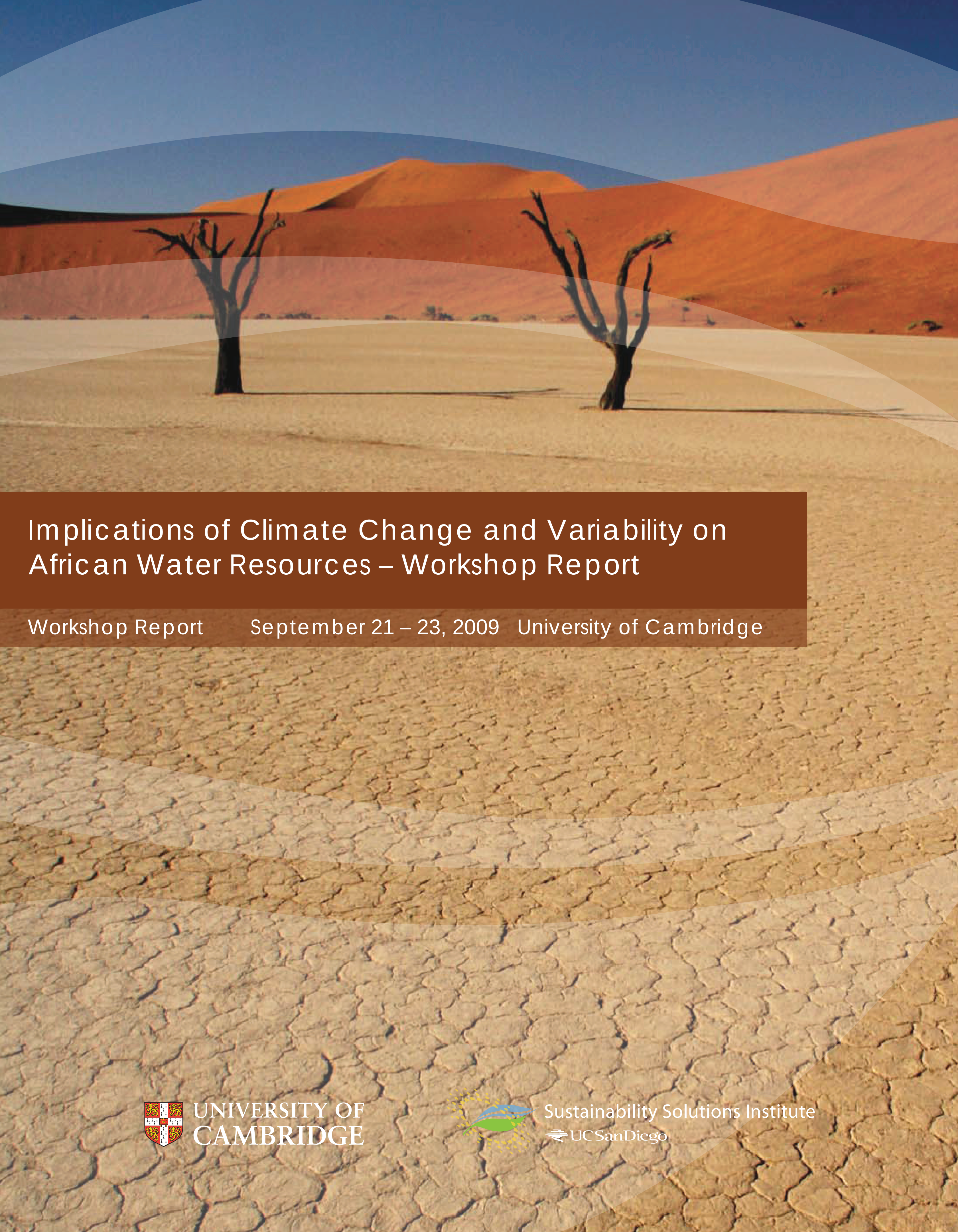

# Implications of Climate Change and Variability on African Water Resources – Workshop Report

Workshop Report September 21 – 23, 2009 University of Cambridge

UNIVERSITY OF CAMBRIDGE

Sustainability Solutions Institute
UC San Diego

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# Executive Summary

With support from the Gordon and Betty Moore Foundation, the University of California, San Diego (UCSD) and the University of Cambridge have developed a partnership relating to the science, technology, and policy of environment and sustainability. The partnership's first project, the Cambridge-UC San Diego Global Water Initiative (GWI), is intended to help stimulate adaptation to the impacts of climate change on water availability.

The University of Cambridge, in collaboration with UC San Diego, convened a workshop from September 21 – 23, 2009, at the Cambridge University campus where more than one hundred multidisciplinary experts from Africa and around the globe met to discuss the impacts of climate change on water resources in regions across the African continent.

Workshop experts represented regional institutions including the Drought Monitoring Centre in the South African Development Community, the University of Ghana Legon, and national African meteorological (met) offices. The keynote speaker for the workshop was Ms. Hanny Sherry Ayittey, Honourable Minister for Environment of Science and Technology from the Government of Ghana.

