24 October 2007

ENGLISH/RUSSIAN/SPANISH ONLY

UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE
Twenty-seventh session
Bali, 3–11 December 2007

Item 3 of the provisional agenda
Nairobi work programme on impacts, vulnerability and adaptation to climate change

Work that could contribute to the improved understanding of current and historical climate, and its impacts

Submissions from the World Meteorological Organization and its member States and other relevant organizations

1. The Subsidiary Body for Scientific and Technological Advice (SBSTA), at its twenty-fifth session, invited the World Meteorological Organization and its member States, the secretariat of the Global Climate Observing System and other relevant organizations, to submit information and their views, by 21 September 2007, on how their work could contribute to improved understanding of current and historical climate, and its impacts, including the identification of gaps and deficiencies in data and observations, stakeholder data and capacity needs, especially at regional and national levels, and ways to improve technical infrastructure. The SBSTA requested the secretariat to compile these submissions into a miscellaneous document to be made available to the SBSTA by its twenty-seventh session (FCCC/SBSTA/2006/11, para. 38).

2. The secretariat has received thirteen such submissions. In accordance with the procedure for miscellaneous documents, the twelve submissions received from Parties and intergovernmental organizations are attached and reproduced[*] in the language in which they were received and without formal editing. In line with established practice, the one submission from an accredited non-governmental organization has been posted on the UNFCCC website at <http://unfccc.int/3689.php>.

[*] These submissions have been electronically imported in order to make them available on electronic systems, including the World Wide Web. The secretariat has made every effort to ensure the correct reproduction of the texts as submitted.

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* This submission is supported by Albania, Croatia, Serbia, The former Yugoslav Republic of Macedonia, Turkey and Ukraine.

PAPER NO. 1: AUSTRALIA

Nairobi Work Programme on impacts, vulnerability, and adaptation to climate change

Information and views of the WMO member states on how their work could contribute to improved understanding of gaps and deficiencies in data and observations, stakeholder data and capacity needs, especially at regional and national levels, and ways to improve technical infrastructure (see FCCC/SBSTA/2006/11, para 38) Due: 21 September

Introduction

Climate change, based on the current state of scientific understanding of climate sensitivity to atmospheric concentrations of carbon dioxide and other greenhouse gases, poses serious threats to humanity. Adverse effects have been modelled to occur across a range of sectors including food security, economic prosperity, human health, physical infrastructure, natural resources and the environment. There are multiple strategies for addressing anticipated climate change across two fronts, mitigation and adaptation. It is widely accepted that even a vigilant mitigation approach across the world will still necessitate broad-ranging adaptation efforts through a range of technical, regulatory and behavioural initiatives. The Nairobi Work Plan (NWP) through its five-year work program on adaptation is aimed at progressing such efforts.

Many governments throughout the world have begun developing national efforts to adapt to climate change. The products, services and strategies that will flow on from these initiatives all rely on high quality data and information on local, regional and global scale climate and related earth systems, and the National Meteorological and Hydrological Services (NMHS) are central to the collection and delivery of these facts and knowledge. It needs to be recognised that the success of future adaptation studies and activities will be largely determined by the availability and quality of the data and information on which they are based.

Unfortunately, there are widely held presumptions that the data required is readily available and of sufficient quality. Numerous UNFCCC decisions, which refer to urgent actions required to ensure “climate quality” observing systems, suggest otherwise and that the infrastructure required to underpin much of the climate change mitigation and adaptation should not be taken for granted. Significant effort and resources are needed to improve the climate and earth system observational networks, as well as the associated data management and distribution systems. In most countries, the implementation of this basic infrastructure largely falls to the local NMHSs. Another common misconception is that international programmes such as the Global Earth Observation System of Systems (GEOSS) or Global Climate Observing System (GCOS) will ‘fix’ problems in existing, inadequate observing systems. For the most part, such programmes provide some level of coherence and coordination between national efforts, but again it is the NMHS that must garner the resources to fund and implement the improvements.

For a developed country such as Australia, the local NMHS (Bureau of Meteorology) will not only strive to make improvements within its own areas of responsibility but will also try to assist neighbouring developing countries underpin their own adaptation studies with better data and information.

Observing and monitoring the climate system is but two of the several vital functions that NMHSs carry out in support of activities to adapt to climate change. These functions fall across a number of broad themes.

Weather

Basic variations of weather from one day to the next have always been of interest to the community. Extreme events can be critical for human health, basic public safety and amenity, and performance across wide sections of industry and commerce. Knowledge of how the climate is changing suggests that extremes will be more prevalent, whether through more extreme heat, flood, wind-speed or sea-level. Communities need the earliest possible warning of such events in order to prepare and minimise any adverse outcomes. Advising and warning the community of such extremes has always been the responsibility of the NMHS, but the projections of exacerbated extremes, as summarised in IPCC reports, makes even more critical the role of the NMHS. Many of the adverse effects of climate change will be manifest in the greater incidence and intensity of extreme weather related events.

Knowledge of upcoming extreme conditions is crucial, but strategies also need to be developed to facilitate adaptive behaviour that will minimise the consequences. Efforts to promote preparedness and adaptation to the increasingly challenging variability and extremes in weather and climate are on-going around the world. But it is equally clear that the NMHS is central to the success of these activities. The enhancement of the every-day services delivered by NMHSs, such as weather forecasts, warnings of severe weather, monitoring of incipient weather extremes in the form of cyclones, floods and severe storms, will be critical to a successful community response to climate change.

Climate

Of late, variability in the climate has become of comparable interest to changes in the weather. In Australia, climate variability is high and in areas of marginal climate with respect to water availability, this means that the all too frequent dry years can be very difficult. Drought has a considerable impact on the bottom line for the Australian economy; it certainly affects directly the lives of primary producers, and the wider community bears the consequences too through instabilities in the availability and pricing of food. South-east Australia has been gripped by a sustained ten-year period of reduced rainfall which has led to a significant draw down in the major water storages. Water restrictions imposed on the community have become semi-permanent and other ways of harvesting and managing water are being investigated. Reassessment of water resource management practices in order to secure adequate supplies for human use and consumption is undoubtedly the most important area where Australia is having to develop strategies urgently to lessen the impact of long term changes in the climate. Such strategies need to be informed by accurate information about past climate, effective monitoring of present climate variations and reliable climate predictions and projections into the future. Most NMHSs have a monitoring and prediction role on a range of timescales out to a season, with a few taking on the challenging task of including interannual, decadal and even longer term predictions and projections.

Collecting and managing climate data is an enormous job. The ‘climate record’ has been developed over a long period of time. The quality of this record is of the utmost importance, particularly when it is used for trend detection, and in any data stream there are inevitably problems that must be identified, documented and accounted for. Thus it is not only the collection of data, but also the management of the data, including its quality control and storage that are crucial. Further, data only has value when it can be accessed and used. Some countries have NMHSs with the capacity to carry out effective data management tasks, whilst others, particularly in developing countries, often do not and require assistance. Australia is working closely with neighbouring Pacific Island countries to assist them improve the climate

and related data management systems. Even in Australia there is a backlog of historical observations that need to be digitised into an easily accessed computerised form. The GCOS Implementation Plan gives priority to this important data rescue and digitisation effort. Data, around the world, that have been collected but are currently unavailable and at risk of permanent loss represent a major and real road-block to the progress of many adaptation studies. It is likely to remain so unless more resources can be mobilised to carry out the work.

NMHSs will need to be responsive through the development of additional climate services that will meet the demands of communities attempting to adapt to climate change. Through their knowledge of climate, NMHSs can certainly add more value to basic data than it has done in the past. These new climate services will vary according to the needs of individual sectors and their circumstances.

Water

As noted above, the availability of water for human use and consumption has become one of the most pressing socio-economic and political issues in Australia. In an already marginal environment with dwindling rainfalls, run-off is one of the first victims of climate change. Restrictions on the use of water are now an ongoing part of life in Australia. Constraining water use will not be sufficient alone, and various other measures are being investigated to shore up Australia's water supplies. Many of these revolve around water use efficiency, desalinisation and allocations of water based on better estimations of likely availability. However, a major stumbling block towards finding solutions has been a lack of quality data. Recently, the Australian Government has initiated a major national program to collect and analyse Australia's water data and this task will be carried out by its NMHS, the Bureau of Meteorology. Not only will the Bureau of Meteorology be responsible for the collection and audit of water data, but will also provide a wide range of value-added services to government, industry and community sectors.

Research

Australia has a very active and productive climate change research programme of activities, much of which now gets carried out within the Centre for Atmosphere, Weather and Climate Research (CAWCR), a joint research facility of the Bureau of Meteorology and the CSIRO[1]. This research in this facility cuts across many themes of the physical sciences, as well as impacts, vulnerability and adaptation. The physical science research revolves around fundamental understanding of the basic processes that cause climate variability, and developing models and techniques to represent these processes. These models of the climate systems, which are now tending towards models that aim to represent the whole earth system, can then be used to generate projections of climate under different scenarios of greenhouse gas forcing. The output of one or more models can then be compared and used for a variety of studies including assessments of vulnerability and adaptive capacity. When the scale of a particular problem requires high spatial resolution, techniques such as downscaling or 'nested', limited area modelling can be employed. The climate projections along with the historical data sets provide the primary information base to underpin adaptation strategies. Rationalising trends in the climate record with future trends in model projections and understanding the physical basis behind these provides a great challenge for the research community.

[1] Commonwealth Scientific and Industrial Research Organisation

The profile of research into potential changes in extreme weather and climate events has been raised significantly of late given that changes in the frequency and intensity of extremes will most likely be one of the earliest consequences of climate change on communities. Determining key areas and sectors of vulnerability and developing adaptation strategies will therefore be paramount. The Australian CAWCR has already been active in these areas and studies include likely impacts of climate change on El Niño (including related large scale droughts and flooding), tropical cyclones, heat-waves and changes in the probability of exceedence for flooding events.

