Vol. 47: 83–94, 2011
doi: 10.3354/cr00950

CLIMATE RESEARCH
Clim Res

Published March 31

Contribution to CR Special 25 'Climate services for sustainable development'

Provision of climate information for adaptation to climate change

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ABSTRACT: Climate data and information is central to understanding the risks of climate change and to planning for adaptive actions to reduce such risks. The multi-scale, multi-disciplinary and multi-stakeholder nature of climate change impacts, vulnerability and adaptation require effective and sustained collaboration between the providers and users in order to ensure the relevance, practicality and applicability of climate data and information. The Nairobi Work Programme (NWP) on impacts, vulnerability and adaptation to climate change was launched as a mechanism under the United Nations Framework Convention on Climate Change (UNFCCC) to engage stakeholders, facilitate knowledge sharing and collaboration, and catalyze targeted actions on adaptation. The NWP has engaged a wide array of stakeholders, providers, users and knowledge intermediaries for climate data and information. Through discussions under the NWP, Parties to the UNFCCC recognized that there is an urgent need to improve the provision and delivery of climate information, particularly in developing countries. Improvement in the availability of and access to high quality observed climate data and climate scenarios, practical guidance for the use of climate information, and the systematic documentation and wide dissemination of good practices in applying climate information to support adaptation are all identified as priority areas of work. These clearly defined priorities, together with synergies among relevant initiatives, represent considerable opportunities to enhance the provision and delivery of climate information and services, particularly within the context of the development and implementation of the Global Framework for Climate Services (GFCS).

KEY WORDS: Climate information · Adaptation · Nairobi Work Programme

1. INTRODUCTION

Until recently, international discussions on climate change were dominated by the technical, technological, economic and policy aspects of mitigation. However, with the impacts of climate change on the natural environment and human society being more evident and, particularly, the ensuing losses and damages affecting the lives and livelihoods of many across the world, adaptation to climate change has been gaining attention. Along with mitigation, finance and technology, adaptation is one of the 4 pillars of a new international climate change architecture being negotiated under the United Nations Framework Convention on Climate Change (UNFCCC) since 2007 (UNFCCC 2008a). Recognizing the inertia within the climate and socio-economic systems and the current trend of global greenhouse gas emissions, policy makers from both the public and private sectors are engaged in discussions on integrating climate risk management into development policies and plans. By definition, adaptation is a highly complex and dynamic process: it involves a wide range of stakeholders, cuts across different administrative levels and time horizons, and entails decision-making under a cascade of uncertainties. The science community is facing the challenge of providing policy-relevant information and knowledge to inform the decision-making on adaptation to inevitable climate change impacts; this requires efficient partnerships and collaboration amongst all stakeholders (Adger et al. 2007).

The Nairobi Work Programme (NWP) on impacts, vulnerability and adaptation to climate change, under the Subsidiary Body for Scientific and Technological

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Advice (SBSTA) to the UNFCCC, aims to engage stakeholders, facilitate knowledge sharing and collaboration, and catalyze targeted action on adaptation (UNFCCC 2006). Under this work programme, significant progress has been made in fostering partnerships and collaboration to improve the provision and delivery of relevant information and knowledge products in support of climate change adaptation.

Within the context of international climate change policy and science processes, this paper reviews the increasing demand for climate data and information to support adaptation to climate change. It highlights the need for effective and sustained partnerships and collaboration amongst the providers and users. The NWP is introduced as a mechanism for engaging stakeholders and facilitating collaboration. To conclude, the paper outlines some of the potential opportunities for enhancing the provision and delivery of policy-relevant climate data and information that are emerging from the implementation of the NWP.

2. CHANGING DEMANDS FOR CLIMATE INFORMATION

As outlined in Table 1, there has been a progressive shift in the thematic focus of the international scientific process on climate change, mirrored by the assessment reports of the Intergovernmental Panel on Climate Change (IPCC) over the past 2 decades. It moved from the nature of climate variability and change, and its potential impacts with the First Assessment Report (FAR) in 1990, to the cost effectiveness of responses to climate change in 1995 with the Second Assessment Report (SAR) (IPCC 1995), equity and distributional issues related to the impacts of and responses to climate change in 2001 with the Third Assessment Report (TAR) (IPCC 2001), towards global sustainability as a guiding principle for policy responses to climate change in the Fourth Assessment Report (AR4) published in 2007 (IPCC 2007). This shift in focus of the scientific investigation on climate change has been partially a result of the enhanced understanding and knowledge in the scientific, socio-economic and technological aspects of climate change, and partially in response to the international policy discussions under the UNFCCC.

As summarized in Table 2, the co-evolution of the international climate change science (i.e. the IPCC) and policy (i.e. UNFCCC) processes can be described in 3 stages with progressively increased demand for climate information:

(1) The exploratory stage up to 1990. Early scientific efforts attempted to answer the questions 'Is climate changing?' and 'Does climate change matter?', and focused on the detection and attribution of variability and change observed in the climate system, and sensitivity of natural and socio-economic systems to key climatic variables. Research findings from these investigations provided important inputs to the formulation of the UNFCCC. At this stage, observational records for essential climate variables were used for the analyses.

(2) The scientifically active phase up to 2005. This period saw a rapid growth in the amount of scientific work on climate change. With early sensitivity analyses pointing to potentially significant impacts of climate change, the IPCC coordinated the development of greenhouse gas emissions scenarios, first the alternative IS92a–f scenarios in 1992 (IPCC 1994) and then the Special Report on Emissions Scenarios (SRES) in 2000 (IPCC 2000), to provide common inputs to climate model experiments. Projections of future climate conditions (scenarios) from these model simulations were used to assess the potential impacts of climate change on the natural environment and key socio-economic sectors. Research during this period was driven by the question of 'What are the potential impacts of unmanaged climate change?', as climate scenarios applied to these assessments were based on emission futures assuming no explicit mitigation or adaptation policies. A large body of literature was synthesized in the IPCC Second (IPCC 1995) and Third (IPCC 2001) Assessment Reports. Most impact assessments of projected climate change applied a top-down, scenario-driven approach. Observed data for a larger set of climate variables were used to construct a climate baseline, against which impacts of projected changes in these variables were assessed. In addition, scenarios for a wide range of climate variables were derived, in most cases, from global climate model experiments, and