### The three-day workshop brought together these experts in order to:

- Understand the impacts of local climate change and climate variability across the world, with a particular emphasis on water resources in African regions;
- Identify research, technology, and climate data management needs for integrated policies for sustainable development;
- Improve connections and develop partnerships to promote regional climate initiatives and exchange of climate data, best practices, policies, and technologies for adaptation with the involvement of local policy makers and communities.

This workshop was devoted to an assessment of variability and predictability of climate change in Africa, including connections between regional climate data and modelling of extreme events; the impacts of climate change and variability on water resources and subsequent effects on ecosystems, agriculture, health and resource supply chains; and the impacts on society from changing climate and water availability. Participants also discussed applying new sources of data and data management practices to link climate change to societal impacts and policy solutions; and the role of the private sector, NGOs, and information and data networks in current decision-making processes and future developments.

Breakout groups placed particular emphasis on practical and systemic obstacles to information exchange and open knowledge transfer in linking climate research with policy and decision making for adaptation in Africa while enhancing existing systems for achieving integrated responses to climate change impacts by applying new sources of data and data management.

The third day of the workshop was devoted to drawing conclusions. African and international colleagues stayed for a series of focused meetings after the workshop to determine next steps for climate change adaptation in Africa based on the results of the workshop.

### Conclusions from at the workshop include:

- Climate change adaptation in Africa must be linked with the broader human rights and development agendas;
- Knowledge Action Networks for dynamic adaptation to climate change and climate variability are necessary to facilitate communication and action between physical and social scientists, policy makers, and the communities

of practice in regions that will be hardest hit by climate change. They must make the right environmental and social data available at the right place at the right time to constructively engage decisions makers at the smallest scales;

- For regional adaptation to be successful, attention must be focused on capacity building to train African scientists on African problems in Africa, with appropriate support from international organizations;

Workshop leaders presented these findings at the 2009 Forum on Science and Technology in Society in Kyoto, Japan, in October 2009, along with findings from an earlier GWI workshop held at UCSD in May 2009 on climate impacts on glaciers in the Himalayas. The University of Cambridge and UCSD will continue facilitating the discussion of the global water crisis with the long-term goals of creating effective Knowledge Action Networks through developing partnerships, sharing best practices, promoting common monitoring and assessment standards, and expanding regional capacity to adapt to the impacts of climate change.

## ■ Workshop Declaration

Global scientists call for a new approach to climate change adaptation that focuses on region-specific predictions and impacts. While climate change mitigation efforts focus on the global level, regional climate initiatives (Knowledge Action Networks) are emerging to offer new technical, policy, and social adaptation mechanisms to the impacts of climate change – many of those impacts are already apparent in sub-Saharan Africa and elsewhere. Global temperatures over land are still rising, and quite rapidly in the worst affected and most vulnerable areas of the globe – including Africa. According to the UK Met Office, global average temperatures are now rising again and, according to model predictions, could see a 4°C average rise by 2090, while western and southern Africa could experience warming up to 10oC as well as drying (Betts, 2009). Global carbon emissions will also continue to rise for the foreseeable future. The Workshop noted that Chinese General Secretary Hu Jintao's September, 2009 statement on decreasing Chinese emissions intensity without pledging to decrease total emissions (Jintao, 2009) as an example of the economic and political realities facing climate change mitigation.

Over the past 50 years, Africa alone has recorded increasingly more droughts and greater stress on its water supply systems as a result of the interaction of climate change impacts with development, population growth, and other factors. Climate change induced warming in the Indian Ocean, resulting in drought in East Africa, has decreased per capita agricultural capacity and led to dramatic increases in food insecurity in Eastern Africa (Funk, 2009). According to the Ghana NGO Forum, in the last 30 years Ghana has seen its average temperature increase by 1oC, annual rainfall decrease by 20 percent and sea level rise by 2.1 mm per year (Asiedu, 2009). The increase in temperature has caused droughts and diseases such as spinal meningitis in northern Ghana.

For Africa, climate change and water availability, water quality, limitation of water hazards, and preservation of wetlands are not long-term scientific or technical issues as the West sees them, but basic human rights that are closely linked with poverty alleviation and human development right now. The increasing prevalence of droughts has given rise to food insecurity and forced urbanisation in East and South Africa, and has major implications for social and governance structures, water resources, and food supply, especially at the boundary between urban and rural areas. Networks of scientists, policy makers, and the communities of practice must take coordinated action at the regional and local level on what is now a series of urgent and interconnected problems in Africa.

Addressing these impacts is complicated by the relative lack of data collection, standardisation, and availability in Africa. For their 4th assessment report, the Intergovernmental Panel on Climate Change (IPCC) was able to use only seven data sets for all of Africa that met IPCC criteria for admission to its regional climate change impact report, as compared to

over 28,000 data sets for Europe (IPCC, 2007). Aided by regional and global networks that link scientists with practitioners to exchange data and best practices, Knowledge Action Networks are best placed to identify points of influence in the scientific – policy system where there is the greatest opportunity for improvements in responses to climate change and variability.