Another area of research in the Bureau of Meteorology critical for effective adaptation studies is the improvement in techniques for seasonal-to-interannual prediction. Accurate seasonal scale forecasts offer great promise as an important tool for adapting to climate variability and extremes. Early knowledge of impending conditions will allow industries and communities to position themselves better in a risk management sense to deal with expected conditions, whether the action be, for example, limiting water consumption at an early stage, using different planting strategies or planning for different energy demands. Whilst it is not clear how much predictability can be extracted from new modelling techniques, undoubtedly they can be pushed further than the current generation of empirical tools based on historical climatic conditions.

Outreach

NMHSs play an important role in the provision of information to the community. The drive for adaptation to a phenomenon is unlikely to be successful if the phenomenon is not understood. A NMHS disseminates many routine information products on current and likely weather and climate to the community, but it can also play an important role expanding community understanding of the changing climate and how this change might be manifest. Our understanding is that many of the adverse effects of climate change will be manifest in the greater incidence and intensity of extreme weather related events and thus there will need to be a particular focus on such events. These type of events also have scope for successful adaptation measures.

A great deal of effective public education is carried out through the media and the Bureau of Meteorology, like many NMHSs, is regularly requested to provide data and information including interviews. By building strong relationships with key media personnel, it has been possible to project a more accurate picture of what might be expected from climate change for the community. The media too will continue to be one of the principal preferred vehicles for disseminating urgent warnings and forecasts for impending events.

There are other forums for outreach. The Bureau of Meteorology web-site is one of the most popular in the country and it provides a great deal of useful information, both services and information based. There is also a significant move towards the provision of more of the Bureau's basic climate data to be retrievable through the web, which will improve countries' access to and potential use of this data, as anticipated under the Nairobi Work Programme. It may also encourage more collaborative arrangements between the NMHS and stakeholder groups.

Direct community engagement, which includes government and non-government bodies from different sectors as well as individuals and groups is an activity on which the Bureau of Meteorology dedicates considerable time and effort. A number of collaborative projects are underway exploring and using climate data in a manner to make the Australian community

more resilient or even to take advantage of climate variability including the changing climate. It is anticipated that such activities will become even more sought after in to the future.

Conclusions

Undoubtedly, NMHSs around the world are going to be central for efforts to adapt to climate change. As the primary source of long term records of data for our changing climate and also a provider of services and information in the fields of weather, climate, water and climate change research, their role is without question. There will be a requirement for an enhancement in services that they provide across a range of fields as well as a need for further improved data in order to meet the needs of increasingly complicated questions of adaptation. Administrators around the world need be aware of these increased demands and requirements on NMHSs and support them accordingly.

PAPER NO. 2: BOLIVIA

Programa de trabajo de Nairobi sobre impactos vulnerabilidad y adaptación al cambio climático

Rol de la OMM en el entendimiento de eventos extremos clima actual y histórico en el marco del Programa de Nairobi sobre impactos, Vulnerabilidad y adaptación al cambio climático

Mandato

En respuesta al secretariado de la Convención Marco de las Naciones Unidas sobre el cambio climático decisión FCCC/SBSTA/2006/11, Párrafo 28 "Información y revisión de como el trabajo de la OMM y sus estados miembros podrían contribuir a mejorar a entender el clima actual e histórico incluyendo la identificación de vacios deficiencias en información, datos de los actores sociales, necesidades de capacidad especialmente en los niveles regional y nacional y la manera de mejorar la infraestructura técnica.

Posición de Bolivia sobre La Organización Meteorológica Mundial en el Marco del Programa de Trabajo de Nairobi.

Bolivia considera importante el rol que juega la OMM en el entendimiento de la variabilidad climática asociado a cambios en el clima actual respecto a los registros históricos en variables climáticas, la información sistemática y su cobertura con estaciones meteorológicas. Sin embargo consideramos que con la finalidad de validar modelos climáticos la OMM debería:

- Reestructurar los sistemas de información sistemática en países en desarrollo, donde el sistema no funciona con eficiencia.

- Mejorar la cobertura, la calidad de la información y el análisis de la misma en los estados miembros que contribuya a entender el clima histórico y futuro.

- Promover en sus estados miembros el desarrollo de capacidades en el personal técnico y los observadores; extendiendo este a la generación de investigación científica del clima, para mejorar los productos y desarrollo de escenarios climáticos y validación de estos resultados.

- Promover la formación de redes de comunicación para los flujos de información para el análisis y uso en la toma de decisiones en los diferentes niveles para enfrentar los riegos e intensidad de las amenazas climáticas.

- Fortalecer sistemas de comunicación para los flujos de información, para el análisis y uso en la toma de decisiones en los diferentes niveles para enfrentar los riegos y intensidad de las amenazas climáticas.

- Recomendar a los servicio de meteorología e hidrológica cambio en su políticas de conservar la información como información bruta y sin procesar puesto que esta política, no permite avanzar en el entendimiento del clima actual e histórico.

- Mejorar la información para el análisis del clima actual y futuro, a través de una lectura más precisa continua de los registro de históricos.

- Mejoramiento de los sistemas de análisis de la información en las redes nacionales de los servicios nacionales de meteorología e hidrología.

- Recuperar estaciones con record históricos largos y proteger las mismas.

- Mejorar la infraestructura técnica con redes de observación en superficie y ampliar la cobertura de la misma a regiones de alta vulnerabilidad para la implementación de sistemas de alerta temprana.

- Iniciar procesos para el establecimiento de una red de observación meteorológica de alta atmosfera.

- Poner al servicio de las instituciones de los estados miembros la información meteorológica para el análisis y validación de escenarios climáticos.

La OMM debe influenciar en sus miembros para que el análisis de la información sea oportuno para la toma de decisiones, puesto que sin información confiable, no es posible tomar decisiones rápidas y oportunas.

PAPER NO. 3: CHINA

China's Views on how the work of the WMO and its member States could contribute to improved understanding of current and historical climate and its impacts, and ways to improve technical infrastructure

The 25th session of the Subsidiary Body for Implementation invited Parties to submit to the Secretariat their views on how the work of the WMO and its member States could contribute to improved understanding of current and historical climate and its impacts, and ways to improve technical infrastructure. China welcomes the opportunity to submit its views on this issue, and would like to submit the following views:

1. The WMO and its member States should continue to strengthen climate observations and monitoring systems, such as the Climate Observing System (GCOS), and provide technical financial assistance to the climate observation stations in developing countries. Through implementing the Program of GCOS, the capability of monitoring climate and extreme climate events, as well as the capability of preventing or reducing damages, can be enhanced. Meanwhile, GCOS may help increase the WMO member States' ability to describe, simulate and predict quantitatively the climate and climate change, and strengthen the assessment of climate change. The WMO and its member States, and the secretariat of GCOS should support the enlargement and improvement of climate observation stations and networks, and the construction of new climate stations in typical climate regions in developing countries.

2. WMO and National meteorological and Hydrological Services should help other sectors define their needs for climate information and provide user-driven products and services, and decision support for health sector, environment sector, and energy sector, etc. Climate information, such as data, predictions, formats, timing and method of information dissemination, etc, it very important for the health, environment, energy, agriculture and tourism sectors to cope with the adverse impacts of climate change. User-driven products and services, including forecasts, are essential for those sectors to use climate information conveniently and effectively.

3. WMO and its member States should promote climate risk management at regional and national levels. WMO and its member States could improve existing prevention strategies, reinstitute effective prevention programs that have been neglected, understand the changing patterns of risk, and apply win/win or no-regrets strategies. And they should also help other sectors to find when and where interventions should be implemented.

PAPER NO. 4: JAPAN

Submission by the Government of Japan

Nairobi Five-year programme of work on impacts, vulnerability and adaptation to climate change

At its 25th session, the Subsidiary Body for Scientific and Technological Advice (SBSTA) invited the WMO and its member States, the secretariat of the Global Climate Observing System (GCOS) and other relevant organizations, to submit information and their views on how their work could contribute to improved understanding of current and historical climate, and its impacts, including the identification of gaps and deficiencies in data and observations, stakeholder data and capacity needs, especially at regional and national levels, and ways to improve technical infrastructure.

The Government of Japan is taking this opportunity to respond to this request. National Institute for Environment Study has already made their submission for Japanese Alliance for Climate Change Observation (JACCO). This submission includes other additional information Japanese government has.

1. Japan Meteorological Agency (JMA)

For more than one hundred years, the Japan Meteorological Agency (JMA) has operationally conducted observations of the atmosphere and ocean with a wide variety of platforms including surface observing stations, ships and satellites. JMA has provided observed data to governmental organizations, institutes and the public domestically and internationally, in order to contribute to the better understanding of climate changes and variability.

The World Data Centre for Greenhouse Gases (WDCGG) has been operated by JMA since 1990 as one of the World Data Centres under the WMO Global Atmosphere Watch (GAW) programme, so as to gather, archive and provide data of greenhouse gases (GHG) and related gases in the atmosphere and ocean. WDCGG analyzes the global trends of GHG concentrations, and the results of the analysis are published in the WMO Annual Greenhouse Gases Bulletin. In 2007, WDCGG issued the WDCGG Data Submission and Dissemination Guide in order to increase the archived data from various platforms and to archive data with detailed quality information in accordance with the GAW Strategic Plan (2008-2015). Through such activities, JMA has been contributing to the improvement of GHG monitoring.