Table 1. The evolving focus of the IPCC assessment reports

	First Assessment Report (IPCC 1990)	Second Assessment Report (IPCC 1995)	Third Assessment Report (IPCC 2001)	Fourth Assessment Report (IPCC 2007)
Continuing focus	Climate; Impacts	Climate; Impacts	Climate; Impacts; Cost-effectiveness	Climate; Impacts; Cost-effectiveness; Equity
New focus	–	Cost-effectiveness	Equity	Global sustainability
Emerging issue	Cost-effectiveness	–	Global sustainability	Risk management

Table 2. Evolving international climate change policy and science processes and changing demands for climate information. FAR, SAR, TAR: First, Second, Third Assessment Reports, respectively; SRES: Special Report on Emissions Scenarios; AR4, AR5: Fourth, Fifth Assessment Reports, respectively

Time-line	Decision question	IPCC	UNFCCC	Methodological approach	Requirement for climate information
~1990	Is climate changing? Does climate change matter?	FAR (1990)	UN General Assembly to draft a UNFCCC	Sensitivity analysis	Observational data to represent past and present climate
~2007	What are the potential impacts of unmanaged climate change?	IPCC IS92a–f scenarios (1992) IPCC SAR (1996) IPCC SRES (2000) IPCC TAR (2001)	UNFCCC entering into force (1994) Kyoto Protocol adopted (1997) Kyoto Protocol entering into force (2005)	Scenario-driven impact assessments	Observational data for constructing climate baseline Climate model-derived scenarios for a larger number of variables, at global and regional scales
2007 ~	How do we effectively manage climate change?	IPCC AR4 (2007)	BAP launched (2007) Copenhagen Accord (2009) COP16 (2010) Global long-term climate change agreement (2011?)	Risk management framework	Observational data for constructing climate baseline Model-derived scenarios for a larger number of variables Integration of climate scenarios with other scenario components, as well as scenarios at different geographic scales
		IPCC AR5 (2014)	Successor of Kyoto Protocol (?)		

provided inputs to process-based models, or other assessment tools, to estimate the impacts on a diverse range of sectors and systems. Key UNFCCC milestones during this period included the adoption in 1997 and entry into force in 2005 of the Kyoto Protocol (UNFCCC 1998).

(3) Heightened political interest since 2007. In the 2 years since the launch of the Bali Action Plan (UNFCCC 2008a) at the end of the 13th session of the Conference of the Parties to the UNFCCC (COP13), there has been a significant surge in political attention on climate change. This heightened political interest was notable at COP15 in Copenhagen in December 2009, attended by over 120 Heads of State and Government. Driven by increasing political interest and demand for policy-relevant information, research on climate change, as synthesized in IPCC AR4 (IPCC 2007), was directed towards addressing the question of 'How do we effectively manage climate change?' Departing from typical top-down, scenario-driven frameworks, climate change assessments took a more integrated approach and placed mitigation and adaptation within a risk management framework (IPCC 2007). Key findings from the AR4 have been the key scientific basis informing the international negotiations under the UNFCCC. To be policy relevant, climate change research is making a much greater demand for high quality observational climate data and climate scenario information that enable (1) assessments to be carried out at temporal and spatial scales relevant to adaptation and mitigation decisions, (2) changes in socioeconomic and technological conditions to be considered in the climate change decision process in an integrated and consistent fashion, and (3) adequate representation of a wide range of uncertainties, and robust decision-making.

Thus, climate information is required (1) at a diverse range of spatial and temporal scales, depending on the decision context, (2) as part of a wider set of integrated data and information including the characterisation of climatic and other environmental and socioeconomic conditions, and with probabilistic estimates attached.

In response to this need for the provision and dissemination of accurate and timely climate information products and services in support of climate risk management, Heads of State and Government, Ministers and Heads of Delegation at the World Climate Conference-3 decided to establish a Global Framework for Climate Services (GFCS) to enable better management of the risks of climate variability and change through development and incorporation of science-based climate information and prediction into planning, policy and practice. The GFCS was proposed to serve as a long-term cooperative arrangement through which the international community and relevant stakeholders will work together to achieve its stated goal. It will have 4 major components: (1) observation and monitoring, (2) research, modelling and prediction, (3) a climate information system, and (4) a user interface programme. An action plan with timelines for establishment and implementation of the components of the

GFCS is being developed by a high level taskforce which is to deliver its report in early 2011 (WMO Secretariat 2009).

3. KEY CHARACTERISTICS OF ADAPTATION TO CLIMATE CHANGE

In contrast to mitigation—where there is much more established knowledge on the design, implementation, monitoring and evaluation of processes, policies and actions—adaptation is a multifaceted process characterised by the following:

3.1. Multi-disciplinary

Adaptation is a knowledge intensive undertaking. A vast amount of knowledge and information is required to assess the sensitivity of ecological systems and socioeconomic activities to key climate variables under present day climate, and potential impacts of and vulnerability to projected climate change in the future; to identify and appraise possible adaptation options; and to evaluate the effectiveness of adaptation actions. From adaptation assessment to planning, implementation and evaluation, knowledge and expertise from biophysical, engineering, social and economics disciplines are needed to a varying extent. Adaptation is, therefore, a meeting place of scientists and experts from different disciplines to discuss key climate risks, weighing up the pros and cons of different adaptation options, and learning from each other's experiences and good practices in managing risks. Adaptation efforts cannot be effective, efficient or sustainable if they are carried out as a single sector engagement. Rather, policy-relevant assessments and informed adaptation decisions depend on meaningful and long-term partnerships and collaboration among different stakeholder groups representing a diverse range of insights, expertise, and experiences.

