

WMO UPDATES AND INPUT ON NAIROBI WORK PROGRAMME (NWP)

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Introduction

This input covers primarily updates on contribution of the World Meteorological Organization (WMO) and of its co-sponsored bodies Global Climate Observing System (GCOS) and World Climate Research Programme (WCRP) to the Nairobi Work Programme (NWP). Noting that the Global Framework on Climate Services (GFCS) will enter implementation phase after October 2012 to further contribute to the areas of work mentioned in this report, WMO suggests that these activities continue in the future structure of the NWP, to ensure consistency and further maturity of the outcomes for adaptation practices.

1 Data and observations

1.1 *Developments for improvement of data policy*

At the request of the Sixteenth World Meteorological Congress (Cg-XVI), in the context of the requirements for implementation and sustained operation of the GFCS, WMO is exploring ways to facilitate international exchange of climate data and products, including a review of the existing Resolution 40 (Cg-XII, 1995) – WMO policy and practice for the exchange of meteorological and related data and products including guidelines on relationships in commercial meteorological activities, with a view to including therein the climate data and products needed for climate services.

From the perspective of climate data requirements in the realm of the GFCS, Resolution 40 (Cg-XII) is considered to be limited by the narrow scope of meteorological data and products that it covers. The new effort on the exchange of information of meteorological and related data could be improved and promoted by analysis of the practice of application for all types of data in the WMO Member countries.

Considering that over the two past decades significant changes have occurred in data, technology, and policies within countries, and that progress has been made in identification of requirements, the WMO Executive Council has established a Task Team on the WMO Policy for International Exchange of Climate Data and Products to Support the Implementation of the Global Framework for Climate Services.

Taking into account the outcomes of the 2012 Extraordinary World Meteorological Congress to be held in October 2012 and new developments within WMO related to the exchange of data and products, for example, the WMO Integrated Global Observing System and the WMO Information System, the Task Team shall study the implications of, and the potential for, applying the principle of free and unrestricted exchange of data and products, while respecting national policies, for the provision of climate services, including identification of examples of climate data and products that are available. It will also consider how other United Nations agencies and international organizations can collaborate with WMO on the exchange of data and products that will support the provision of climate services.

WMO recognizes the importance of addressing new and evolving requirements for climate data for improved climate monitoring products and services that would support the analysis and assessment of climate extremes, climate change adaptation at regional and national levels, issuing early warnings and perform climate watches.

WMO reiterates the importance of safeguarding, digitizing and making accessible historical climate archives available on paper format and modernizing obsolete electronic archives, such as those available on old magnetic tapes and floppy disks. These activities underpin the development of climate services by NMHSs and support achieving the objectives of the WMO Data Rescue (DARE) project.

1.2 Developments on observations- GCOS

The Steering Committee of the Global Climate Observing System (GCOS) would like to emphasize the need for a continued role of observations in the Nairobi Work Programme and for adequate climate observations to assist in the design of effective policies to address adaptation to climate change. The GCOS Programme thus intends to organize an international workshop in 2013 to consider the climate observation requirements for supporting adaptation to climate change. The workshop, which would be undertaken in cooperation with UNEP and IOC-UNESCO, would bring together representatives of the GCOS community and representatives of sectors in which adaptation to climate variability and climate change is, or is likely to become, an important concern. These would include the agriculture, water resources, health, and energy sectors and also the disaster risk reduction community. The goals of the workshop will be to identify observational requirements for adaptation, to review the Essential Climate Variables (ECVs) to determine their adequacy for adaptation, and to develop a plan to address the gaps and deficiencies identified. The workshop will be closely aligned to the implementation of the Global Framework for Climate Services, and its results will directly feed into the preparation of the next GCOS Adequacy Report, to be developed in the 2014 timeframe.

Four major outcomes will be sought, including:

1. A statement on the general adequacy of observations to support adaptation to climate variability and change and identification of further work on the assessment of adequacy that may be undertaken in preparation of the third GCOS adequacy report during 2013 and 2014 or in support of other programmes represented at the workshop;
2. Identification of the requirements for observations and their use in monitoring to support climate services addressing adaptation needs, in particular in the context of the Global Framework for Climate Services (GFCS) and related to a) water resources, b) health c) agriculture, d) coastal zone management, e) energy production, f) disaster risk reduction and g) transport;
3. Identification of the requirements for observations to support research into adaptation, such as to be undertaken under the Programme of Research on Climate Change Vulnerability, Impacts and Adaptation (PROVIA); and
4. Strategic guidance on what steps the GCOS Programme should take in the coming years to address the needs for observations for adaptation to climate variability and change, in particular in the context of its preparation of a new Implementation Plan by 2016.