The GAW's Quality Assurance/Science Activity Centre (QA/SAC) for Asia and South-Western Pacific Region has been operated by JMA since 1995 as one of QA/SACs within the framework of the GAW programme, in order to ensure the collection of high quality data especially from developing countries. The QA/SAC has technically assisted countries in the region to improve their capabilities in carrying out GHG observations and maintaining the data quality. JMA has been contributing to the improvement of climate data quality through these activities.

The GCOS Surface Network (GSN) Monitoring Centre (GSNMC) has been operated by JMA in collaboration with German Meteorological Service (DWD) since 1999, in order to improve the performance of GSN and to obtain observed data in high quality. Based on the monitoring reports of GSNMC, WMO Members are urged to improve climate reporting. The reception rate of GSN temperature and precipitation data via CLIMAT messages is raised from about 65% in 2005 to nearly 80% in 2007. The activities of JMA as GSNMC have contributed to the better exchange of climatological observation data.

2. Ministry of Education, Culture, Sports, Science and Technology

Through three Earth Observation Summits in Washington, D.C. 2003, in Tokyo 2004 and in Brussels 2005, the Global Earth Observation System of Systems (GEOSS) was decided to be put in

place. Its purpose is to achieve comprehensive, coordinated and sustained observations of the Earth system, in order to improve monitoring of the state of the Earth, increase understanding of Earth processes, and enhance prediction of the behavior of the Earth system. The GEOSS is intended to yield a broad range of societal benefits in 9 areas including climate throuth the 10 - Year Implementation Plan.

As a national activity along the line of GEOSS, Japan Earth Observation System Promotion Program (JEPP) was launched in 2005 by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). In order to improve the scientific understanding of the global environment change including climate, the Program is intended to promote research and development for the formation of the international observation network filling observation gaps in Asia-Pacific region as a high priority in development of GEOSS.

PAPER NO. 5: KAZAKHSTAN

SUBMISSION BY KAZAKHSTAN

Astana, 8th October of 2007

Subject: In the Nairobi work programme on impacts, vulnerability, and adaptation to climate change the SBSTA invited the WMO and its member States, the secretariat of the Global Climate Observing System (GCOS) and other relevant organizations, to submit information and their views on how their work could contribute to improved understanding of current and historical climate, and its impacts, including the identification of gaps and deficiencies in data and observations, stakeholder data and capacity needs, especially at regional and national levels, and ways to improve technical infrastructure (FCCC/SBSTA/2006/11, p. 8)

Kazakhstan through the National Hydrological and Meteorological Service (Kazhydromet[1],) has extensive activities in the framework of its cooperation with the WMO on systematic observations, in accordance with its national circumstances.

1 Contribution to improved understanding of current and historical climate

The National Hydrological and Meteorological Service (Kazhydromet) is responsible for operating the national hydrometeorological observing network for meteorological, hydrological and climatological users. The network comprises 276 meteorological stations, 261 hydrological stations, and 9 aerological stations throughout the whole of Kazakhstan. First meteorological observations in Kazakhstan started in late 19th century. Kazhydromet is monitoring climate at national level through its Climate Department. Climate Department operates all observations, including its metadata that are stored in relational databases. Kazhydromet is maintaining and further developing the national digital climatological data archives. In addition to routine monitoring and operational data collection, efforts are made by Kazhydromet on homogenisation of historical data. Kazhydromet provides controlled time series of climate variables in order to derive climate evolution, as well as to contribute to quantitative estimates of climate change impacts and to inform on possible adaptation and mitigation strategies of Kazakhstan.

As part of the project GEF "Enabling activities for the preparation of Kazakhstan's Second National Communication to the UNFCCC"[2] calculation of the return periods of extreme weather events was carried out based on measurements made at about 70 weather stations in Kazakhstan utilizing statistical methods designed for extreme value analyzes. This work is done by the National Hydrological and Meteorological Service (Kazhydromet).

A total of 27 climate change indices were calculated for the period from about 1936 to 2005 that are based on daily temperature values or daily precipitation amount. These calculations are based on measurements made at about 70 weather stations in Kazakhstan utilizing RClimDex Software. These 27 core indices were developed by the Experts Team on Climate Change Detection Monitoring and Indices (ETCCDMI).

2 Contribution to improved understanding of climate impact

The climatological data, as well as, analyzed results are been used in different sectors of

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1 www.meteo.kz

2 http://www.climatesnc.kz

economy and society (water resources, agriculture, pasture, sheep breeding, health, forest) as a basis for estimation the impacts of climate variation and change. This work is managed by the Ministry of Environment Protection and is done by the Kazakh Research Institute for Ecology and Climate[3], the National Hydrological and Meteorological Service (Kazhydromet), and other relevant organizations. Kazhydromet developed and published national climate scenarios up to 2100 focussed for impact analysis, adaptation and spatial planning. The regional climate scenarios and impact studies are used in national assessments and international collaboration.

Kazhydromet has as its main purpose to apply regional climate models for climate analyses and future projections. The resulting scenarios will be used for information to stakeholders, as well as a base for impact studies on many sectors, such as water resources, forestry and agriculture.

In 2006 the Government of Kazakhstan has launched the Conception of Transition to Sustainable Development and set up an Advisory commission on Sustainable Development.

3 Contribution to identification of gaps and deficiencies

3.1 In data and observations

National hydrometeorological observation infrastructure is currently funded by the Ministry of Environment Protection. Following the political endorsement and financial support by the Ministry, important progress has been made. For example, new observation stations are opened, the existing network of hydrometeorological observations are being restored, updated and equipped with the up-to-date instruments and equipment. Historical data from Kazakhstan meteorological stations are being digitized to extend the instrumental record and upgrade of the number of time series spanning hundred years.

Kazakhstan contributes to global efforts such as GCOS. The GCOS national coordination is the responsibility of Kazhydromet. Kazhydromet conducts meteorological and atmospheric observations (with surface climate stations, upper air stations). However, there is no national GCOS implementation plan in place. More background information on Kazakhstan's contribution to the GCOS programme will be provided in the Second National Communication, which is now under preparation. But Kazhydromet noted the importance of designing national GCOS implementations plans to improve systematic observations. In particular as national GCOS implementation plans should be an important means to help overcome some of the gaps and barriers.

3.2 In stakeholder data

Kazhydromet has well established relationship to its stakeholders and about 3,000 customers in all sectors. These relationships are being further developed. Kazhydromet needs maintaining an inventory of user needs concerning data on climate change, climate desk for stakeholder questions about climate (change). Users and stakeholders have to be involved in the data acquisition and dissemination process.

Since November 2005 the Kazhydromet is certified according to ISO 9001:2000. Prerequisite for this certification is a well established process to identifying user needs and improving services.

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[3] http://www.ecoclimate.kz

There is need for regularly round tables and workshops of policy makers, industry stakeholders, experts, researchers, municipality representatives to address the impacts of climate change.

It will useful to set up pilot projects with stakeholders to supply and use climate data, climate desk for questions about climate (data), and to prepare of climate atlas. Such projects will contribute to the identification of gaps and deficiencies in capacity needs.

3.3 In capacity needs, especially at regional and national levels

An important effort are undertaking by the project GEF "Enabling activities for the preparation of Kazakhstan's Second National Communication to the UNFCCC"[4] to define a national adaptation strategy, proposing a general framework to address impacts and adaptation concerning different resources, economic sectors and according to geographic specificities. This strategy will be considered by the Government in 2008.

There is need for development of the web-based monitoring application, more workshops and wide consultation.

4 Ways to improve technical infrastructure

Kazhydromet regularly evaluates the observing programs and systems. This year Kazhydromet is elaborating investment project that has goals to integrate modern technologies with complete weather observation systems, end-user product development and demonstration and data distribution for public and research community. There is need for higher network density with focus on sensor networks. This project will be considered by the Government in 2008.

There is need for capacity building to generated own detailed local climate predictions (for example PRECIS).

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4 http://www.climatesnc.kz

PAPER NO. 6: MEXICO

Submission by Mexico

**Nairobi Program of Work on Impacts, Vulnerability and Adaptation to Climate Change –
Data and Observations**

21 September 2007

Mexico thanks the Secretariat of the UNFCCC and welcomes the opportunity to submit information and views on how its work could contribute to an improved understanding of current and historical climate, and its impacts, including the identification of gaps and deficiencies in data and observations, stakeholder data and capacity needs, especially at regional and national levels, and ways to improve technical infrastructure, as mandated in paragraph 38 the Nairobi Program of Work on Impacts, Vulnerability and Adaptation to Climate Change.

Current understanding and capacity

Mexico actively supports the implementation of the Global Climate Observing System (GCOS); in 2005, the installation of the National Center for High Altitude Climate Observation began, in the state of Veracruz, located at an altitude of 4,200 meters above average sea level. This Center will monitor concentrations of greenhouse gases, the stratospheric ozone layer, and solar radiation. With this observatory, Mexico joins the Earth's global observation systems, as well as the maps of the international network of climate surveillance, in order to study the global atmospheric balance over the long term. A support instrument is thus created for decision making regarding civil protection, social development, cycles of farming production at the regional and national levels, forecasting of catastrophes, and definition of lines of research. The Center operates under the coordination of the Veracruz University, the state government of Veracruz, the National Meteorological Service (SMN) and the National Disaster Prevention Center (CENAPRED).

The National Center for High Altitude Climate Observation receives funding from the Clinton Global Initiative and from the Pedro and Helena Hernandez Foundation (CGI, 2005) that is paid out by means of a co-participation of the Veracruz University, the Interactive Museum of Xalapa, the state government of Veracruz, the International Environmental Monitoring System (SIMA) company, and the non-government organization called The Climate Institute. Points of contact for the project are (http://www.sima.com.mx) and (http://www.climate.org/aboutus/staff.shtml).