3.2. Multi-scale

Reflecting the wide-ranging impacts of climate change on the natural environment and human society, climate risk assessment and adaptation planning entail the consideration of multiple scales, both in space and in time. Adaptation assessment and planning must address issues and systems at a wide range of spatial scales: (1) the global-scale climate system, (2) regional-scale trans-boundary water basins, (3) national-scale production and social wellbeing systems, (4) local communities and (5) site-specific exposure units such as farms (Fig. 1 top panel). Similarly, adaptation planning needs to consider a wide variety of time horizons (Fig. 1 bottom panel): (1) seasons to several years for farm activities and provision of health services, (2) decadal-scale tourism and protected area development, and (3) infrastructure projects ranging from a few decades to over a century. Therefore, there

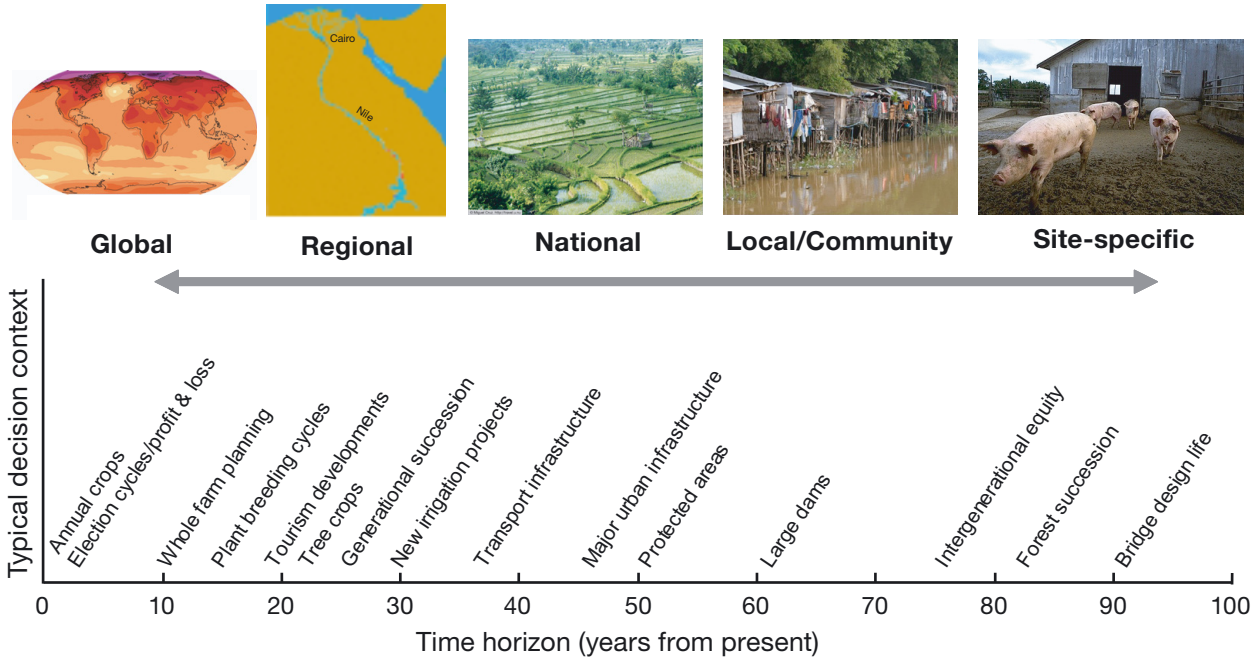

Fig. 1. A selection of spatial scales (top) and time horizons (bottom) to be considered in climate risk assessments and adaptation planning

is no one-size-fits-all answer to adaptation. The accumulation and application of information and knowledge to support adaptation are necessarily dependent on partnerships and collaboration among partners working at the different scales.

3.3. Multi-dimensional

In addition to the multitude of technical disciplines and scales that adaptation needs to consider, the process of adaptation is also multi-dimensional. To be effective and sustainable, adaptation to climate change needs to be integrated into ongoing planning processes (Fig. 2), horizontally across different climate sensitive sectors (e.g. agriculture, energy, tourism, public health), and vertically across different administrative levels (e.g. local, national, global). Further, adaptation initiatives need to build on and exploit synergies with relevant ongoing processes and programmes in different sectors and at different administrative levels, for example, disaster risk reduction initiatives, national poverty reduction strategy papers, various national processes under the UNFCCC such as the National Communications and National Adaptation Programmes of Action (NAPAs). Existing institutions, expertise and experiences from these ongoing processes and relevant communities of practice can make significant contributions to enhancing the knowledge base as well as informing the decision-making for adaptation.

3.4. Decision-making under uncertainties

There is a cascade of uncertainties (Fig. 3): e.g. future trends in global economy, demography, technology and agricultural practices are all highly uncertain. Hence, projections of global greenhouse gas emissions and their atmospheric concentrations vary widely; this leads to a wider variation in projections of climate system responses at a global scale, which when compounded with an imperfect understanding of natural and socioeconomic systems, results in an even wider range of likely impacts and possible adaptive responses at regional and local scales. Given the fact that there is a certain degree of inherent unpredictability in natural and socioeconomic systems, uncertainty will be a standard feature in adaptation decision-making. Within this context, partnerships and collaboration can help determine the relative significance of different sources of uncertainty to ensure decisions are informed by the best available information and robust to a range of likely future conditions.

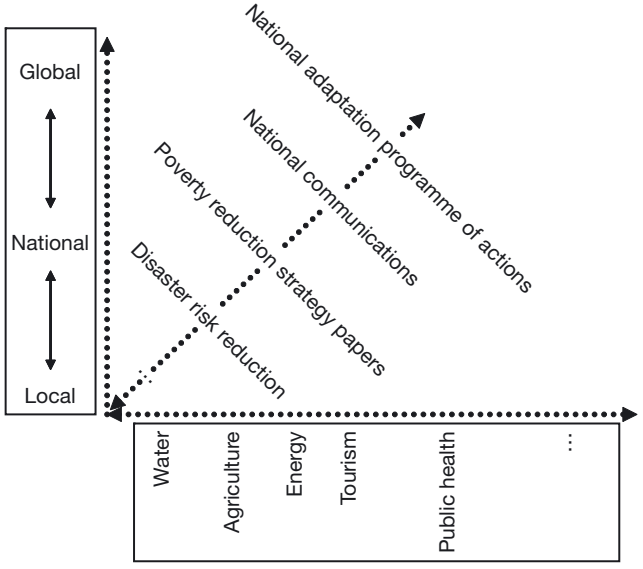

Fig. 2. Integration of adaptation into ongoing planning and other relevant processes

4. PARTNERSHIPS AND COLLABORATION FOR THE PROVISION OF CLIMATE INFORMATION

To date, understanding the process and economics of—and of barriers and limits to—adaptation to climate change is at an early stage. Particularly, there has been limited empirical knowledge to guide the design, implementation, and evaluation of adaptation actions. A knowledge base will need to be built upon the documentation and dissemination of practical adaptation experiences, partnerships, and collaboration between different stakeholder groups across sectoral and geographical boundaries.