2 Methods and Tools

2.1 Climate Service Information System (CSIS)

For the effective delivery of climate information, it is imperative that appropriate institutional mechanisms are in place to generate exchange and disseminate information at the global, regional and national levels on an operational basis. The Climate Service Information System (CSIS) is the principal GFCS mechanism through which information about climate (past, present and future) will be routinely collated, stored and processed to generate products and services that help to inform often complex decision making processes across a wide range of climate-sensitive activities and enterprises. The CSIS will comprise a physical infrastructure of institutes, centres and computer capabilities that, together with professional human resources, will develop, generate and distribute a wide range of climate information products and services.

The implementation strategy of the CSIS is based on a three-tiered structure of collaborating institutions (CSIS ‘entities’) that will ensure climate information and products are generated, exchanged and disseminated:

- a) at the global scale through a range of advanced centres;
- b) at a finer regional scale through a network of entities with regional mandates; and

c) at the national and local levels by National Meteorological and Hydrological Services (NMHSs) and their partners through appropriate national institutional arrangements.

A set of primary and high priority functions of CSIS can be defined to include (i) climate data rescue, management and mining, (ii) climate analysis and monitoring, (iii) climate prediction, and (iv) climate projection. These functions include processes of data retrieval, analysis and assessment, re-analysis, diagnostics, interpretation, attribution, verification and communication (including exchange/dissemination of data and products) carried out over a global-regional-national system of inter-linked producers and providers. CSIS implementation will take into account standardization, sustainability, reliability and adherence to established policies and procedures. Effective design, dissemination and uptake of CSIS products and services will require knowledge of user requirements and of their decision systems. Interaction with users for CSIS implementation and operation will require interface with users (e.g. through Regional Climate Outlook Forums (RCOFs) and collection and response to their feedback.

2.1.1 Global Producing Centres of Long Range Forecasts (GPCs)

In 2006, WMO began a process of identifying a network of Global Producing Centres for Long Range Forecasts (GPCs) that make and distribute global seasonal predictions. There are twelve officially designated WMO GPCs at present, spread over the world, operationally producing and disseminating global-scale long range forecasts to all WMO Members. Through a rigorous designation process, GPCs adhere to certain well-defined standards that support consistency and functionality among themselves. WMO has also designated two Lead Centres among the GPCs, namely the Lead Centre for Long-Range Forecast Multi-model Ensembles (LC-LRFMME) and the Lead Centre for Standard Verification System for Long-Range Forecasts (SVSLRF). LC-LRFMME collects a number of GPC real-time LRF products as well as some hindcast data, and by arrangement makes available a range of ensemble products to regional and national users in uniform formats and with common graphical displays. LC-SVSLRF is the authoritative source for mandatory verification information for all the GPCs, providing a single source for all information on the skills of the GPC products for any specific region/country in the world.

Given the fact that there are multiple sources of climate information, CSIS will actively promote consensus-based approaches, where consistent signals are present, and will help clarify aspects of uncertainty where the signals are divergent. This involves close cooperation between the concerned CSIS entities. A product exemplifying this approach is the WMO El Niño and La Niña Update, which Cg-XVI has endorsed to be expanded into a Global Seasonal Climate Update (GSCU), a more comprehensive product that will also encompass information on other factors that drive climate variations and extremes.

2.1.2 Regional Climate Centers (RCCs)

There are already a number of advanced centres providing global-scale CSIS products, though there is a need to coordinate and standardize their operations, especially with respect to the exchange of routine data and products, which will help ensure compatibility across geographical and jurisdictional boundaries. Making regional implementation a first priority gives countries that need the most help something to work with quickly, while longer-term efforts to build national climate capacity are described, funded and accomplished. At the regional level, WMO is actively pursuing the establishment of a number of formally designated WMO Regional Climate Centres (RCCs) around the world, that will generate and deliver more regionally focused, high-resolution data and products as well as offer training support on the use of their products. The aim of RCCs is to assist WMO Members in a given Region or a defined sub-Region to deliver better climate services and products including climate monitoring and long-range forecasts, and to strengthen their capacity to meet national climate information needs. A representative collection of WMO RCCs, building, where possible, on centres already in place or in planning, will form the backbone of the CSIS at the regional level. National entities under CSIS will acquire, interpret and apply the data and products from global and regional centres, and to the extent possible, will develop their

own national products. Considerable capacity development will be required, especially in developing countries, to strengthen national scale CSIS operations around the world.