In addition, the Climate Prediction Forum, where advances in the application and dissemination of climate information and future plans for systematic observation are discussed, is held every year. Producers as well as users of climate information participate in these forums, including academic and research institutions, the insurance company sector, the SMN, and representatives of the sectors whose activity depends on climate conditions. Information from the forums is available to the public at the SMN website, in the category of products, http://smn.cna.gob.mx/ .

Work on systematic observation makes it possible for Mexico to forecast and monitor hydro-meteorological phenomena, and issue informative notes and hurricane alerts. This information has also given rise to the preparation of the Integrated Information System

on Disaster Risks, published by CENAPRED at http://atl.cenapred.unam.mx/metadataexplorer/index.html .

Mexico is also part of the GLOBE Program (Global Learning and Observations to Benefit the Environment) which is an international scientific and educational program promoted by the US government that encourages environmental monitoring among students at different educational levels all over the world, in order to improve scientific education and increase environmental awareness. Mexico joined the GLOBE initiative in 1996, and the program is administered by the National Center for Environmental Education and Training (CECADESU). At the moment there are 100 Mexican (public and private) schools that report weather data to the GLOBE world network. In November, 2005, the First Encounter of GLOBE Students was held in Mexico City. General information on the program is available at http://www.globe.gov/globe_flash.html

Systematic observation of the climate in Mexico is done mainly through the National Network of Meteorological Radars, made up of twelve radars that give coverage to 70% of the national territory for the measurement and monitoring of atmospheric phenomena, and by means of 94 automatic meteorological stations of the SMN distributed throughout the country. It also works jointly with the radar system of the National Oceanic and Atmospheric Administration (NOAA) of the USA and the acquisition of satellite images. The images and products generated are available to the public on the SMN website (http://smn.cna.gob.mx/).

Of special interest are hydro-meteorological impacts, such as hurricanes. Between 1970 and 2005, a total of 58 hurricanes struck the coasts of Mexico, 16 of which were category 3 or higher; altogether, these latter were responsible for more than 1,200 deaths, left hundred of thousands of victims homeless, and caused damages of over $4 billion dollars (Table VI.4).

Based on data gathered by the SMN and the National Hurricane Center in Miami, between 1966 and 2005 the average number of hurricanes in a category higher than 3 per year in the Pacific was 4.1 hurricanes and in the Atlantic, 2.5.

The systematic observation of the climate is also supported by the National Network of State Agro-climatic Stations, through which the National Institute for Forestry, Agricultural and Livestock Research (INIFAP) and SAGARPA provide meteorological information to the country's productive chains. This network came about in response to the guidelines of the Fund to Assist the Rural Population Affected by Climate Contingencies (FAPRACC). One of its products is the state climate bulletin, which is circulated in technical reports by region throughout the country, and in which recommendations are also issued to support the processes of agricultural production. The bulletin is accessible through the Internet, together with the weekly, monthly and biannual climate forecast. In addition, users can access information in real time from the agroclimatic stations installed. All this information can be consulted at http://clima.inifap.gob.mx/redclima/

The Ministry of the Marine (SEMAR) also operates a Network of Automatic Surface Weather Stations (EMAS). These stations are located along the Mexican coasts and on islands and coral reefs; they measure air temperature variables, atmospheric pressure,

relative humidity, wind speed and direction, and accumulated rain. The data are sent via satellite every 3 hours, with observations every half hour, to the SEMAR Center of Marine Analysis and Weather Forecasting.

In 2001, 22 EMAS were operating, and in 2004 the network was enlarged to 33 stations. Since May, 2005, the data have been sent in real time to the SMN, the Center for Atmospheric Sciences of the UNAM and the National Hurricane Center, Miami, Florida, USA, so that they can be used in weather forecasting, atmospheric monitoring and scientific research. Since July, 2005, the data have been published in real time on the website of the SEMAR Marine Meteorology, and they are useful for the public in general in the face of extreme hydro-meteorological events such as hurricanes Emily, Stan and Wilma in 2005, and John and Lane in 2006.

Since June, 2006, specialized forecasts have been prepared daily for the maritime areas:

a) Forecasts for fishermen: two daily, valid for 24 hours, covering from the coast to 30 nautical miles out to sea.
b) Forecasts for navigators: one daily, valid for 24 hours, covering from the coast to 200 nautical miles out to sea (exclusive economic zone).
c) Forecasts for the coastal population: one daily, valid for 24 hours, covering the coastal zone from the coast to 10 kilometers inland.

Gaps and needs

The following lines and topics of research and capacity building stand out among what has been set as national priorities:

Observation of the phenomenon

- To reinforce and consolidate the capacity of measurement systems and monitoring of climate data; to cover the national research objectives and to expand the effort to recover historical data in time series of over thirty years.
- To analyze the existing information in order to detect signs of climate change.
- To consolidate the National Bank of Climatological Data at the state levels.
- To expand the observation network, taking advantage of remote perception systems, such as radars and satellites.

Risks and extreme phenomena

- To diagnose extreme meteorological events/phenomena and their consequences
- To prepare maps of present and future risk, in view of climate change conditions (to incorporate the information generated by the different sectors) and fully incorporate climate variability into the national risk maps.
- Studies of forecasts for associating change and climate variability with increasing risks.
- To assess vulnerability to extreme hydro-meteorological events.
- To identify strategic high-risk areas and activities in the country.
- To assess civil protection strategies.

PAPER NO. 7: PORTUGAL ON BEHALF OF THE EUROPEAN COMMUNITY, FINLAND, FRANCE, GERMANY, ITALY, LATVIA, SWEDEN, THE NETHERLANDS AND THE UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND

SUBMISSION BY PORTUGAL ON BEHALF OF THE EUROPEAN COMMUNITY, FINLAND, FRANCE, GERMANY, ITALY, LATVIA, SWEDEN, THE NETHERLANDS AND THE UNITED KINGDOM

This submission is supported by Croatia, Turkey, Former Yugoslav Republic of Macedonia, Albania, Ukraine and Serbia

Lisbon, 21st of September of 2007

Subject: In the Nairobi work programme on impacts, vulnerability, and adaptation to climate change the SBSTA invited the WMO and its member States, the secretariat of the Global Climate Observing System (GCOS) and other relevant organizations, to submit information and their views on how their work could contribute to improved understanding of current and historical climate, and its impacts, including the identification of gaps and deficiencies in data and observations, stakeholder data and capacity needs, especially at regional and national levels, and ways to improve technical infrastructure (FCCC/SBSTA/2006/11, para. 38)

Portugal is honoured to make a submission on the above mentioned issue on behalf of Finland, France, Italy, Germany, Latvia, Sweden, The Netherlands and the United Kingdom as parties to the WMO and on behalf of the European Community.

1 Introduction

In §38 of the Nairobi work programme (NWP), contained in FCCC/SBSTA/2006/11, the Subsidiary Body for Scientific and Technological Advice (SBSTA) invited the WMO and its member States, the secretariat of the Global Climate Observing System (GCOS) and other relevant organizations to submit information and their views, by 21 September 2007, on how their work could contribute to improved understanding of current and historical climate, and its impacts, including the identification of gaps and deficiencies in data and observations, stakeholder data and capacity needs, especially at regional and national levels, and ways to improve technical infrastructure.
Activities in the NWP in the area of data and observations are undertaken in line with the objective in the annex to decision 2/CP.11 to advance subtheme a (ii), *"Improving collection, management, exchange, access to and use of observational data and other relevant information on current and historical climate and its impacts, and promoting improvement of observations, including the monitoring of climate variability"*.

2 Contributions and outlook at Community Level

The European institutions and agencies have been mobilising important resources, e.g. under the impulse of the Sixth Environmental Action Programme, 2001-2010, which has climate change as one of its four

priorities,

2.1 Contribution to improved understanding of current and historical climate

The European Centre for Medium-Range Weather Forecasts (ECMWF[1]) has as its main purpose to develop and provide numerical weather forecasting resource focusing on the time range from a few days to a few weeks. The efforts at ECMWF also contribute to understanding of climate, not least thanks to its recent global meteorological reanalysis projects known as ERA-15 and ERA-40. The latter, that is most recent, is probably the best consistent global weather data compilation for the period from about 1958 to 2002 constructed from a wealth of weather data put through an advanced global analysis and forecasting model. The length of the ERA-40 period provides many opportunities for use also in climate studies. Additional reanalysis projects are being discussed.

Within EUMETNET [2], a network of 22 National Meteorological Services of Europe, the European Climate Support Network (ECSN) has published the "European Climate Assessment 2000" and made the corresponding dataset (called ECD [3]) available.

The European Organisation for the Exploitation of Meteorological Satellites, EUMETSAT [4], is operating meteorological satellites and has climate monitoring included in its convention. The main purpose of the EUMETSAT is to deliver weather and climate-related satellite data, images and products – 24 hours a day, 365 days a year. This information is supplied to the National Meteorological Services of the organisation's 20 Member and 10 Cooperating States in Europe, as well as other users world-wide. EUMETSAT is an international organisation and was founded in 1986.

2.2. Contribution to improved understanding of climate impact

At EU level, major contributions are being realised through the Community Research Framework Programme, which contribute to this issue. The Community Sixth Framework programme, priority on Global Change and Ecosystems resulted in 260 projects in 2002-2006 with a total project cost of € 1.3 billion. A comprehensive overview of these projects is available on the Internet [5].

The Community Seventh Framework programme, 2007-2013, continues its efforts along the same lines with in addition the contribution to the activities of the Group on Earth Observation (GEO) and the implementation of the Global Earth Observation System of Systems (GEOSS).