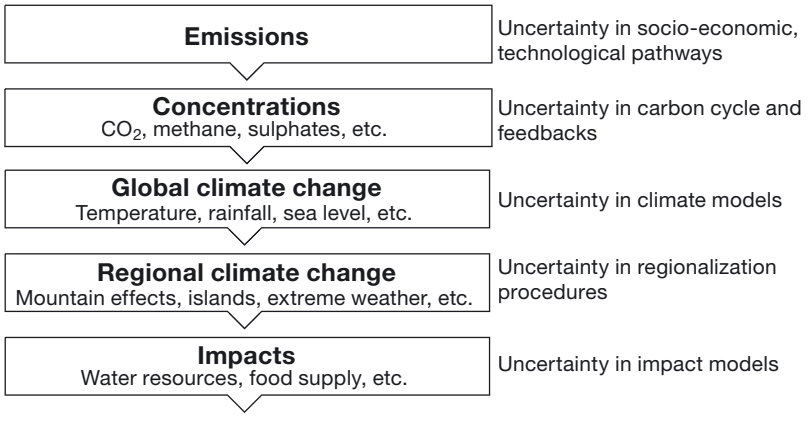

Fig. 3. Cascade of uncertainties associated with regional level impacts of climate change (source: modified from Jones et al. 2004)

Partnerships and collaboration among relevant stakeholder groups is critical to the efficient and effective provision, delivery and application of climate change information. As illustrated in Fig. 4 on the providers side, National Hydro-Meteorological Services (NHMSs) and associated national and regional agencies are typically responsible for collecting, archiving, processing and analyzing data on key meteorological and hydrological variables. Depending on the demand and financial support received, they may also provide sector-based tailored weather products, such as drought forecasts and pollution indices. But there have been limited interactions and collaboration between the NHMSs and line ministries, as well as the private sector in most countries. This is partially due to the traditional divide between governmental agencies, and partially due to a lack of human and financial resources, which in turn could be explained as a result of insufficient recognition of the importance of climate information services and products to the social and economic development of the wider society. However, with growing public awareness and political momentum, climate information (including observational data and projections) is increasingly considered as a vital basis for climate risk assessment and adaptation planning. Particularly, natural resource managers, development practitioners and business leaders are increasingly engaged in integrating adaptation to climate change impacts into routine resource management, development planning and business investment decisions.

As shown in Fig. 5, climate adaptation policy frameworks may differ in technical details and decision contexts; assessment of system sensitivity to climate variables and potential impacts on and vulnerability of systems and socioeconomic activities form the basis for decisions on possible adaptation policies and actions. Baseline as well as projected data on key climatic variables is essential to perform such assessments. Depending on the adaptation decision context, the exact requirement for climate data and information varies widely. As discussed in Lu (2009), the provision of climate information needs to be informed by the adaptation decision context. Therefore, the engagement of climate data end-users in the development and deployment of climate data services and products becomes critical.

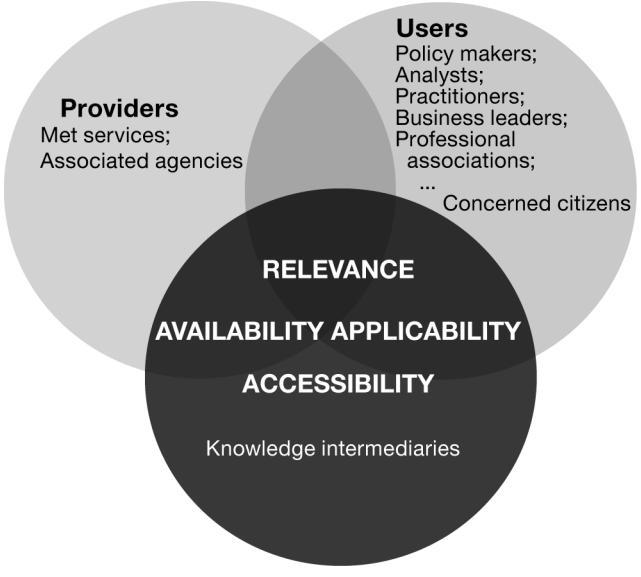

Fig. 4. Key interactions between providers and users of climate information and services

Given the wide range of time horizons (from the next season for estimating the balance of food supply and demand, to several decades or longer for the design of major infrastructure), spatial scales (from regional efforts to manage trans-boundary natural resources, to onsite farm management), and the exposure units (from trans-national business operations, to local community livelihoods) involved in adaptation decisions, there is a need for knowledge intermediaries or knowledge brokers to work at the interface between the providers, producers and end-users of climate information services and products. As shown in Fig. 4, these intermediary entities can help provide essential inputs on the needs of end-users to data producers by working with NHMSs and research institutes (e.g. climate modelling centres), and decision makers of the public and private sectors, as well as community leaders. Data also need to include the format (e.g. numbers versus maps), medium (e.g. paper-based versus audio material) and language that is most appropriate to the targeted end-users. Similarly, these knowledge brokers could also help 'translate' the sometimes technical data and information into a more accessible format and language so that it is more readily understood by end-users.

In summary, to ensure the relevance, availability, accessibility and applicability of climate observational and projection data in support of climate change adaptation efforts, there is a clear need for partnerships and collaboration among providers, end-users and knowledge intermediary entities. As discussed in the next section, the NWP has been effective in facilitating such partnerships and collaboration among the diverse adaptation stakeholder groups.

5. EARLY LESSONS FROM THE NWP

The UNFCCC, through its SBSTA, launched the NWP[1] at COP11 in 2005 (UNFCCC 2006). This section

[1]Details available at: www.unfccc.int/nwp (Accessed 5 September 2010)