These Knowledge Action Networks must be supported locally – so support for existing initiatives must be improved, or new initiatives must be put into place that stop the brain drain of scientific personnel, expertise, and data from Africa. Scientists come and work in Africa, but it is essential for them to leave their results and methods there. For regional adaptation to be successful, attention must be focused on capacity building to train African scientists on African problems in Africa, with appropriate support from international organizations.

For well-managed adaptations, farmers and communities must monitor their local environment and have two-way data and knowledge exchange with the scientific community, governments, and regional agencies, especially where change is very rapid and severe. Likewise, scientists and decision makers must form new regional links to better translate scientific findings to support rapid action by policy makers.

There is a need to place actionable data in the hands of those who desperately need it, to get the right information to the right place at the right time and to urgently examine the scope for scaling up Web 2.0 to reach those regions currently un-served and most impacted by climate change. During the workshop, African colleagues learned where to find essential data on the internet, and that colleagues now have the capability to develop locally tailored internet products to help farmers and decision makers communicate with feedback – perhaps the first African application of Web 2.0.

There are many instances in Africa of habits and approaches which inhibit the availability, and thus the use, of information about behaviour of the water system and associated meteorological system. These may have evolved for multiple reasons – from a policy of seeking to derive profit from the information, or protective tendencies, or a failure to recognise the utility of making this sort of information widely available. However, participants stressed that building development and adaptation capacity will often require much wider availability and openness of this sort of information. Further, an informed community can, if appropriately supported and encouraged, provide vital information to assist in building scientific predictions which will be important in making development and adaptation decisions at all levels of government. Governments that work to free up and make available this sort of information should achieve greater capacity to build economic development and adaptive resilience for their communities. Funding for such policies to support local adaptation efforts will be an essential next step after the COP15 negotiations at Copenhagen.

### We recommend that:

- Climate change adaptation in Africa must be linked with the broader human rights and development agendas;
- Knowledge Action Networks for dynamic adaptation to climate change and climate variability are necessary to facilitate communication and action between physical and social scientists, policy makers, and the communities of practice in regions that will be hardest hit by climate change. They must make the right environmental and social data available at the right place at the right time to constructively engage decisions makers at the smallest scales;
- For regional adaptation to be successful, attention must be focused on capacity building to train African scientists on African problems in Africa, with appropriate support from international organizations.

# African Regional Climate Change

## Climate Drivers

Global climate change, the Pacific Decadal Oscillation, the Atlantic Meridional Oscillation, and the Pacific Gyre Oscillation describe 78% of the variance of the variability of global climate on the decadal time scale and of Africa in particular (Baines, 2009). Understanding of each of them is incomplete, but the nature of decadal climate variability may be advanced by studying them individually as separate entities. The most important pattern for Africa is the Atlantic Meridional Oscillation, which may cause long-term changes within a few years (Baines, 2009).
Tropical Africa is also the world's largest source of atmospheric dust. Both the fine aerosols and dust play a major role in radiative forcing and in cloud microphysics, and are thus important parts of the West African Monsoon (WAM) and the Indian monsoon (Ghosh, 2009). Thus, increased drought and biomass burning in Africa may lead to a self-reinforcing weakening of the WAM. Because of the strong coupling between land surface, sea surface, and atmosphere interactions in West Africa, there is a potential for abrupt climate change – especially if the WAM shifts out of the Sahel (Cook, 2009). Understanding of such fundamental processes of regional climate change and variation is incomplete and needs to be improved in order to predict such abrupt change.

Key drivers of eastern African climate variability are the El Nino Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) phenomena. The warming Pacific Ocean, as well as increased precipitation in the Indian Ocean, have been linked to drought in east Africa (Funk, 2009). However, the development of east African regional climate models (such as PRECIS and REMO) is hampered by the lack of input data (Marchant, 2009). In Madagascar, the local perception is that overall rainfall is decreasing, with a later arrival of first rains and a shorter season overall. This is combined with an increase in the frequency of extreme events (Ratsirarson, 2009).

In southern Africa, climate change is expected to make wet areas wetter and dry areas dryer, while increasing the frequency of extreme weather. ENSO is a key driver behind variability in this region. The impacts of previous El Nino and La Nina events on the Southern African Development Community (SADC) foretell some of the probable effects from climate change: crop and livestock failures due to floods and droughts, failure of hydropower systems, and increases in disease. Sub-tropical regions could see as much as a 30% reduction in rainfall by 2100 (Garanganga, 2009). In addition, flow changes, sea level rise, and increased storm wave action are expected to increase erosion and salt intrusion into coastal farmlands and fisheries (Stretch, 2009).

## Comprehensive Effects on Water Resources

Increased climate variability has a multiplicative effect on already-stressed systems due to increasing population, urbanization and more intensive land use. In total, these factors interact to create enormous challenges for water resource management, including supply, storage, treatment, and distribution. Africa's overdependence on natural resources and its weak adaptive capacity make it highly vulnerable to the adverse impacts of climate variability and change.
As a result, the rate of environmental decline continues at a greater rate than our current ability to mitigate in Africa generally. There is often a significant delay between the evidence of environmental degradation and the implementation of related programming. This is exacerbated, for example, by the complex interactions of herders, farmers and wildlife in a changing environment. Land fragmentation also accentuates climate vulnerability because it impedes the formation of integrated adaptation solutions. Several factors now combine to threaten the viability of wildlife and pastoral herds: sedentarization, cultivation, irrigation, loss of drought refuges, habitat fragmentation and segregation of migratory ranges into isolated parks and small ranches (Western, 2009).