2.2.1 Contribution to identification of gaps and deficiencies

2.2.1.1 In data and observations

Relevant operational European observation infrastructure is currently operated and funded at individual European Union member state level or through intergovernmental approaches and organisations, e.g. the European Space Agency, the European Meteorological Infrastructure

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1 www.ecmwf.int

2 The Network of European Meteorological Services (www.eumetnet.eu.org)

3 http://eca.knmi.nl/

4 www.eumetsat.int

5 http://ec.europa.eu/research/environment/pdf/global_change_ecosystem.pdf

(EMI), which comprises ECMWF, EUMETSAT, EUMETNET and European National Meteorological Services, or EuroGOOS in oceanography. European Union member states individually also contribute, to global efforts such as GCOS.

In addition, important infrastructures are deployed in the context of European research projects of limited duration in time.

The European Commission and the European Space Agency launched in 2001 the Global Monitoring for Environment and Security (GMES) initiative in order to address gaps and deficiencies. Following the political endorsement by the European Council and Parliament for the Commission and the European Space Agency Council of Ministers, important progress has been made.

The following projects, in which leading European organisations such as the ECMWF, EUMETNET, EUMETSAT, ESA, the Joint Research Centre and many national meteorological and environmental services bundled their forces, are of particular importance for the identification of gaps and deficiencies: GMES-GATO[6], HALO[7], BICEPS[8]. In addition several projects with a focus on atmosphere such as CREATE[9], APMOSPHERE[10], DAEDALUS[11], METH-MONitEUR[12], GEMS[13], PROMOTE[14] identified gaps and deliver pre-operational information services. Other projects focussed on the marine and land-systems.

An overview of GMES and all projects financed by the Community Research Framework Programme and the European Space Agency GMES programme can be accessed on the Internet.[15]

In the future it is foreseen that the GMES programme will contribute to the provision of climate-relevant parameters (such as the Climate Essential Variables identified by GCOS) through its Land, Marine and Atmosphere Core services, based on Earth monitoring data obtained from both satellites and in situ observations on oceans, atmosphere, air, and land.

The European Space Agency, under its mandate as the implementing agency for space, is currently designing the GMES Sentinel satellite constellation, for which the first launch is foreseen for 2012.

The European Commission will through the Seventh Framework Programme, Priority Space and Aeronautics, co-finance the first operational services. These will be available as of 2008, with full-fledged data and information delivery services operating as of 2011/2012.

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6 http://www.nilu.no/gmes-gato/

7 http://www.ecmwf.int/research/EU_projects/HALO

8 http://www.gmes.info/library/index.php?&direction=0&order=&directory=Cross-Cutting%20Studies%20Documents

9 http://www.nilu.no/projects/ccc/create/index.htm

10 http://www.apmosphere.org/

11 http://www-loa.univ-lille1.fr/Daedalus/

12 http://www.gl.rhul.ac.uk/METH/MonitEUr/

13 http://www.ecmwf.int/research/EU_projects/GEMS/index.html

14 http://www.gse-promote.org/

15 http://www.gmes.info/

In addition, it is planned to feed existing European capacities on climate change analysis by coupling the above mentioned GMES services, which are structured according to Earth system compartments. These services should in particular provide controlled time series of Climate Essential Variables in order to derive climate evolution and to calibrate Earth system models, as well as to contribute to quantitative estimates of climate change impacts and to inform on possible adaptation and mitigation strategies.

This integrated approach should also assure a significant European contribution to the climate module of the GEOSS.

3 Country contributions

All Member States of the EU have extensive activities in the framework of their cooperation with the WMO on systematic observations. The approach to such cooperation varies among Member States, in accordance with their national circumstances. The examples provided below, try to give a flavour of how different Member States contribute to this important work under the WMO. However, this is not an exhaustive collection of activities implemented by the Member States listed below, nor does this submission try to include information from every single EU Member State.

While collecting the information included below, the EU noted the importance of designing national GCOS implementations plans to improve systematic observations. In particular as national GCOS implementation plans should be an important means to help overcome some of the gaps and barriers identified.

3.1 Finland

3.1.1 Contribution to improved understanding of current and historical climate

The Finnish Meteorological Institute is maintaining and further developing the national digital climatological data archives.

As part of the Finnish Climate Change Adaptation Research programme ISTO, the ACCLIM project aims to calculate the return periods of extreme weather events based on measurements made at about 10 weather stations in Finland utilizing statistical methods designed for extreme value analyzes. This work is done by the Finnish Meteorological Institute. These data and information are used by e.g. the other ISTO projects as they analyse sectoral adaptation. Active interaction with stakeholders and other research groups is part of the ACCLIM mandate to better understand user needs. Further information is given on the Internet [16].

3.1.2. Contribution to improved understanding of climate impact

The climatological data, as well as, analyzed results (see 3.6.1.) are been used in different sectors of society as a basis for estimation the impacts of climate variation and change.

[16] http://www.mmm.fi/ISTO and http://www.ilmatieteenlaitos.fi/organisaatio/yhteys_92.html

3.1.3. Contribution to identification of gaps and deficiencies

3.1.3.1 In data and observations

Climatological data measured available at observing station locations is not always enough to provide good enough spatial coverage. To improve the situation spatial interpolation methods have been used to create so called gridded climatological data sets. At the moment most important climatological parameters are available in digital database with 10*10 km resolution since 1961. The work to extent the gridded data set backwards until the beginning of last century is underway.

3.1.3.2 In stakeholder data

In WMO conference Living with Climate Variability and Change[17] large emphasis was put on the discussion about ways to utilize climatological data at different sectors of society. According to the conference statement the process of developing effective climate-related risk management works best if it is:

- Driven by the needs and requirements expressed by relevant decision sectors
- Developed within real-world decision contexts
- Enabled through facilitating institutions and policies
- Based on environmental, sectoral and socioeconomic data
- Based on tailored climate information
- Supported by local capacity
- Included in planning strategies that incorporate incentives
- Supported by sector-specific services from National Meteorological and Hydrological Services and related institutions.

3.1.3.3 In capacity needs, especially at regional and national levels

3.1.4 Ways to improve technical infrastructure

There are projects like “Helsinki-test bed” [18] that have goals which broadly consist of meso-scale weather research, forecast and dispersion models development and verification, demonstration of integration of modern technologies with complete weather observation systems, end-user product development and demonstration and data distribution for public and research community.

3.2 France

3.2.1 Contribution to improved understanding of current and historical climate

CNES (Centre National d’Etudes Spatiales) also collects current and historical data.

3.2.2 Contribution to improved understanding of climate impact

[17] http://www.livingwithclimate.fi/
[18] http://testbed.fmi.fi/

Météo-France [19], as well as other research or environmental agencies (INRA for agriculture, ONF for forestry) contribute to collect information on impacts of climate change on agronomy and forestry.

Météo-France collects analyses and provides regional atmospheric data. A similar work is done under the aegis of Mercator [20] for oceanography. In addition to routine monitoring and operational data collection, efforts are made by Météo-France on homogenisation of historical data on continent and overseas territories.

Managed by the Ministry of Ecology and Sustainable Development, under the GICC [21] programme ('Management and Impacts of Climate Change' or 'Gestion et Impacts du Changement Climatique (GICC)' in French), research is done concerning the impacts of future climate change on different socio-economic conditions (health, energy, agriculture, tourism sectors).

3.2.3 Contribution to identification of gaps and deficiencies

3.2.3.1 In data and observations

Continuous and long-term engagement in the climate observation is done under the structure of ORE [22] (Observatory for research for environment) under responsibility of Ministère de l'Enseignement supérieur et de la Recherche. Such an example can be found for the observation of the mountain glaciers (Glacio-Clim) or for greenhouse gases (RAMCES observatory). More generally the regular National Communication provides all the background information on the French contribution to the GCOS programme (see fourth National Communication, click on National reports on UNFCCC web site).

Considering space activities there is a French participation in different international projects in order to improve the space component of the observational system. Specifically concerning climate change, the JASON satellite (cooperation CNES with NASA) is used to monitor the sea-level. The GMES concept is also intended to develop techniques and specifications for data and observations integrating space and in-situ observations for environmental applications.

3.2.3.2 In stakeholder data

ONERC [23]: National Observatory for the impacts of Climate change is intended to collect the information from research programs and to define a national strategy, by studying the impacts of the different socio-economic areas. It does not observe itself but can make use of the observations done by specific networks.

3.2.3.3 In capacity needs, especially at regional and national levels

An important effort has been done to define a national adaptation strategy (www.onerc.gouv.fr),

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19 www.meteo.fr
20 www.mercator-ocean.fr
21 http://medias.obs-mip.fr/gicc
22 www.ore.fr
23 www.onerc.gouv.fr

proposing a general framework to address impacts and adaptation concerning different resources, economic sectors and according to geographic specificities. This strategy has been adopted by the Government in November 2006.

3.2.4 Ways to improve technical infrastructure

Météo-France regularly evaluates the observing programs and systems. Concerning observations done by research agencies there is a portal giving access to data (Service d'Observation de l'INSU). For dealing with climate impacts in continental France the portal of ONERC (www.onerc.gouv.fr) presents a number of climate change impacts indicators and two reference climate simulations resulting from the Météo-France Arpège model on the basis of the IPCC A2 and B2 scenarios.

3.3 Germany

Germany has submitted two national reports on GCOS, which provide detailed additional information about German contributions to global climate observing systems. The reports are available from UNFCCC [24] as part of national communications.

