO recognizes that the rapid urban population growth would have serious consequences to the health and well-being of an increasing share of the world's population, which would be at risk from the effects of urban climate hazards. There is therefore a need to develop building codes for reducing vulnerability in high-risk areas, and adapting to new statistics of extreme values. To address this issue, WMO is updating a Technical Note on building climatology, and a WCP/CCI/DPM project has been formulated on Integrating Hydrometeorological Risk Assessment in Urban Planning and Building Design.

41. Climate research of direct end-user value is co-coordinated worldwide by the WCRP. For example the 2006 WCRP Workshop on Understanding Sea-level Rise and Variability concluded that since 1992 the global mean sea level has been rising at a rate of  $3.2 \pm 0.4$  mm a year, based on combination of tide gauge and altimetry data compared to  $1.7 \pm 0.3$  mm a year from tide gauges over the previous century (see Statement). This is faster than the rate of 0.1 to 0.2 mm per year that has characterised the previous several millennia. Sea level rise is a result of thermal expansion of the ocean, melting of ice sheets and glaciers, changes in water storage on land, alterations in gravity and geometry of the ocean basin and coasts. Early warning of changing risks and of specific ocean inundation, especially during intense storms, is vital for national infrastructure planning and adaptation strategies. WCRP plans on holding subsequent Sea-level Rise workshops every two years especially for Least Developed Countries and Small Island Developing States.

42. WMO and ICSU initiated the IPY<sup>37</sup>, 2007-2008, a major intensive burst of internationally coordinated, interdisciplinary, scientific research and observation in the Earth's Polar Regions. WMO, through the NMHSs of its Members, will be offering substantial contributions to the IPY in the areas of polar meteorology, oceanography, glaciology and hydrology, in terms of scientific research and observations. The Polar Regions are of great significance in the global climate system and IPY will provide valuable contributions to the assessment of climate change and its impacts.

### **At the policy level**

43. WMO considers climate change issue in the context of sustainable development, which encompasses also the economic and social dimensions—such as, in this case, the links with energy, poverty and health. This vision (a) reinforce the centrality of multilateral participatory decision making frameworks; (b) link climate change to the sustainable development of energy, transport and land use, and more generally to less carbon-intensive world economic development; (c) underscore the need to advance rapidly in both mitigation of emissions of greenhouse gases and adaptation to the local effects of climate change; and (d) emphasize the need for actions by governments and the private sector, and thus of market and non-market approaches, taking into account the principles enshrined in the UNFCCC, in particular, cost effectiveness, efficiency and equity.

44. WMO emphasizes the centrality of the UNFCCC and the Kyoto Protocol in moving forward the global discussion on cooperative multilateral action to address climate change. In particular, it emphasizes the importance of rapid advance in the area of adaptation and of ambitious multilateral support to countries (particularly SIDS), and that are more vulnerable to the effects of climate change.

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<sup>37</sup> International Polar Year (IPY)

45. WMO emphasizes the importance of strengthening the existing international framework required to coordinate national and institutional scientific efforts to monitor, detect, attribute and understand current climate change and to project future climate changes. Elements of this framework exist in the international programmes supported by ICSU, WMO, (UNEP and UNESCO<sup>38</sup>).

46. Capacities of countries to adapt and mitigate impacts of climate variability and change can be enhanced when climate policies are integrated with national development policies including economic, social and other environmental dimensions. Climate mitigation and adaptation options can yield ancillary benefits that meet human needs, improve well being, and bring other environmental benefits. Countries with limited economic resources and low level of technology are often highly vulnerable to climate change and other environmental problems. WCRP in collaboration with the ICTP<sup>39</sup> will host the Interpreting Climate Change Simulations: Capacity Building for Developing Nations seminar in November 2007. Participants from developing and least developed nations in Africa, Asia and Central and South America will be invited to attend.

47. The effectiveness of climate policies can be enhanced when they are integrated with broader strategies designed to make national and regional development paths more sustainable. This occurs because of the impacts of natural climate variation and changes, climate policy responses, and associated socio-economic development will affect the ability of countries to achieve sustainable development goals, while the pursuit of those goals will in turn affect the opportunities for, and success of, climate policies.

#### **At the Implementation level**

48. WMO promotes science-based decision-making at national and global levels and also promotes the enhanced engagement by other UN agencies at national and local levels, of the scientific information provided by the WMO/UNEP joint body of the IPCC.

49. WMO supports strengthening the contribution of national governments, regional and UN organisations to systematic observation for climate change studies managed by GCOS and adequate measurement of relevant variables describing climate variability and change, as well as analysis of possible future climate scenarios. Such analyses should also provide the information needed for adaptation planning aimed at reducing vulnerability to impacts of climate variability and change.