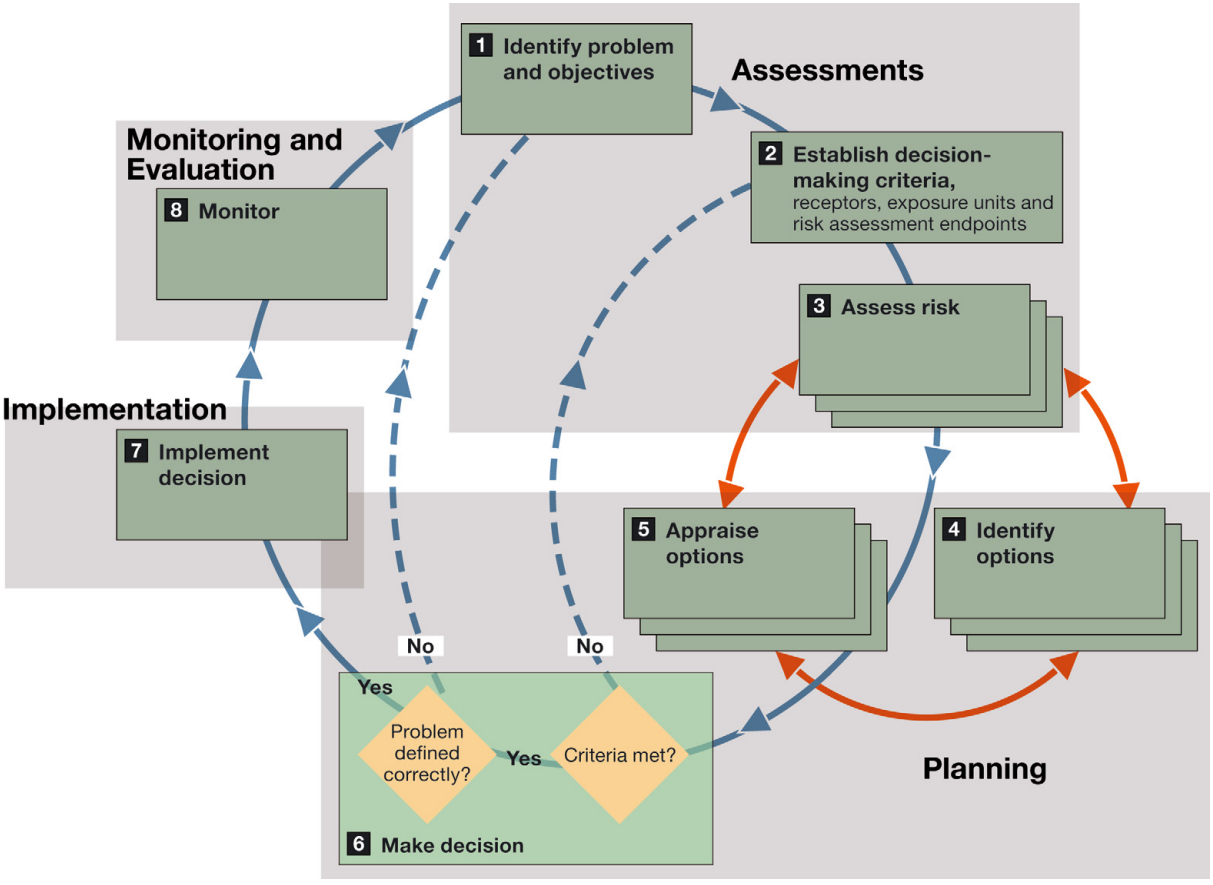

Fig. 5. Example of an adaptation policy framework within which assessment of system sensitivities, impacts and vulnerability represents a key element (Willows & Connell 2003)

provides an overview of the work programme, discusses the modalities for implementation, and summarizes some early lessons learned and good practices with relation to the provision of climate data and information from the implementation of the NWP.

5.1. Objectives and thematic areas

As shown in Fig. 6, the objective of the NWP is to assist all Parties, particularly developing countries, Least Developed Countries (LDCs) and Small Island Developing States (SIDS) to improve their understanding and assessment of impacts, vulnerability and adaptation, and make informed decisions on practical adaptation actions and measures to respond to climate change on a sound scientific, technical and socio-economic basis, taking into account current and future climate change and variability.

The NWP comprises 2 themes: impacts and vulnerability, and adaptation planning, measures and actions. In addition, 9 action-oriented work areas were identified to further guide the implementation of the work programme: (1) methods and tools, (2) data and observations, (3) climate modelling, scenarios and downscaling, (4) climate-related risks and extreme events, (5) socioeconomic information, (6) adaptation planning and practices, (7) research, (8) technologies for adaptation, and (9) economic diversification (UNFCCC 2006). Therefore, 3 (numbers 2, 3 & 4) out of these 9 work areas are directly linked to the provision and application of climate information products and services.

5.2. Modalities of implementation

Implementation of the NWP is guided by the Chair of the SBSTA, facilitated by the UNFCCC secretariat, with participation and contributions from all Parties, a diverse range of organisations including private sector entities, and experts undertaking work on adaptation. Modalities for implementation include: (1) organisation of technical workshops, expert and informal meetings, focal point forums, (2) elicitation of views and information on specific issues from Parties and organisations, (3) preparation of technical and synthesis