3.3.1 Contribution to improved understanding of current and historical climate

German National Meteorological Service (Deutscher Wetterdienst, DWD [25]):
The DWD is responsible for operating the national meteorological observing network for meteorological and climatological users. The network comprises 2,200 main and secondary stations throughout the whole of Germany. DWD is also contributing to VOS, ASAP and AMDAR. First meteorological observations in Germany started in late 18th century. DWD is monitoring climate at national, regional and global level e.g. through the GPCC and the Global Collecting Centre (together with UK MetOffice) for marine meteorological information. All observations, including its metadata, are stored in relational databases, operated by the German National Climate Data Centre (NKDZ).
DWD also contributes to the Global Atmosphere Watch (GAW), i.a. through the GAW Global Station Hohenpeissenberg/ Zugspitze.

The German Federal Maritime and Hydrographic Agency (Bundesamt für Seeschiffahrt und Hydrographie, BSH) is collecting marine physical and chemical data, including those relevant for climate monitoring. Germany also contributes to Array for Real-time Geostrophic Oceanography (ARGO) under a national programme funded by the BMBF and coordinated by the Leibniz Institute of Marine Sciences together with partners BSH and AWI. In addition, various contributions are made to ARGO within the framework of scientific programmes or EU funded project.

The DWD together with Ministry for Environment (UM BW) Baden-Württemberg, Department Water and Soil of the Bavarian State Ministry for Environment, Health and Consumer Protection (BayStMUGV) and Department Water Management of the Ministry for Environment, Forestry and Consumer Protection (MUFV) of Rhineland-Palatinate jointly have funded the KLIWA [26]

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[24] www.unfccc.int
[25] www.dwd.de
[26] http://www.kliwa.de/index.php?pos=&lang=en

project (KLIWA is the shortcut for the co-operation project "Climate change and consequences for water management"). In KLIWA project sector A "Assessment of changes in climate to date ("retrospective analysis")" the existing multi-annual time series of climate and water balance quantities are being analyzed.

3.3.2 Contribution to improved understanding of climate impact

German National Meteorological Service (Deutscher Wetterdienst, DWD):
The DWD also operates a phenological observation network at about 1400 sites in Germany.

The Humboldt University, Berlin, has taken the responsibility to manage the International Phenological Gardens (IPG) network [27].

At Potsdam Institute for Climate Impact Research (PIK) researchers in the natural and social sciences work together to study global change and its impacts on ecological, economic and social systems. They examine the Earth system's capacity for withstanding human interventions and devise strategies for a sustainable development of humankind and nature.

The German Federal Ministry of Education and Research (BMBF) runs several programmes that address the issue of "improved understanding of climate impact" such as:

- Sustainable Forestry 2004 – 2008 for which an executive summary is available in English on the Internet [28].
- NEWAL-NET investigates on sustainable development of forest landscapes in the lowlands of North-Eastern Germany (summary available in German only [29]).
- Foresight and potentials in rural areas under regional weather and climate changes (LandCaRe 2020, summary available in German only [30])

The Bavarian State Ministry of Sciences, Research and the Arts initiated the Bavarian Climate Research Cooperation (BayFORKLIM). In project (5)W climate effects to forests are investigated. A summary of this project is available in German only[31].

The Ministry of Environment and Transport of the German federal state of Baden-Württemberg funded the project "Climate change – impacts, risks, adaptation" (KLARA). A report was published in 2005. It is available on the Internet [32] and includes an abstract in English. It presents results of investigations on different areas of potential vulnerability for Baden-Württemberg.
In the German Federal State of Hesse the Ministry for environment, the rural area and consumer protection (HMULV) funded an integrated climate protection programme (INKLIM 2012). The final results have been presented in 2005. Information is available on the Internet in German only[33].

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27 http://www.agrar.hu-berlin.de/struktur/institute/pfb/struktur/agrarmet/phaenologie/ipg/index_html?set_language=en&cl=en

28 http://www.nachhaltige-waldwirtschaft.de/

29 http://www.newal-net.de/e

30 http://www.landcare2020.de/

31 http://www.abayfor.de/forklim/arbeitsfelder_detail.php?pk=67

32 http://www.lubw.baden-wuerttemberg.de/

33 http://www.hlug.de/medien/luft/inklim/index.htm

The DWD together with Ministry for Environment (UM BW) Baden-Württemberg, Department Water and Soil of the Bavarian State Ministry for Environment, Health and Consumer Protection (BayStMUGV) and Department Water Management of the Ministry for Environment, Forestry and Consumer Protection (MUFV) of Rhineland-Palatinate jointly have funded the KLIWA [34] project (KLIWA is the shortcut for the co-operation project "Climate change and consequences for water management"). In KLIWA project sector B "Assessment of the effects of possible climate changes on the water balance", simulation calculations are performed using water balance models.

The project "KLIWAS", which is funded by the German Federal Ministry of Transport, Building and Urban Affairs (BMVBS), is focused on the consequences of climate change for navigable waterways:

- How will the climate in Central Europe develop during the 21st century?
- What effects will this have on water levels along the course of navigable rivers like the River Rhine?
- Will this affect the role of the River Rhine as a major inland waterway?

The German Research Centre Jülich, the Helmholtz-Centre for Environmental Research Leipzig/Halle, the Research Centre Karlsruhe, and the GSF-Research Centre for Health are jointly running an intensive mapping of three reference basins. Information colleted is on meteorology, hydrology, soil and plant growth.

3.3.3 Contribution to identification of gaps and deficiencies

3.3.3.1 In data and observations

The GCOS national coordination is the responsibility of DWD. However, there is no national GCOS implementation plan in place. DWD is contributing to the national GEO implementation plan, being developed. Historical data from German meteorological stations are being digitized to extend the instrumental record and upgrade of the number of time series spanning hundred years. This includes digitization of information contained in ship logs.

3.3.3.2 In stakeholder data

DWD has well established relationship to its stakeholders and about 30,000 customers in all sectors. Since July 2004 the DWD is certified according to ISO 9001:2000. Prerequisite for this certification is a well established process to identifying user needs and improving services.

3.3.3.3 In capacity needs, especially at regional and national levels

The Federal Environment Agency (Umweltbundesamt, UBA) has initiated the KomPass [35] project which is a platform where climate change and the impacts/adaptation strategies are presented and awareness is created.

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[34] http://www.kliwa.de/index.php?pos=&lang=en

[35] www.anpassung.net

3.3.4 Ways to improve technical infrastructure

The meteorological observing network of DWD is being modernized, with more stations' observations being online available. At international level the GCOS Surface Network Monitoring Centre (GSNMC) jointly operated by DWD and JMA (Japan Meteorological Agency) provides information about the availability of surface climate data. This information forms the basis to improve the availability. The Global Precipitation Climatology Centre (GPCC), operated by DWD, improves access to high quality monthly precipitation products at global level. The EUMETSAT Satellite Application Facility for Climate (CM-SAF), hosted by DWD, is providing high quality satellite products for climate research. In general DWD has only very limited resources to directly support other National Meteorological and Hydrological Services and/or GCOS.

Within the KLIWAS project mentioned above the following questions are being considered. Which are the best adaptation strategies for enterprises dependent on reliable river transport? Which measures are the most suitable and sustainable choice for the responsible public authorities (in Germany: the Federal Waterways and Shipping Administration - WSV) to protect and improve the quality of the River Rhine as a navigable waterway?

3.4 Italy

3.4.1 Contribution to improved understanding of current and historical climate

The *Italian National Environmental Protection and Technical Services Agency (APAT)* [36], in collaboration with the system of the *Regional Agencies for Environmental Protection (ARPAs)* and several research institutions [37] (such as *National Research Council – CNR, National Institute of Geophysics and Volcanology – INGV, Italian National Agency for New Technologies, Energy and Environment – ENEA*) are conducting direct research on different aspects of climate and climate change including monitoring, observation and modelling of current and historical climate.
Efforts to improve this knowledge are carried out through National Projects whose research topics include, for example: 'Climate variability during the Eemian: Mediterranean paleo-ecosystem dynamics', 'The impact of the large explosive eruptions on environment and climate: Campanian Ignimbrite the most powerful eruptions of the last 200,000 years in the Mediterranean area', observations of the planet Earth, Climate Dynamics (study, mainly through numerical simulations and theoretical studies, of the variability of the climate system with an emphasis on the Mediterranean area, 'Evolution in the frequency of extreme precipitation and

[36] http://www.apat.gov.it

[37]
- National Institute of Geophysics and Volcanology, (INGV) (http://www.bo.ingv.it)
- Italian National Agency for New Technologies, Energy and Environment (ENEA) (www.enea.it)
- Institute of Atmospheric Sciences and Climate - Italian National Research Council (ISAC -CNR) (www.isac.cnr.it)
- Abdus Salam International Centre for Theoretical Physics (ICTP) (http://www.ictp.it/)
- National Interuniversity Consortium For Marine Sciences, (CONISMA) - Local Research Unit: Department of Geological Sciences and Geotechnologies - Milano-Bicocca) (http://www.geo.unimib.it/Conisma/).
- ENI Enrico Mattei Foundation (FEEM) (http://www.feem.it/)
- EuroMediterranean Centre for Climate Change (CMCC) http://www.cmcc.it:8080/web/public/home

drought events in Italy over the last 120 years and their impact on bio-ecosystems'[38], 'Global Change' [39] (to evaluate, through models and field measurements, ancient and recent climate change of the Earth system, due to natural and anthropic causes), 'Climate change observation and definition of possible scenarios' [40]
Research on current and historical climate is also carried out through several EU funded projects.