Climate change induced reductions in water resources are especially important where temperature already constrains crop development. Modelling suggests that the interaction of drought caused by a climate-change induced warming of the Indian Ocean and decreased per capita agricultural capacity has led to dramatic increases in food insecurity in Eastern Africa (Funk, 2009).

Increasing rainfall variability has induced rapid switches between drought and flood conditions, which wash away soil fertility – as demonstrated during the floods in Ghana in 2005 and 2008 (Asiedu, 2009). These impacts are driving significant changes in agriculture, which include crop diversification, new soil management practices, and increased water storage and irrigation (Ratsirarson, 2009). These local responses to environmental change must be better studied to facilitate widespread adoption of sustainable and robust farming practices.

Several alarming trends are already intersecting in Africa. Population is increasing at a 2.3% annual rate in eastern and southern Africa (Funk, 2008), and that population is increasingly concentrated in urban areas, with a majority of the African population projected to be urban by 2030 (Montgomery, 2008). One change that is driving urbanisation is the increasing frequency of droughts, which make it difficult to earn a consistent living by farming (Douglas, 2008). These demographic transitions will have major implications for social and governance structures, water resources, and food supply, especially at the boundary between urban and rural areas.

## Developing Tools for Adaptation in Africa

An enhanced understanding of the histories of ecosystem dynamics in Africa offers insights into how ecosystems have responded to past climate changes, and is used to constrain models of how ecosystems and associated services will change under predicted future climatic, governance and economic scenarios, as demonstrated in East Africa. New regional-scale projections of future climate change over northern Africa have been generated by a 9-member regional model ensemble for the end of the 21st century (2081 – 2100), resulting in finer horizontal resolution in order to support improved impacts analysis (Cook, 2009). Models, such as those used by the Centre for Ecology and Hydrology (CEH) in the UK, provide capacity to project the impacts of climate change on river flows and underpin policy development for flood management in the UK. These models have a strong capacity to simulate land-atmosphere interactions for climate impacts studies to address key research questions in atmospheric science (Dadson, 2009). Such modelling expertise can be used in partnership with researchers from Africa, and works best when combined with both ground-based and satellite data.

Satellite observations are beginning to play a larger role in the understanding of and adaption to climate change in Africa. Real-time precipitation and land surface data from satellites are being integrated with hydrologic models for flood potential mapping, flood forecasting and water resources management and science. Partnerships between national space agencies and regional stakeholders in Africa are increasing the capacity for this satellite remote sensing data to be used in management and decision support. New capacity is being developed to implement snow and ice melt physics constrained by satellite observations. The NASA SERVIR programme integrates satellite data with in-situ observations, models and forecasts and end users in Africa, such as the Regional Centre for Mapping of Resources for Development in Kenya (Boen, 2009). SERVIR uses a GIS web portal for access by decision makers in Africa and is an example of the data transfer and capacity building that will play a large role in future adaptation.

A key challenge encountered during the process of creating a "climate smart" Durban (South Africa) has been in downscaling global climate change predictions to a regional scale, and incorporating the local available data. The city is currently preparing an Urban Integrated Assessment Framework which will include a computer tool that will enable the evaluation of strategic development plans within the context of climate change impacts (Mather, 2009). Such regional sustainability assessments will aid other regions in Africa in formulating climate change adaptation plans.

Well-managed adaptations will be facilitated by recognising the dependence on environmental data at the smallest scales – the farmers, villagers, urban dwellers, and organisations that must make day-to-day decisions based on uncertain future variability. The African Centre of Meteorological Applications for Development (ACMAD) has initiated several successful programmes on this model, including efforts to provide early warnings for floods to farmers (Diallo, 2009). The strengthening of existing efforts through Knowledge Action Networks can facilitate this exchange of data and knowledge.

## ■ Breakout Session A

On Day One of the workshop, participants broke out into four discussion groups by discipline – Climate and Atmospheric Science, Water Management and Engineering, Conservation and Environmental Management, Physical and Human Geography of Climate Change. Breakout Session A examined the prospects and obstacles for enhancing existing systems for achieving integrated responses to climate change impacts. The principle conclusions reached by the breakout groups were:

1. There is a great need for data fit for purpose. Data availability must be made so that 'the right data is available at the right place, at right time'. It must be delivered to the proper local authorities in a timeframe where adaptive policy responses can be effectively implemented. Additionally, the data must be in a form that supports the decision process, and must have proper meta-data in order to fully judge the accuracy and the associated risk of making decisions based on environmental data and the predictions derived from it.