WMO reiterates the importance of RCCs as a key element of the CSIS/GFCS, and particularly in helping participating Member countries develop improved climate activities for provision of a wide range of climate information, and emphasized the need that RCCs be developed as centres of excellence, with adherence to standards and criteria that will ensure the highest quality products.

2.1.3 Regional Climate Outlook Forums (RCOFs)

In partnership with regional institutes, WMO has promoted Regional Climate Outlook Forums (RCOFs) around the world in Africa, Asia, South America and the South Pacific Islands which are being held regularly, and supported the initiatives by Members to establish and sustain new RCOFs in South-eastern Europe, South Asia, Southeast Asia, Northern Eurasia, the Caribbean and Polar Regions. WMO Member countries continue their support to these efforts and expand the RCOF process that serves as an excellent interface with the users of climate information in various sectors and gives wider exposure to the activities of NMHSs. In this connection, National Climate Outlook Forums (NCOFs) are also important as a logical extension of the RCOF process for NMHSs interaction with national users. WMO encourages Members to develop efficient mechanisms to organize NCOFs through appropriate partnerships with national user sectors.

2.1.4 Climate Services Toolkit

The implementation of climate services is likely to impose considerable demands upon service providers, including upon NMHSs regardless of the extent of their role in national climate service provision. In any realistic scenario, the availability of additional resources for climate service provision is inevitably going to fall short of the ideal requirements to meet the new demands. One partial solution to this problem is to make available a suite of tools that can be used by climate service providers and users to facilitate the production, communication, and application of climate information products. However, to avoid the possibility of a proliferation of inconsistent, and possibly sub-standard, tools, there is a need to implement a set of standards, and to establish a certification process for new tools. WMO has made efforts to define the purpose of such a Climate Services Toolkit (CST), to outline a set of standards, and to propose a certification process. CST consists of a set of bespoke software products (including data management, data analysis, and prediction packages), and accompanying training modules, that are specifically designed to support the generation and use of climate information and prediction products that meet user needs. WMO will sustain its efforts to build and distribute CST under the guidance of CCI to all its Members, as part of the proposed initial implementation activities of the GFCS.

3 Climate related risks and extreme events

Acknowledging that the effective assessment and management of climate risk requires an understanding of the complex interplay between the climate factors and the vulnerability of the affected sector, WMO's Commission for Climatology (CCI) to consider developing interdisciplinary knowledge, based on vulnerability information, to support its work related to Climate Risk Management and adaptation in collaboration with other technical commissions and UN agencies.

WMO, recalling that water resources will be significantly affected by potential climate change, recognized the important role that WMO's Hydrology and Water Resources Programme (HWWRP) can play in helping Members in better understanding the impacts of climate change on the management of water resources and the risks linked to hydrological extremes, such as floods and droughts, and in developing adequate response and mitigation measures. WMO therefore welcomes the various initiatives aimed at fostering cooperation between the hydrological and climatological communities, the development of national adaptation strategies and the reinforcement of natural risks management capabilities.

There is a continued need for facilitating access to hydrological observations for global studies, particularly in downscaling climate information for water management and recognized the important role played by GTN-H, through the Global Runoff Data Centre (GRDC), International Groundwater Resources Assessment Centre (IGRAC) and the International Centre for the Hydrology of Lakes and Reservoirs (HYDROLARE) and the valuable contributions made by it in the generation of derived products and in support of climate change studies.

Disaster Risk Reduction (DRR) is a priority for WMO because protection of lives, property and livelihoods are at the core of the priorities of the WMO Members and the National Meteorological and Hydrological Services (NMHS). Furthermore, the implementation of the Hyogo Framework for Action (HFA) by national governments is leading to changes in national DRR policies, legal and institutional frameworks, with implications on the role, responsibilities and new working arrangements for the NMHSs. These changes provide opportunities such as increased recognition of the NMHSs by their governments and stakeholders, which could result in strengthened partnerships and increased resources. However, NMHSs face increasing demand and liabilities related to the provision of products and services to larger and more diverse group of DRR stakeholders (e.g., government authorities, public and private sectors, NGOs, general public and media, etc.) whom have direct responsibilities for DRR decision-making. To meet these new challenges, the WMO's crosscutting DRR Programme two-tier work plan aims to facilitate better alignment of the activities of WMO constituent bodies and global operational network as well as strategic partners to assist NMHSs to:

- (a) Engage effectively in the National DRR governance and institutional frameworks;
- (b) Identify, prioritize, establish partnerships and service delivery agreements with national DRR user community (users);
- (c) Establish partnership agreements with other national technical agencies (e.g., hydrological services, ocean services, etc.) as well as global and regional specialized centers (e.g. Global Producing Centres (GPC), Regional Specialized Meteorological Centres (RSMCs), Regional Climate Centres (RCC), Tsunami Watch Centers, etc.), with standard operating procedures;
- (d) Develop and deliver core and specialized products and services for DRR decision support (e.g., hazard/risk analysis, multi-hazard EWS, sectoral risk management and disaster risk financing and risk transfer) in a cost-effective, systematic and sustainable manner;
- (e) Ensure that core operational capacities (e.g., observing networks, forecasting systems, telecommunication systems, data management systems, human resources, etc.) are built upon the principles of Quality Management Systems (QMS) to support product and service development and delivery;
- (f) Engage in regional and global efforts for development of risk information for large scale and transboundary hazards, through strengthened regional and global cooperation.

4 Research

The World Climate Research Programme (WCRP) is facilitating cutting edge climate research to address challenges identified in its Programme's Strategic Framework 2005-2015 "Coordinated Observation and Prediction of the Earth System". The WCRP leadership and network of affiliate researchers focuses their efforts on:

- 1) coordinating international climate research, modelling and prediction in support of the priorities identified by WCRP sponsors and stakeholders

- 2) developing a future research strategy and priorities in response to the rapidly emerging needs for science-based climate information for decision making, in close consultation with the international science community
- 3) participating actively in major international initiatives such as the Future Earth: Research for Global Sustainability, Global Framework for Climate Services, and Sustained Global Oceans Observations to assist in identifying the required observations, modelling and research priorities for the ensuing decade; and
- 4) establishing a vigorous capacity development initiative to train the next generation of scientists and research networks at the global and regional level.

The WCRP organized for the first time a major open science conference on the occasion of its 30th anniversary in October 2011 to assess the current state of knowledge on climate variability and change, consult with the international community of experts to identify the most urgent scientific issues and research challenges.

WCRP in cooperation with its sister programmes made progresses in developing high quality climate data records, especially from space-based observing systems, development of a comprehensive set of model simulations of centennial and decadal Earth/climate system projections. Twenty-six groups from around the world participate in the WCRP Couple Model Intercomparison Project (CMIP5, cmip-pcmdi.llnl.gov/cmip5/) experiments that represent the most ambitious multi-model intercomparison and analysis project ever attempted. CMIP5 model output is shared by federated centres around the world that appear like a single archive, the Earth System Grid Federation (ESGF, <http://www.earthsystemgrid.org>). This distributed archival and distribution capability was widely viewed as the future of accessing both model and observed data for a wide variety of applications in climate science. These efforts together will provide for the first time an unprecedented volume of data and information to be used in international science-based policy assessments such the Fifth Intergovernmental Panel on Climate Change (IPCC), international adaptation planning and risk management studies, water resources and food production analysis and assessments, and evaluation of alternative energy and transportation planning to just name a few.

Climate information at regional to local scales is needed to assess the impacts of climate variability and change on human and natural systems, enabling the development of suitable adaptation and risk management strategies at the regional to local level. Despite significant advances in the horizontal resolution of most global climate models, there are still limitations in their ability to represent important regional/local forcing features, such as complex topography, land surface heterogeneity, coastlines and regional water bodies, all of which can modulate the large-scale climate on regional to local scales. Coarse spatial resolution of models also precludes an accurate description of extreme events, which are of significant importance in assessing the societal impact of changes in climate variability. In order to foster greater progress on development and use of regional climate information, in 2008 WCRP established a modelling framework for COordinated Regional Climate Downscaling (RCD) EXperiments (CORDEX, <http://cordex.dmi.dk> for access to some products and several other URLs). There are now considerable CORDEX activities in Africa. Ten groups have completed the first reanalysis driven runs, 14 groups are completing different scenario runs, a diagnostic team was established from research and operational organizations in Africa to assist with evaluation of CORDEX products and to prepare scholarly papers to be published in the open literature. Twenty-two modelling groups are participating in the Euro-CORDEX, which is also producing high-resolution simulations in addition to standard 50km simulations. Mediterranean CORDEX has 11 participating groups. Plans are underway for coordinating CORDEX activities of the East Asia and South Asia domains. Some CORDEX activities are also taking place in South America. There is an important capacity development aspect to CORDEX and many training workshops have been held or are being planned for the near future in Asia, Americas and Africa. The second pan-CORDEX conference is being planned in boreal fall 2013, in Brussels, Belgium.