3.4.2 Contribution to improved understanding of climate impact

The major effort to improve the understanding of climate impacts is probably the initiative by the *Italian Ministries for: Economy and Finance (MEF), University and Research (MIUR), Environment Land and Sea (MATTM), Agriculture Food and Forestry Policies (MiPAAF)* that has co-funded the "***Strategic Programme for Sustainable Development and Climate Change***"[41], currently running onward since 2006, to meet the research needs identified by the *National Research Programme* (*PNR,* 2000) in fields such as:

- study of the evolution of climate variability and its impacts on urban, agricultural and forestry sectors;
- characterization of local soil structures, regional climate simulation and optimization of land management, with a special emphasis on water resources, agriculture and forestry resources, and fishery resources;
- regional studies on vulnerability of coastal zones and impacts assessments; projections for land and water ecosystems, with a special emphasis on biodiversity;
- atmospheric processes dynamics (aerosols, clouds, past climate reconstruction);
- applications of remote sensing to understand the climate processes;
- monitoring, assessments, simulations and predictions of the evolution of the agricultural systems in relation to climate change;
- studies of the oceanic carbon cycle;

The main objective of the Programme is indeed to conduct simulations, assessments and projections of climate change. Climate impact research includes: socio-economic topics (energy, industrial sectors, insurance, transport, tourism), soil degradation (e.g. salinization, acidification, eutrification, pollution), water ecosystems (e.g. river catchments, lakes, coastal, oceanic, ground water), biodiversity, human health, human settlements (i.e. urban, coastal, etc.), marine biology, forestry, agriculture, with a main geographic focus on the Mediterranean area.

Through the "*Strategic Programme for Sustainable Development and Climate Change"* nine **Research Projects** have been funded. The ones relevant to improve the understanding of climate impact are the following:

- *AEROCLOUDS: Study of the direct and indirect effects of aerosols and clouds on climate*[42]
- *VECTOR: Vulnerabilities of Italian coastal areas and marine ecosystems and their role in the oceanic organic carbon cycles* [43]

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38 http://www.isac.cnr.it/~climstor/firb.html

39 http://www.cnr.it/commesse/dipartimenti-progetti/1/TA-P02.html

40 http://www.acs.enea.it/attivita/ossclima/index.php?lang=en

41 Special Integrative Fund for Research (FISR), aimed at funding specific activities with particular strategic relevance, pursuant to the National Research Programme (PNR) 2001-2003. Activities of the Strategic Programme extend to the period 2005-2007, pursuant to the PNR 2005-2007.

42 http://www.isac.cnr.it/~aeroclouds/

43 http://vector-conisma.geo.unimib.it

- *CLIMESCO: Evolution of cropping systems as affected by climate change* [44]
- *SOILSINK: Climate change and agro-forestry systems: impacts on soil carbon sink and microbial diversity*
- *M.I.C.E.N.A.: An integrated model for the evolution of natural and agricultural ecosystems in relation to climate change in the Mediterranean area* [45]

Furthermore, the "*Strategic Programme for Sustainable Development and Climate Change"* has included the creation of a research network: the ***Euro-Mediterranean Centre for Climate Change*** *(CMCC)*[46], which include Universities, Public Research Centres, Foundations and Consortiums [47].
The aim of CMCC is to study climate change and the impacts of climate change on the economy, agriculture, sea and earth ecosystems, coastal zones, and health over the Mediterranean area, and relative interactions with the global climate.
The CMCC is developing climate numerical models, simulations and scenario experiments.

Finally, several National research Projects are carried out by Italian Research Institutions, Universities and Agencies including climate change impacts assessment.

3.4.3 Contribution to identification of gaps and deficiencies

Continuous, long-term work in these areas is in line with the prioritisation of research of the *MIUR* and *MATTM*.
Recently efforts have also been made in the identification of gaps and needs in the framework of the *National Conference on Climate Change* [48] (12-13 September 2007) organized by the *MATTM*, in collaboration with the APAT and the ARPAs.
Preparation activities of the conference included seven preparatory topical workshops and meetings on the key vulnerabilities of the country. Workshops and meetings' contributions highlighted, in their respective sector (e.g. desertification, coastal erosion, alpine area, hydro-geologic instability, the Po river basin, human health) research gaps and needs at the national, regional and local level. Proceedings and outcomes of the workshops and meetings have been compiled in a report, available on the Conference website and distributed to participants to the Conference for dissemination.

3.4.3.1 In data and observations

The *ARPAs*, the *Basin River Authorities* and some research institutes (e.g. *ENEA*, with the "*Dossier on the Workshop: ENEA for climate change study and their effects – March 2007*") have given a major contribution to identification of gaps and needs during the *National Conference on Climate Change* (see par. 3.4.3), reporting on the outcomes of the workshops and meetings, and based on their experience of direct work on the territory.

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44 http://www.isac.cnr.it/schedaprog.php?idmenu=2&idprog=734

45 http://www-b.unipg.it/micena/

46 http://www.cmcc.it:8080/web/public/home

47 The members of CMCC are: National Institute of Geophysics and Volcanology, University of Lecce, ENI Enrico Mattei Foundation ,Italian Centre for Aerospace Research, Venice Research Consortium, University of Sannio.

48 http://www.conferenzacambiamenticlimatici2007.it/

Italy also contributes to *GCOS* with systematic observation relevant to global climate needs. Italy also conducts meteorological and atmospheric observations (with surface climate stations, upper air stations, *Global Atmospheric Watch (GAW)*, Key climatological datasets), oceanographic observations (e.g. *Voluntary Observing Ships (VOS)*, Tide gauges (GLOSS), drifting buoys, global reference mooring network and tropical moored buoys, sub-surface profiling floats (Argo), hydrographic surveys, ocean carbon measurements, Continuous Plankton Recorder (CPR) survey), terrestrial observations (including hydrological monitoring, carbon flux monitoring, ecological monitoring) and space-based observations (EUMETSAT, GMES).

3.4.3.2 In stakeholder data

Some efforts in this area have started in the context of the *National Conference on Climate Change* (see par. 3.4.3) and preparatory workshops and meetings, aimed also at promoting stakeholders involvement and information exchange, including their role, data and specific needs on different sectors.
An on-going dialogue with stakeholders is in line with the activities of the *MATTM*.

3.4.3.3 In capacity needs, especially at regional and national levels

Some efforts are included in various ongoing research, such as in the Projects funded under the "*Strategic Programme for Sustainable development and climate change*" (see par. 3.43.4.2).

3.4.4 Ways to improve technical infrastructure

Some recommendations were highlighted during the *National Conference on Climate Change* (see par. 3.4.3) and preparatory workshops and meetings, dealing mainly with improving networks and databases of existing monitoring infrastructures.

3.5 Latvia

3.5.1 Contribution to improved understanding of current and historical climate

Latvian Environmental, Geological and Meteorological Agency (LEGMA):
The LEGMA data fund records results of annual hydro meteorological, geological, and environmental observations conducted in Latvia. The amount of information recorded in this fund is the largest in Latvia. Gradually, data fund information is converted into an electronic format and stored in databases. LEGMA is providing hydrological and meteorological observations and is responsible for national climate change monitoring - according to the National Environmental Monitoring Programme.
LEGMA manages the Greenhouse Gas (GHG) Emission Trading Register.

It also provides environmental quality observations. Atmospheric air quality monitoring, assessment of the impact of air quality on ecosystems and monitoring of the impacts of trans-boundary air pollution on ecosystems is carried out within the scope of several international programs: GAW - Global Atmosphere Watch program, EMEP-Cooperative Programme for the Monitoring and Evaluation of Long Range Air Pollutants in Europe, ICP-Integrated Monitoring - International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems.

LEGMA maintains databases and registers where information on meteorology, terrestrial and

marine hydrology, environmental quality, emissions, underground nature resources and chemicals are entered, controlled and revised. On-line access to all main databases ensures that institutions subordinate to the Ministry of Environment and more than 200 other electronically registered users (both organizations and private persons) can directly obtain free and operative information.

3.5.2 Contribution to improved understanding of climate impact

Latvian University (LU), Faculty of Geography and Earth:
The Project ASTRA assesses regional impacts of the ongoing global climate change and developing policies & adaptation strategies to climate change in the Baltic Sea region (2005-2007) - case study of River Salaca Basin.
The Project Climate Change: a retrospective indication in the background of economic activities (2006-2009). Information on this project is not yet available on the internet.
The University is contributing to a state research programme on climate change impact on water environment, including adaptation (2006-2009). There is a rather well-made home page on this project, where several types of information (presentations) is available.

Latvian State Forestry research Institute "Silava":
Several research activities on interaction of wind and forest (trees) results in windthrow and storm breakage (2005, 2006).

Latvian State Institute of Agrarian Economics:
Research on justification of agriculture insurance system development in Latvia (2006) is carried out.

Latvian Institute of Biology:
National adaptation strategy for climate change risk management: extreme climate phenomena and its impacts (2006).

The Latvian Environmental, Geological and Meteorological Agency (LEGMA) serves as registry on protected territories according to the Water Framework Directive (WFD).
According to the National Environmental Monitoring Programme, LEGMA is also responsible for monitoring of geological processes of the sea coast and climate change monitoring.
Monitoring reports are available on the Internet.

Two projects are funded by the Latvian Environmental Protection Fund:

- Global fluctuations of climate and measures to reduce their impact in Latvia (2005);
- Providing education on climate change in Latvia (2005).

There is no possibility to see project reports on the Internet which would be very useful.

3.5.3 Contribution to identification of gaps and deficiencies

3.5.3.1 In data and observations

The Latvian Institute of Aquatic Ecology plans to resume a National Assessment System for Maritime Environment.