2. New forms of information technology, such as mobile phone networks, can facilitate exchange of data and horizontal learning. Data exchange must be needs-driven. Technical, political, legal, and social barriers to such communication must be broken down for data and knowledge to reach appropriate levels for decision making. Data collection, exchange, and analysis techniques should be in the public domain to the greatest extent possible to give people at the local level the power to interpret data in their own context.

3. The "brain drain" in Africa must stop. Too many of Africa's best minds are educated elsewhere and do not return to contribute to African development and adaptation. African scientists need to work on African problems in Africa. Efforts should focus not just on knowledge dissemination but on education for long term capacity building in climate and adaptation-related sciences in Africa.

# ■ Breakout Session B

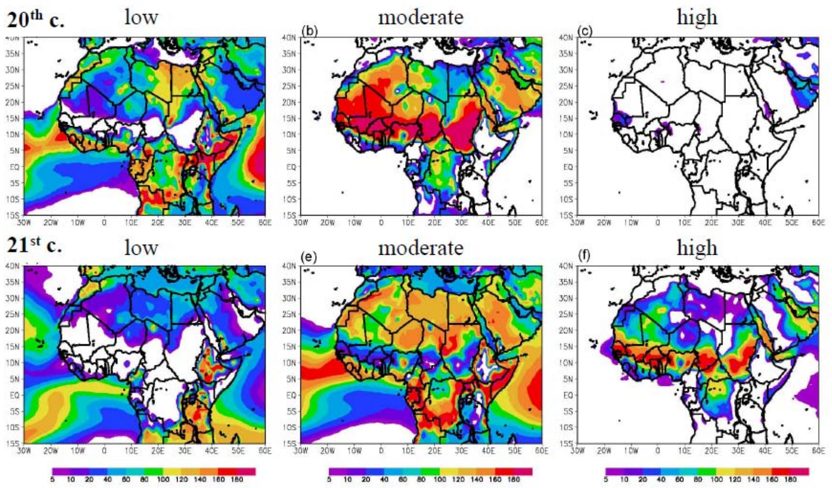
On Day Two of the workshop, Breakout Session B addressed the challenge of linking climate research with policy and decision making for adaptation in Africa, especially considering practical and systemic obstacles to information exchange and open knowledge transfer. Participants were randomly assigned to one of four breakout groups in order to encourage cross-disciplinary discussion. The principle conclusions reached were:

1. Massive efforts are needed in Africa to digitise existing environmental and social data, standardise methods of data collection, and ensure that appropriate metadata (including spatial, temporal, and uncertainty information) is collected so that different data sets can be better integrated into regional models. Data will always be collected and stored in many different places, but to the greatest extent possible, a library of available data sets needs to be available at one location with appropriate bandwidth for Africa-wide access. This will encourage better use of the data that is already collected.

2. Researchers and decision makers need to be better connected at different levels – internationally, nationally, regionally, and locally – through scale-free networks. There is opportunity and need to work on jointly on projects (such as EU Framework projects, U.S. projects, JICA projects, etc.). It is important to include ‘national staff’ as co-authors in publications so they have credibility when applying for project funding. Better access is needed in Africa for data and results that appear in academic journals outside of Africa.

# Recommendations

## Climate Science




**Climate model of heat indexes in the 20th and 21st century for Northern Africa. Provided by Professor Kerry Cook, University of Texas at Austin.**

Much remains to be understood about inter-annual to inter-decadal variations of African rainfall and climate. There are still fundamental gaps in our knowledge of the coupled atmosphere-land-ocean system-lack of observations, complex scale interactions between the atmosphere, biosphere and the hydrosphere. Aerosol and cloud microphysical modelling and observational analyses are necessary in the years to come to understand how to provide solutions to impacts on local cloud and precipitation processes.

Regional agreement between models in Africa is relatively weak compared to regional climate models in parts of the world with better studied atmospheric processes as well as more comprehensive data for understanding, monitoring, and model evaluation. Specifically, regional climate models require climate data inputs at finer spatial and temporal resolutions than is generally available in Africa to increase the usefulness of the models for adaptation purposes. Development of better observational datasets for monitoring, assessment, verification, calibration, understanding of processes is essential.

Decadal prediction systems have been developed to help answer questions including African rainfall forecasts and what the average climate will be like in African regions in the 2020s, though these systems are still at an early stage. To improve the quality and usefulness of seasonal to decadal predictions relevant to African water resource management, necessary activities include the continued improvement of earth system models to allow for higher resolution, better representation of physical processes, and the incorporation of interactive carbon cycles.

'Seamless' forecasts that are consistent and compatible on timescales of days to decades must be developed and consistently maintained. Such forecasts should include sufficient regional/local detail for action by the community of practice. Close connections between a diverse set of forecast products fitted to user needs will provide support for well integrated policies. Such forecasts should be downscaled to include impacts on farming, livelihoods, water resources, water quality and health, rather than just temperature and rainfall projections.

## Research to Action for Adaptation

Research and assessment activities must have continuity of support to be conducted and repeated on appropriate timescales. Such longitudinal studies are better able to show subtle environmental changes and to develop integrated responses to complex problems. For example, a four decades long study of the Amboseli ecosystem in Kenya shows the importance of landscape linkages and drought refuges in buffering wildlife and biodiversity against episodic droughts and mitigating the impact of climate change (Western, 2009).