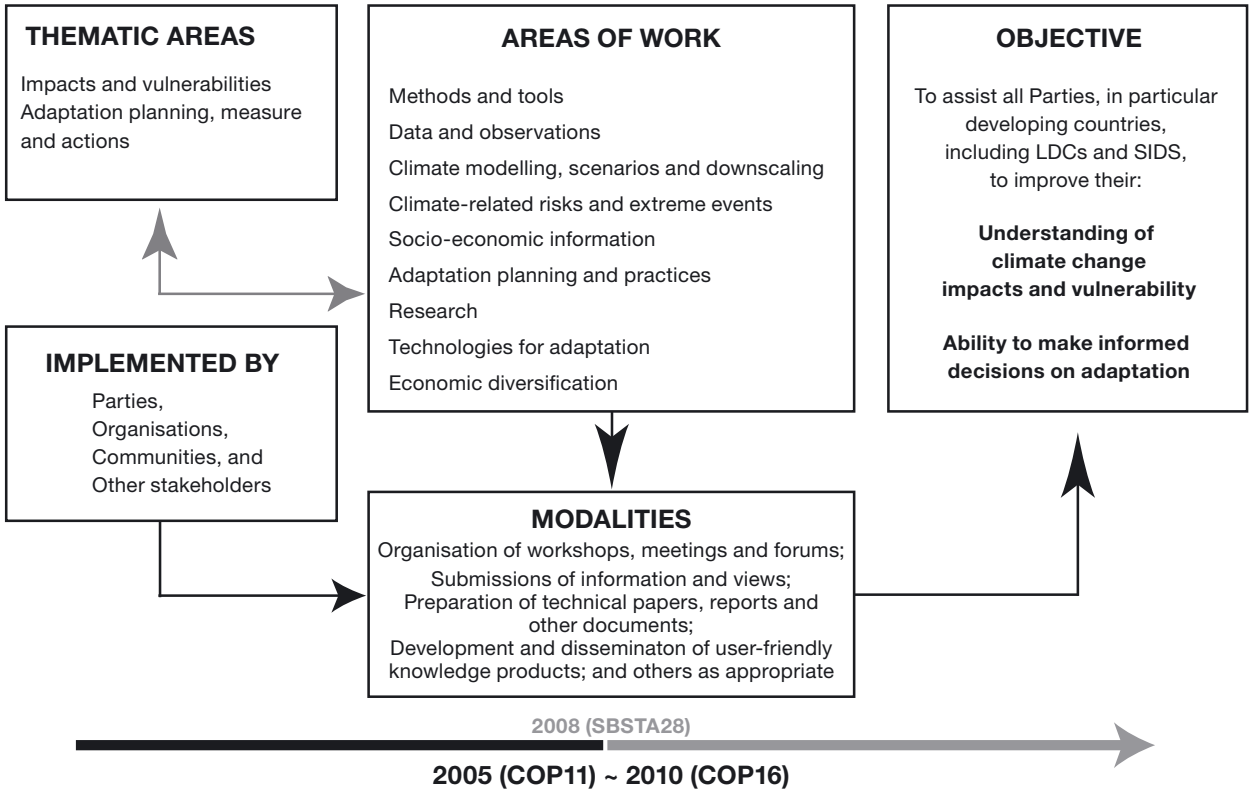

Fig. 6. Overview of the Nairobi Work Programme (NWP) on impacts, vulnerability and adaptation to climate change. LDC: Least Developed Countries, SIDS: Small Island Developing States

papers, meeting reports and other relevant documents, and (4) the development and dissemination of user-friendly publications and knowledge products.

Through the participation in mandated NWP activities, Parties and organisations identify needs and gaps in the 9 work areas, and propose priorities for further action to address these gaps. Such information and knowledge are captured in Calls for Action under the NWP, providing a clear indication of 'demands' for resources and action. In response to Calls for Action, organisations make Action Pledges based on relevant ongoing and planned activities and programmes. Partners with Action Pledges also provide, primarily through the UNFCCC secretariat, updates on the implementation of their pledges. This constitutes a significant part of the 'supply' side of adaptation actions and measures under the NWP (Fig. 7).

As of July 2010, the NWP has engaged 189 partners representing intergovernmental bodies, UN agencies, academic institutions, grassroot organisations, and the private sector (Fig. 8). A significant number of partners are engaged in activities directly or indirectly related to the 3 work areas focusing on climate information products and services. Seven technical workshops and 4 expert meetings were held under various work areas of the NWP. Parties and organisations made 14 rounds of submissions of views and

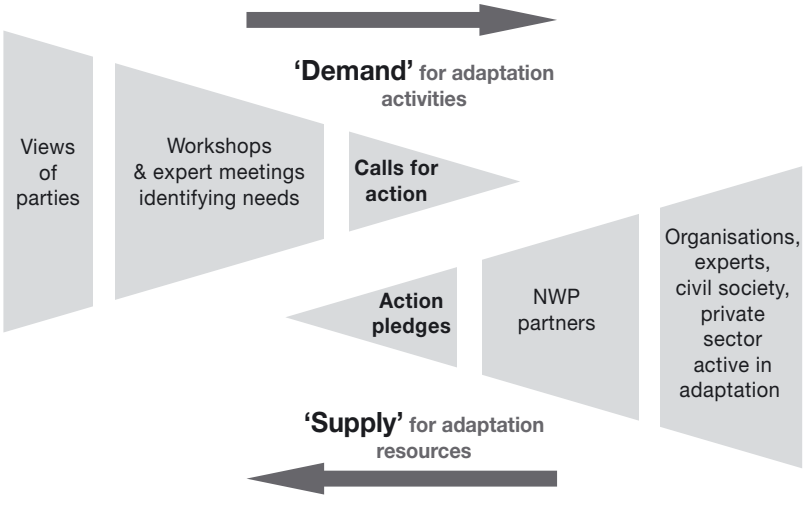

Fig. 7. 'Calls for Action' and 'Action Pledges' as key instruments for NWP to facilitate knowledge sharing and catalyze targeted actions

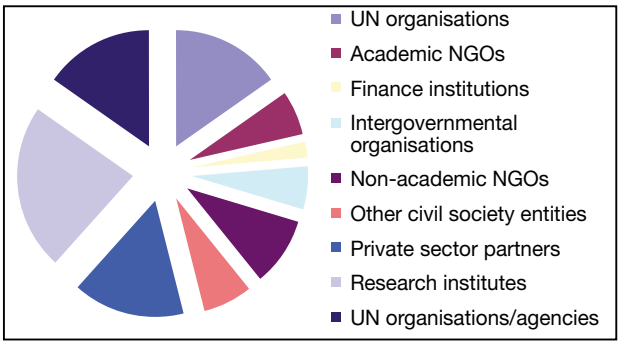

Fig. 8. The diverse range of partners engaged in the implementation of the NWP. Wedges represent the % share of each type of partner to the total number of partners, and overall show the relatively well-balanced mixture of partners under the NWP. NGOs: non-governmental organisations

information on a wide array of subjects. Based on discussions at workshops and meetings, and submissions, 9 Calls for Action were issued, and a large number of technical and synthesis reports prepared. In response to the Calls for Action, 104 Action Pledges were made by 47 organisations. As shown in Fig. 9, the combined number of Action Pledges under the 3 climate information related work areas (i.e. D+O = data and observations, MSD = models, scenarios and downscaling, and CRR+EE = climate-related risks and extreme events) represent a notable portion of the actions pledged by NWP partners. In addition, partner organisations, guided by the Chair of the SBSTA and facilitated by the UNFCCC secretariat, published a synthesis of results achieved, good practices and lessons learned from implementing Action Pledges (UNFCCC 2009a). Five organisations contributed to a chapter of this synthesis on the provision of climate data and information.