50. WMO recognises that every major social, economic and environmental sector is sensitive to climate variability and change, both of which are significant factors in each sector's sustainable development. To this effect, it encourages improvement of policy formulation and operational decision-making in climate sensitive sectors by more widespread use of climate knowledge and information in managing risks and exploiting opportunities.

51. WMO emphasizes that climate-related risk management requires multidisciplinary collaborations and a cross-disciplinary exchange of information that can be achieved through interfacing institutes and processes. It further believes that on-going collaboration at national and regional scales between sectoral partners and climate information providers will benefit all parties.

52. WMO recommends that collaborative mechanisms should be developed to facilitate needs and requirements driven activities in climate-related risk management, and that they be used to improve the quality and efficiency of practices of climate-related risk management to the benefit of all. These mechanisms could promote: development of decision-support tools and capacity building in climate-related risk management.

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<sup>38</sup> United Nations Education, Scientific and Cultural Organisation (UNESCO)

<sup>39</sup> International Centre for Theoretical Physics (ICTP)

53. As far as adverse impacts of climate change are concerned, WMO emphasises the need to make reference to the likely relationship between climate change and natural disasters (floods, droughts, heat waves, etc.) and supports adaptation practices supplemented by mitigation. In light of this, the WCRP has a role as the international coordinator of world climate research to provide guidance on the nature and occurrence of climate extremes and also a framework under which observations and projections of climate extremes can be assessed. Through its new initiative on Climate Extremes, WCRP aims to summarize, compare and assess definition(s) of extremes, to develop a common language amongst researchers and end users and to design an Intercomparison 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.

54. WMO has recently started working with other UN Agencies and Governments to plan for a possible WCC-3 and believes that it can contribute to already established initiatives like the UK-led post Gleneagles dialogue on climate change and help developing countries and regions obtain full benefit from expertise and knowledge for decision-support systems and tools relevant to local needs. The benefits from a WCC-3, focused on seasonal to inter-annual prediction, would be of direct interest and relevance to policy makers, the media and the public. The conference has the potential to:

- Contribute to significant and immediate socio-economic benefits, including the prevention and mitigation of the impacts of natural disasters;
- Link very strongly into internationally agreed development goals, such as the UN MDGs, poverty reduction strategies, and the Hyogo Framework of Action for Disaster Risk Reduction.

55. WMO notes that over the last decade major advances have occurred in understanding and in predicting climate variability for time periods from a month to a season to a year in advance (and sometimes even longer). These scientific advances have been motivated by the ever-increasing demand for climate predictions in decision making and have led to the increasing application of climate information to the needs of the world's nations for improving public health and safety, sustained economic development and stable societal infrastructures. Examples of sectors that have benefited from the application of climate knowledge and prediction include aviation and marine transport, agriculture and food security, health, water resource development, use and conservation, energy supply and allocation, and the management and conservation of biodiversity. Climate knowledge and applications have also been used in international, national, and local planning and response to the impacts of natural disasters associated with climate extremes. This includes reducing the impacts of floods, droughts, tropical and extratropical cyclones, extreme temperatures, avalanches and landslides, and human, animal and plant disease outbreaks.

56. Adapting to climate variability, rapid and abrupt climate changes and their potential impacts poses challenges and offers opportunities for the management of resources and for national and local infrastructures and economies. The pressures of high population densities and intensified land use, such as the extension of human settlements and activities into high risk zones accelerate the demand for effective early warning systems and for effective management of climate-sensitive resources.

57. Many developing countries are highly susceptible to setbacks from climate extremes and thus are dependent on improving their use of climate information for achieving their economic and societal goals. Rural food production and water resource development and management are highly dependent on good information on climate variability; yet the availability of and capacity to utilize climate information is limited in many countries, particularly the least developed countries. Human mortality rates from diseases such as malaria are also influenced by climate variability. Ensemble climate prediction applications significantly improve early-warning techniques such as those for malaria outbreaks. In many regions, there is limited use of climate information for sustaining economic development. It is important to find ways for all countries to cope with climate variability

through improved access to climate information and prediction products and the use of risk management techniques.

58. WMO recommends sharing experiences in how users act on climate information and prediction in decisions, planning, and policy and assessing the methodologies of translating climate information into social and economic benefits. Discussions on evaluating climate coordination mechanisms, including the governance of the climate enterprise and in assessing future directions for providers of climate information and predictions and adapting (and optimizing) institutions to future needs for using climate information and predictions would be essential to move this initiative forward.