**Loss of vegetation over the span of one year in the South African Western Cape due to drought. Image provided by Cooperative Governance and Traditional Affairs, Republic of South Africa.**

In an attempt to enhance Ghana's ability to cope with climate change, a number of initiatives have taken place already or are ongoing. There is the need to assess these initiatives in order to facilitate the identification of priorities and gaps in climate change adaptation research. This can help to support capacity building for the future that could shape adaptation and resilient livelihoods in Ghana. Knowledge obtained here could help incorporate climate change into national development planning agendas.

Various actors, structures and networks need to be interconnected To facilitate and improve the governance system needed to tackle these problems (i.e. traditional authorities, local, regional, national and international collaborators). The priority for climate change adaptation should first be embedded in the national government's development policy programme. Policy makers must take a three-pronged approach to dealing with climate change. Adaptation must start with good governance at grassroots level, where communities have some control over their actions and local environments (biodiversity, watershed, etc.). Next, there must be an emphasis on community resilience for development activities, with appropriate support of data and expertise from regional bodies. Community resilience must also be linked explicitly with ecosystem resilience. Policies must be evidence-based and firmly grounded in science, and take into account uncertainty in model predictions in order to increase resilience.

## The Development Context

Climate change studies should be customized and run to fit developmental time frames to have the maximum practical effect on adaptation policy. There is an urgent need for the development of human capital in the field of climate change science and climate modelling in Africa so that climate change studies may be properly linked to adaptation policy.

The context of economic development in Africa must be taken into account in research on the economic and social impacts of climate change – many development activities may impinge negatively on climate and water resources (such as mining, deforestation, land use, etc.). For example, it is essential that 'drought' is thought of as a function of supply and demand – and water shortages can be alleviated either through an increase in supply or better water management practices (i.e., reduction of demand). Modelling of agriculture systems in East Africa suggests that agricultural development could overcome drought-caused famine tendencies, leading to a more food-secure Africa.

## Capacity Building

Reflecting the integrated problems that challenge African adaptation, a multidisciplinary and cross-sectoral approach to climate research is needed in order to provide better data inputs and more useful outputs to regional climate models and thence to policy. In order to accomplish this at the appropriate scale for adaptation, there is a need for local capacity building in Africa. For example, in Ghana the vulnerability to climate change is now considered indisputable and the need to build capacity is considered a priority by the government and donor agencies. Effective capacity building will involve sustained efforts at developing and strengthening existing institutions, human resource base, methods and practices. Such capacity building should include a concerted effort for gender mainstreaming of the climate change process.

There is currently very low investment made to R&D in Africa. Science and technology investment is a necessary but not sufficient condition for effective regional climate change adaptation. The capacity in Africa to identify, collect and share data, as well as to build integrated knowledge relevant to climate change is critical to support adaptation at the local, national and international levels. An example of this kind of cooperation is the African Technology Policy Studies Network (ATPS), which functions in a knowledge-broker role.

There are demonstrated benefits to a regional approach to the sharing of knowledge, data, and capacity building. At regional levels it is often easier to get necessary resources, and national centres can benefit from the work done in regional centres. Water flows do not necessarily conform to national boundaries, but regional initiatives can be constructed that conform to watersheds or other natural. In the Niger Delta, for example, regional initiatives have been very important in lessening tensions among various states.

The most important thing to improve support for regional centres is the awareness and exchange of technology, data, and best practices. Necessary climate data for decision support already exists in many different mediums (web-based, electronic, paper-based) across different international, national, and regional agencies. Immediate gains in the ability of communities to adapt can be made through the sharing of data, making the right data available at the right place at the right time, rather than the expenditure of scarce resources on new data collection systems. Such communication should especially be facilitated between scientists and the community of practice.

Regional climate networks can also play an important role in capacity building, for example as the Drought Monitoring Centre of the South African Developmental Community has done with its Southern Africa Climate Outlook Forums. Such events strengthen links between scientists, policy makers, and the community of practice, while identifying weaknesses in current systems and spreading expertise and knowledge of best practices. African scientists must be trained in Africa to deal with Africa-specific problems.

The lack of available technology and infrastructure for monitoring and adaptation must be addressed. For example, there is a need for climate change related networks and partnerships to incorporate geo-information methods into assessment strategies. Enhancing capacity in climate change should include spatial data management and GIS-based scenario modelling. Develop appropriate GIS-based applications, products and decision support tools that guide policy formulation and implementation for the sustainable use of water resources.

## Local-Level Initiatives

The integrated knowledge made available should include not only international scientific knowledge, but local knowledge (e.g., quantitative as well as anecdotal knowledge and qualitative observations) from across different disciplines and sectors as well. Local communities and users are the best assessors of their own resources. Knowledge sharing and communication

should be encouraged among scientists, policy makers, and local practitioners. Peer-to-peer communication and collaboration can be encouraged to take advantage of centres of expertise in community-based adaptation. The continuous assessment and monitoring of valuable but vulnerable resources such as water is vital. The development of human resources, infrastructure, and institutional capacity within Africa for the growth and use of earth observation derived applications for an integrated water resource management should be considered a process and not an end in itself. Sustainability, outreach and sound communication strategies should be adopted as guiding principles for the implementation of any geo-information based monitoring and evaluation systems in Africa.