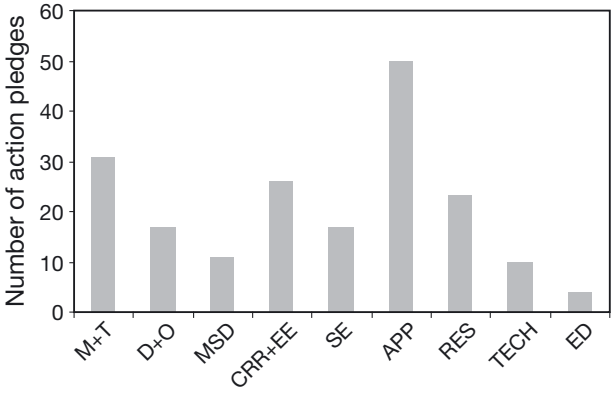

Fig. 9. Distribution of action pledges across the 9 NWP work areas. M+T = methods and tools, D+O = data and observations, MSD = climate modelling, scenarios and downscaling, CRR+EE = climate-related risks and extreme events, SE = socio-economic information, APP = adaptation planning and practices, RES = research, TECH = technologies for adaptation, ED = economic diversification

The current mandate period for the NWP runs between 2005 and 2010. The effectiveness of the implementation of the work programme will be considered by the SBSTA at its 33rd session from 29 November to 10 December 2010. Based on the outcome of the consideration, Parties to the UNFCCC will decide whether or not to extend or expand the mandates of the NWP.

5.3. Key messages, lessons learned and good practices

The implementation of the NWP has generated a wealth of knowledge which will provide valuable support to advance the adaptation agenda in different thematic areas and at different decision levels. With relation to the provision and delivery of climate information products and services, a set of key messages, lessons learned, and good practices have emerged from implementing mandated NWP activities as well as Action Pledges by its partner organisations.

Climate information is fundamental to the understanding of climate risks and planning for adaptation. There is an urgent need to improve the provision and delivery of climate information, particularly in developing countries. As illustrated in Fig. 5 and discussed in the previous sections, effective adaptation requires climate information, including both observational records for defining baselines as well as scenario data for characterising future climate conditions, to assess climate risks and to plan for adaptation interventions. Depending on the adaptation decision context, the requirements for climate information vary widely (Lu 2009). Over the past 15 years or so, significant progress has been made to enhance the provision of climate data and information. For example, the IPCC Task Group on Data and Scenario Support for Impact and Climate Analysis (TGICA) was established to, among other things, facilitate the timely distribution of a consistent set of up-to-date scenarios of changes in climate[2]. However, there is a major gap in the provision of climate data and information at the appropriate scale for policy-relevant analysis and decision-making. Throughout the discussions at the various NWP forums, the lack of appropriate climate data and information has been most frequently cited as a barrier to advancing adaptation work in most developing countries (UNFCCC 2008b, UNFCCC 2008c, UNFCCC 2009b, UNFCCC 2010). Specific issues identified are related to (1) availability of and access to high quality observational data to undertake sensitivity analyses, identify local climate trends and critical climatic thresholds for systems and activities, to calibrate and validate cli-

[2]Details available at: www.ipcc-data.org (Accessed 5 September 2010)

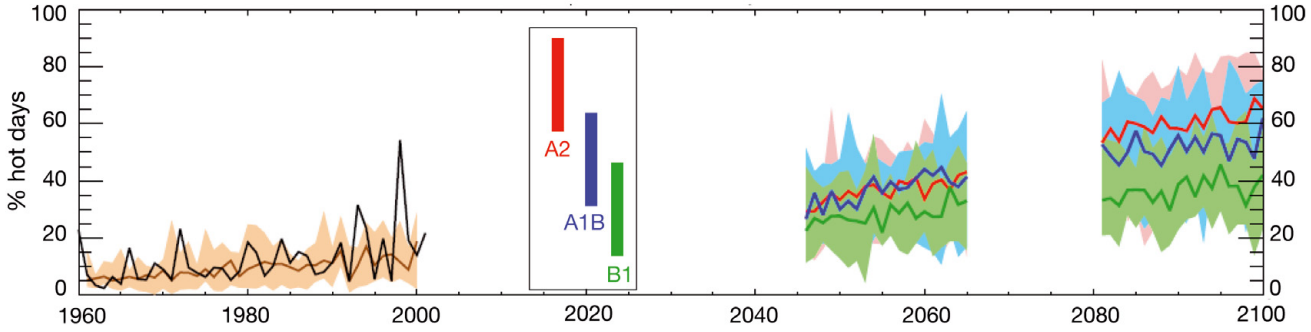

Fig. 10. Example of practical climate scenario information for risk assessment and adaptation planning. Shown here is the percentage of 'hot' days during the January–March period in the recent past as well as in the future, as simulated by climate models. For further information, see: http://country-profiles.geog.ox.ac.uk/UNDP_reports/Ethiopia/Ethiopia.lowres.report.pdf (p. 14, Accessed 11 February 2011)

mate and impact assessment models, (2) availability and scales of and access to climate scenario information required to undertake robust and policy-relevant impacts, vulnerability and adaptation assessments, (3) practical guidance on how to access, interpret and apply climate data and information, and (4) availability of and access to practical examples and good practices for the application of climate information to climate risk assessments and adaptation planning.

In response to these priorities, a growing number of national (e.g. discussions under the WMO to develop National Climate Services), bilateral (e.g. UK working with many developing countries to use Providing Regional Climates for Impacts Studies (PRECIS) regional climate model to generate regional climate scenarios) and multilateral (e.g. the United Nations Development Programme [UNDP] country level climate profiles and more details on this in next section) initiatives have been launched to address some of the climate information gaps. However, the large scale and diversity of demands call for enhanced efforts to improve the provision of climate information.

Relevance and practicality, rather than level of complexity, of climate information is key to its applicability. Lu (2009) discussed the diverse range of climate information required for different types of adaptation activities at different spatial and temporal scales. Parties and NWP partner organisations also repeatedly highlighted that the provision and delivery of climate information need to be demand-driven and tailored to the specific context within which they are to be applied. In particular, discussions under the NWP underlined the importance of considering what is really needed as opposed to what is wanted. As underscored by participants at NWP technical workshops (UNFCCC 2009b, UNFCCC 2010), it is important to include such participatory needs assessment in programme or project design phase to ensure that any data provision exercise is guided by the needs of users. Climate data and information need to be practical for targeted users. Given the diverse range of potential users of climate information, it is essential that the targeted users can interpret and apply the data and information provided for them. This may require, in some cases, additional analyses and extra effort to present the information in a format that is practical for end-users. For example, standard climate model outputs may not always be helpful for user groups who are concerned with human health implications of changes in hot summer days or demand for space cooling during summer months. In this case, climate scenarios supplied in terms of percentage of hot days would be more useful than projections of average temperatures (Fig. 10).