WCRP is now sponsoring a very active network of regional projects through partnership with national and international organizations. Some examples of regional studies that are coordinated

by the WCRP core Projects include:

- The African Monsoon Multidisciplinary Analyses – AMMA (RHP),
- La Plata Basin – LPB project (RHP),
- Mediterranean Climate Variability and Predictability – MedCLIVAR,
- Baltic Sea Experiment – BALTEX (RHP),
- Large-Scale Biosphere-Atmosphere Experiment in Amazonia – LBA (RHP),
- HYdrological cycle in the Mediterranean Experiment - HyMex (RHP),
- Monsoon Asian Hydro-Atmosphere Scientific Research and Prediction Initiative - MAHASRI (RHP),
- Murray-Darling Basin – MDB (RHP),
- Northern Eurasia Earth Science Partnership Initiative – NEESPI (RHP),
- Asia-CliC,
- Variability of the African Climate System (VASC),
- Variability of the American Monsoon System, and
- Asian – Australian Monsoon Panel.

These regional studies are carried out to improve understanding and proper representation of regional specific processes in Earth system models, and to assess the impact of global climate variability and change of these regions. These studies can now potentially serve a third purpose by evaluating the strengths and weaknesses of the regional climate information provided by projects such as CORDEX.

A major WCRP research focus is understanding the characteristics of extreme weather/climate events, with great emphasis on observations, research and modelling activities for developing near-real-time detection of such events and attribution of their causes to mitigate their impacts and to ameliorate their impacts on people, ecosystems and world economy. Some notable activities include international coordination of observations, research and modelling of; 1) meteorological and hydrological droughts and establishment of an international drought information system for sharing of available knowledge and best practices globally; 2) regional sea-level change and impacts on coastal systems and communities; and 3) expanding the development of climate/weather extreme indexes to include factors such as precipitation and temperature for use in agriculture practices and water resources management.

WCRP core projects, CLIVAR and GEWEX, initiated a number of activities focusing on droughts. An ad hoc Drought Interest Group was formed and they developed a report on “Drought Predictability and Prediction in a Changing Climate: Assessing Current Predictive Knowledge and Capabilities, User Requirements and Research Priorities”. The document (see <http://www.clivar.org/organization/extremes/resources>) examines current prediction capabilities and user needs with the aim of identifying areas that would benefit from international coordination. These efforts, along with the world-wide survey of user drought information needs and capabilities (available at <http://www.clivar.org/organization/extremes/resources/dig>) are now part of the planning for an experimental global drought information system (GDIS).

WCRP has been identified as a lead to support the development of the Research, Modeling and Prediction (RMP) pillar of the Global Framework for Climate Services. A series of consultations were held in 2008 - 2011 to define how climate research can help support and develop climate services, and an initial RMP implementation plan is prepared for consideration of the Extraordinary World Meteorological Congress to be held on 29-31 October 2012. The proposed GFCS activities will be integrated with other components of the Framework to ensure timely and effective delivery of resulting information to meet decision makers' needs. Some proposed activities by the RMP component of GFCS include:

- Enhancing research on observations, design and development of observing networks, development and analysis of climate quality datasets; modeling and prediction capabilities, and building the required infrastructure and capacity, especially in developing and less-developed regions;

- Diversifying and expanding research with a major focus on the development of practical applications in the GFCS priority areas and strengthening validation and verification of resulting products in partnership with users communities; and
- Establishing effective partnerships necessary for science support of climate risk management and affective adaptation to climate change and variability and shortening the transition time from research to operations.

Significant progress has been made on our understanding of the climate system however in order to provide the best available state of knowledge on climate variability and change to the decision-makers it is imperative that research continue to be supported and facilitated. WCRP believes that climate research should be kept as an area of work in the future evolved structure of the NWP.