## Knowledge Action Networks

Monitoring and the exchange of data feed at the local level into comprehensive regional sustainability assessments of climate change impact. The organisations collaborating on assessments must work to provide common language and assumptions about how the system works. This must be a shared scientific endeavour, with as many contributions from opposing bodies as possible. The state of California has found that jointly-developed science and data are a crucial common ground for policy negotiations because adaptation has crosscutting requirements spanning scales, sectors and issues. Regular assessments and course corrections can be the most productive and economical adaptation strategies. The availability of environmental monitoring in assessments is as important as predictions, not only for science, but also in decision making and in public recognition of environmental changes. The optimal way to coordinate assessments and subsequent action among agencies is still an open question and will be dependent on the particular region of interest. Because the impacts of climate change will occur through both incremental change and shocks at uncertain intervals, resiliency will only be achieved through the use of long-term policies. Infrastructure planning, with a planning horizon of a decade or longer. This requires political will to invest in robust designs now that will function under adverse conditions 20 years in the future. Designers need to unlearn linear thinking and embrace systems approaches and the management of uncertainty. If done properly, resiliency contributes to sustainable development and achieving the Millennium Development Goals.

Adaptation policies in Africa must take account of the bigger picture, including trends in demographics, land, food, and energy use. Climate change policies will be mainstreamed, put into context and integrated into existing policies on all of these drivers of change in Africa. Farming policies, for example, will need to be adjusted to provide for drought and salt resistant crop varieties, as well changed planting calendars. Polices will also be grounded in the North-South adaptation funding mechanisms that come out of the global mitigation efforts at international policy forums.

Working in partnership (both North-South and South-South) is very important, with a collective effort in an efficient and cost effective way, because the challenge of climate change is a shared responsibility to all of us. Developed countries have an opportunity to provide the necessary investment in fundamental technology needed to monitor and adapt to climate change in Africa. Communities in Africa will be supported in their efforts to adapt to the changes ahead and build wealth creating opportunities to allow the adaptation. International organisations can support and inform local and national initiatives in preparedness and budget allocation. More broadly, good governance must be supported, ensuring that central governments meet decentralized needs. If deemed appropriate tools, continent-scale initiatives, such as an African green revolution or demographic transition, can only be supported by international agencies.

Policies for adaptation begin with the conceptual frameworks of reducing vulnerability, increasing resilience, and developing adaptive capacity. They will start from fundamental human rights principles, such as equity, inclusion (water, sanitation & hygiene for all), and sustainability. Adaptation must start from political will.


## Workshop Speakers [1]

Dr. Sulemana Abudulai, *Critical Factors that Interplay to Define the Nature and Quality of Access to Water Resources in Africa*

Dr. Adama Alhassane Diallo, *African Early Warning and Advisory Climate Services (AEWACS Project) – Towards Adapting to an Ever Changing Climate*

Professor Alex Asiedu, *Some Insights on Gaps Within Environmental/Climate Change Research in Ghana*

Dr. Juati Ayilari-Naa, *Rainfall Onset Date and Seasonal Rainfall Variability in Ghana*

Dr. Peter Baines, *Global Patters of Decadal Climate Variability and their Impact on African Rainfall and Vegetation*

Dr. Anca Brookshaw, *Seasonal to Decadal Climate Predictions and Applications in Africa*

Professor Richard Carter, *Demographic, Climatic, and Behavioural Changes Affecting Sub-Saharan Africa: Approaches to Climate Change Adaptation*

Dr. Declan Conway, *Impacts and Adaptations to Climate Variability*

Professor Kerry Cook, *Climate Change in West Africa: Regional Projections and the Potential for Abrupt Change*

Dr. Simon Dadson, *Wetland Inundation Dynamics in a Model of Land-Surface Climate: Evaluation in the Niger Inland Delta Region*

Dr. Mike Dettinger, *California's Experiences with Regional Sustainability Assessments*

Professor Chris Folland, *African Rainfall and Global Climate Variability and Change*

Professor Chris Funk, *Adapting to Climate Change Impacts on African Water Supplies and Agriculture*

Dr. Bradwell Garanganga, *Current SADC Seasonal Climate Monitoring and Prediction Activities and Impacts on Water Resources in the Region*

Dr. Sat Ghosh, *Aerosol, Cloud and Precipitation Characterisation along Peninsular Land Masses with Extended Coastlines*

Ms. Virginia Hooper, *Resilience and climate change*

Professor Robert Marchant, *Past, Present and Future Climate Variability: A Case Study from East Africa*

Mr. Andrew Mather, *A Climate Smart City*

Dr. Foster Mensah, *Monitoring the Effect of Climate Change on Water Resources in Africa: Strategies for Using Earth Observation Applications*