Technical documentation on the background, appropriate interpretation and application of climate information is as important as the information itself. Climate data and information need to be not only relevant and practical, but also adequately documented. Underlying datasets used, analytical methods applied, caveats and potential applications of data and information provided, are all important to enable the informed selection, appropriate interpretation and application of climate data. For example, UNDP undertook to create climate profiles, including both observed trends and model-based projections into the future, for 52 countries (McSweeney et al. 2010). In addition to the actual data and information, presented in both numerical and graphic formats, a detailed documentation was also prepared to guide potential users.

6. EMERGING OPPORTUNITIES

Ongoing policy discussions and the implementation of initiatives, including the NWP, point to a range of opportunities that could facilitate the further development and application of climate information in support of enhanced adaptation actions. These opportunities include:

6.1. Well defined priorities

Through the diverse range of deliberations under the NWP, Parties and partner organisations identified a set of priority areas where further actions are required to enhance the provision and delivery of climate information and services (UNFCCC 2008b, UNFCCC 2008c, UNFCCC 2010): (1) systematic observations, data archiving and rescuing, (2) provision of and access to climate scenarios at the appropriate scales, (3) dialogue between the providers and users of climate datasets and scenario information, (4) provision of technical guidance on the application of climate data and scenarios products, and (5) technical capacity building and training of in-country experts.

With these clearly defined priorities, ongoing and planned programmes and initiatives can strategically align the design and planning of the efforts to address the gaps and needs identified by countries.

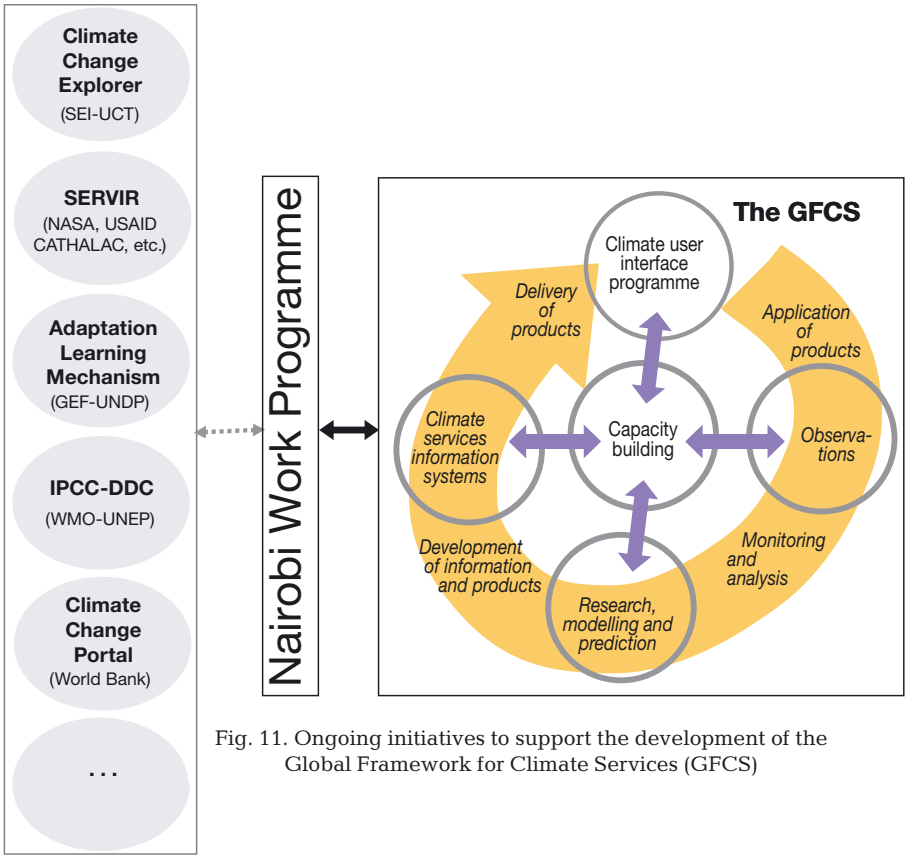

Fig. 11. Ongoing initiatives to support the development of the Global Framework for Climate Services (GFCS)

6.2. Synergistic initiatives

Discussions on the support for adaptation to climate change, including those under the NWP, have highlighted the need for enhanced co-ordination and collaboration amongst relevant partners to promote synergies and to avoid duplication of efforts. In the area of developing, disseminating and applying climate information and products, there are a growing number of initiatives by different entities. To name a few: (1) the IPCC Data Distribution Centre, focusing on the dissemination of up-to-date outputs from climate model experiments, with global coverage at native climate model resolution; (2) the World Bank Climate Change Portal[3], providing quick and readily accessible climate and climate-related data, global coverage and downscaled to provide 'point' level estimates; (3) the Climate Change Explorer[4], by the Stockholm Environment Institute (SEI) at Oxford and at the University of Cape Town, displays outputs from multiple climate models, downscaled to a station level for Africa and Asia with plans to extend to Latin America; (4) SERVIR ('to serve' in Spanish) a joint initiative of the US National Aeronautics and Space Administration (NASA), US Agency for International Development (USAID) and the Water Center for the Humid Tropics of Latin America and the Caribbean (CATHALAC) and other partners—a regional visualization and monitoring system that integrates earth observations (e.g. satellite imagery) and forecast models together with *in situ* data and knowledge for timely decision-making, currently with data for Latin and Central America and in development for East Africa; (5) Adaptation Learning Mechanism[5] of the Global Environment Facility (GEF) and UNDP, hosting country-level climate data relevant for adaptation project design and risk screening.

As illustrated in Fig. 11, these initiatives are directly or indirectly included in the Action Pledges under the NWP by its partner organisations. Therefore, information sharing and discussions on the complementarities of, and possible synergies and collaborations among these initiatives can be facilitated under the NWP. Indeed, knowledge sharing and learning facilitated and actions catalyzed by the NWP can provide im-

[3]Details available at http://sdwebx.worldbank.org/climateportal/ (Accessed 5 September 2010)

[4]Details available at http://www.weadapt.org/wiki/The_Climate_Change_Explorer_Tool (Accessed 11 February 2011)

[5]Details available at: www.adaptationlearning.net (Accessed 5 September 2010)

portant support to the development and subsequent implementation of the Global Framework for Climate Services (GFCS), mandated by the World Climate Conference 3 (WCC-3).

Acknowledgements. The views expressed herein are those of the author and do not necessarily reflect the views of the United Nations

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Submitted: May 4, 2010; Accepted: October 18, 2010

Proofs received from author(s): February 11, 2011