Dr. Alfred Opere, *Vulnerability of Water Resources Due to Climate Change in Africa: Indicators and Impacts*

Dr. Joelisoa Ratsirarson, *Climate Change Adaptation in Madagascar Agriculture*

Professor Derek Stretch, *Regional Climate Change Impacts in South Africa: Estuaries and Coastal Systems*

Dr. Yulia Timoshkina, *Data for Climate Assessment and Sustainable Regional Development Policies in Africa: Results of Case Studies from Ghana and Uganda*

Dr. David Western, *Landscape Linkages, Mobility, Drought and Climate Change*

Dr. Eric Wilcox, *NASA Satellite Data for Disaster and Water Resources Management and Science*

Mr. Ian Willis, *Some Strategies and Challenges for Water Supplies in the Drought Prone Areas of the Coast Province, Kenya*

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[1] All workshop presentations are available at:
http://esi.ucsd.edu/gwi/index.php?option=com_content&task=view&id=21&Itemid=26

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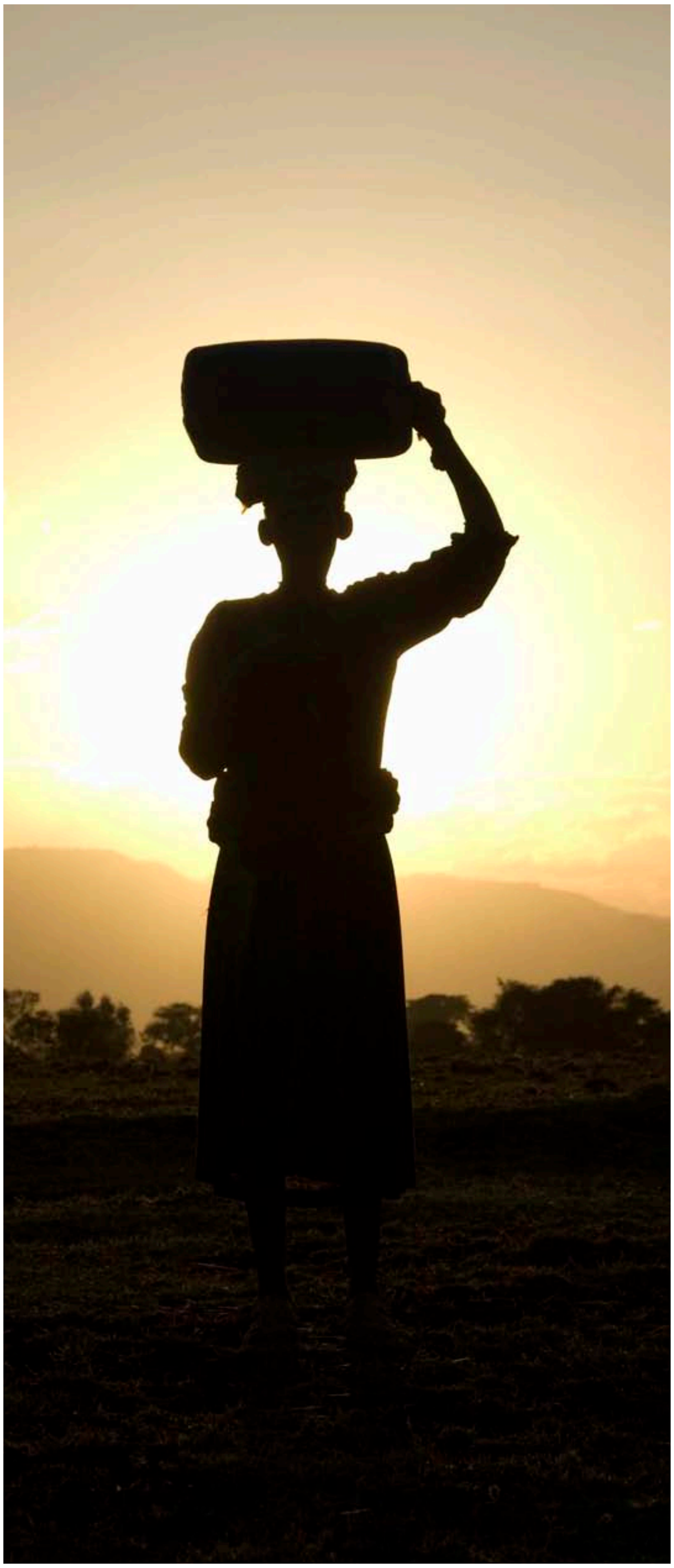

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[1]Portions of this declaration are taken from an article titled "Regional Climate Initiatives for Post-Kyoto Policies" by Julian Hunt (University of Cambridge; House of Lords; formerly Director General of UK Meteorological Office), Elsie Owusu (Director, Just Ghana Ltd., based in Ghana and UK), Arun Shrestha (Director of International centre for Integrated Mountain Development, Nepal), Charles Kennel (Distinguished Professor Emeritus, University of California, San Diego; Chair of the California Council on Science and Technology and the National Academy's Space Studies Board; member of the NASA Advisory Council)

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