Latvian Environmental, Geological and Meteorological Agency (LEGMA):
Precipitation observation data are sent to the German weather service climate centre (Climatology Centre Deutscher Wetterdienst (DWD), Offenbach, Germany) within the framework of Regional Basic Synoptic Network programme. Data of hydrological stations on daily runoff are sent to the Global Runoff Data Centre (GRDC), Federal Institute of Hydrology, Koblenz, Germany. Information from the global atmosphere observation stations that are operating within the framework of Global Atmosphere Watch (GAW) programme are sent to several international institutions. Information on air and precipitation quality from stations operating within the framework of EMEP monitoring program (co-operative programme for monitoring and evaluation of the long-range transmission of air pollutants in Europe) is sent to the Chemical Coordinating Centre hosted by the Norwegian Institute for Air Research. Information on environmental, water quality and hydro-meteorological data within the framework of integrated monitoring program (ICP-IM International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystem) is regularly sent to the Finnish Environment Institute and the surface water acidification monitoring program centre. Data on atmospheric precipitation, river flow and air quality on a regular basis are sent to the European Commission EIONET database in the Netherlands.
Climate change monitoring was established quite recently - in July 2007, although data has been collected already for a long time.

3.5.3.2 In stakeholder data

Latvian University (LU), Faculty of Geography and Earth:
Ministry of the Environment cooperates closely with the scientists of LU, where the first one plays like a focal point role of all stakeholders.
There is need for regularly round tables and workshops of policy makers, experts, researchers, municipality representatives.

Latvian Environmental, Geological and Meteorological Agency (LEGMA):
LEGMA has created well-appointed data service system (separate pay information and free of charge). For example, if student want to receive data, it is necessary to submit a certificate issued by the educational institution, including the following data: information requesting person is a pupil/ student/ doctoral student/ lecturer of the corresponding institution; research work name; specification of LEGMA observation data necessary for the research (precisely indicating time period, location, and type of necessary information).
Climate change monitoring was established mainly for the needs of policy makers.
Observation data are available without restrictions. Monitoring data are exchanged on a regular basis within the frameworks of international projects and programmes.

3.5.3.3 In capacity needs, especially at regional and national levels

In general it is a very big problem to receive analyses in which primary data would be already interpreted and dealt with in the context of socioeconomic information, therefore there is a lack of trans-sectoral oriented information, e.g. analysis and representative models (weakness of modelling).

Latvian Institute of Aquatic Ecology:
Research reports are not available on the Internet yet. Capacity building: competitiveness in

salary system, sufficient staff and budget.

Latvian Environmental, Geological and Meteorological Agency (LEGMA):
Information from the data fund and the electronic database is used by various institutions. Data fund information can also be used by Latvian school pupils, higher school students and doctoral students in their scientific researches.
There is a weakness in the sub-structure in LEGMA to interpret data and to make several reports for stakeholders (now all reports are made only for international policy commitments).

3.5.4 Ways to improve technical infrastructure

Latvian University (LU), Faculty of Geography and Earth:
It would be very useful to build up unitary data basis on all researches and projects concerning climate change impacts, adaptation, etc. (it is related to all positions and institutes!). Now the situation is such: researchers or institutes are very chary of dealing with information made by them, although for the most part all mentioned projects are made with state financial support. Annotation on this project is not available in the internet yet.

Latvian Environmental, Geological and Meteorological Agency (LEGMA):
The first systematic meteorological observations in the territory of Latvia started at the end of the 18th century (in 1795 in Riga), and permanent meteorological observation network was already established by the end of the 19th century. Surface hydrological information: since 1919 water level observations. Sea coastal area hydro meteorological information: since 1835 sea level in Riga port. Aerologic and agro-meteorological information: since 1945. Information on environment quality: since 1946. Synoptic meteorological materials: since 1933. Data of these observations present valuable material for research on climate change in the territory of Latvia. In the course of time, the observation timing, instruments, location of observation stations have changed, therefore research on homogeneity of historical observation series is important in order to obtain reliable results. Nowadays, meteorological observations of LEGMA are carried out in observation stations, spread over the entire territory of Latvia. The monitoring of atmospheric conditions of later years was significantly improved. Meteorological Doppler radar was installed and started operation in 2005, providing precise and regularly updated information on physical characteristics and processes in the atmosphere also in the higher atmospheric layers. Since 2005, Latvia is an associate country of the European Meteorological Satellite Organization (EUMETSAT) which will promote the use of satellite technologies for atmospheric monitoring above the territory of Latvia.
Observations of the meteorological elements most variable in space – atmospheric precipitation, snow cover, extreme air temperatures and some atmospheric phenomena, are carried out in 41 observation stations. The location of the stations is optimized to obtain detailed characteristics of Latvia's weather conditions and climate. The first monitoring report will be published in October, 2008.

3.6 Sweden

3.6.1 Contribution to improved understanding of current and historical climate

The Swedish Meteorological and Hydrological Institute (SMHI) collects, analyses and provides regional atmospheric, ocean and hydrological climate data. These are organised in databases,

such as Swedish climate archive (KLAR), Swedish water archive (SVAR) and Swedish ocean archive (SHARK). SMHI also hosts the hydrological, radar and oceanographic data centres of the international Baltic Sea Experiment (BALTEX) [49], In addition to routine monitoring and operational data collection, there are some efforts on homogenisation of historical data and on reanalysis. Examples of such efforts are the NORDKLIM [50] and MESAN (A mesoscale analysis system) that is used to complement observational meteorological data.

3.6.2 Contribution to improved understanding of climate impact

In the summer of 2005, the Government of Sweden started the Commission on Climate and Vulnerability [51]. One of the tasks was to put together an overall impact and vulnerability assessment of all sectors in Sweden, together with a range of experts, organisations and government authorities. The final report will be released in October 2007.

The Rossby Centre is a research unit at the Swedish Meteorological and Hydrological Institute (SMHI) with focus on regional climate change. The Rossby Centre develops and applies atmosphere, ocean and coupled regional climate models for climate analyses and future projections. The resulting scenarios are used for information to stakeholders, as well as a base for impact studies on many sectors, such as water resources, forestry and physical planning [52]. At the SMHI, there are also extensive efforts on climate impact studies on water resources [53]. The regional climate scenarios and impact studies are used in national assessments and international collaboration.

The Swedish Environmental Protection Agency started the research programme Climatools in 2006. Climatools focuses on tools for adaptation but also on impact assessments in some sectors, such as health and tourism [54].

In 2006, the research council Formas, the Swedish National Space Board, the Swedish Research Council and the Swedish Governmental Agency for Innovation Systems (VINNOVA) issued a joint call for applications in the field of Research on Sustainable Development, with cross-disciplinary research on climate change, including impacts on natural and human environment and how to adapt ecosystems and the infrastructure. Targeted funds on this field are also available in 2007.

The Swedish foundation for strategic environmental research, Mistra, funds few larger programmes that relate to climate impacts, such as SWECIA and the Stockholm Resilience Centre.

The Swedish University of Agricultural Sciences has recently started a programme for Climate impact assessment with several different projects [55]. Among others there are projects on phenology and lake water quality.

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49 www.baltex-research.eu/
50 www.smhi.se/hfa_coord/nordklim/new
51 www.sou.gov.se/klimatsarbarhet
52 www.smhi.se/cmp/jsp/polopoly.jsp?d=6024&l=en
53 www.smhi.se/cmp/jsp/polopoly.jsp?d=6052&l=en
54 www.foi.se/climatools
55 www.slu.se/foma

3.6.3 Contribution to identification of gaps and deficiencies

3.6.3.1 In data and observations

Continuous, long-term, engagement in these areas is in line with the Swedish Government's prioritisation of research and development. Some efforts are made to add older data to the modern databases. Recently efforts have also been made on climate indices useful in communicating both ongoing climate change and climate scenarios. Sweden contributes to GCOS and participates actively to the Implementation plan for the global observing system for climate in support of the UNFCCC. Sweden has recently reported on participation in GCOS and on systematic observation with the view to meeting all requirements of the guidelines for reporting on GCOS and systematic observation [56].

As regards space activities, Sweden participates in international projects in order to improve the space component of the observational system. The ODIN research satellite [57] has led to a unique set of ozone data for aerological research. Within the framework of ESA and EUMETSAT, and within the GMES concept, institutions in Sweden develop new techniques and specifications for data and observations integrating space and in-situ observations with future multidisciplinary requirements.

In 2007 the Government of Sweden has set up an Advisory Commission on Sustainable Development [58].

3.6.3.2 In stakeholder data

Some efforts are ongoing in the context of the Commission on Climate and Vulnerability, such as identifying organisational bottlenecks and specific needs for information on different sectors and by different stakeholders.

3.6.3.3 In capacity needs, especially at regional and national levels

Some efforts are included in various ongoing research, development and commission efforts, such as at the Rossby Centre at SMHI and the governmental Commission on Climate and Vulnerability. In 2008 a new national research programme will be initiated (SWECIA - SWEdish research programme on Climate Impacts and Adaptation), in which such aspects will also be included. Another recent effort is the establishment of the Stockholm Resilience Centre [59].

Ways to improve technical infrastructure

The Swedish Meteorological and Hydrological Institute regularly evaluate national climate observing programmes and systems. Currently new national data portals for dealing with climate impacts are being established, such as the Swedish authorities' climate adaptation portal [60].

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56 www.smhi.se/sgmain/lopsedel/GCOS-2005%20slutlig.pdf

57 http://www.snsb.se/eng_odin_intro.shtml

58 www.sweden.gov.se/sb/d/2164/a/79153

59 www.stockholmresilience.su.se/

60 http://www.smhi.se/klimatanpassning

3.7 The Netherlands

The National Research Programme Climate changes Spatial Planning (CcSP [61]) has been developed in close collaboration with a wide range of stakeholders, including the Ministries of Housing, Spatial Planning and the Environment (VROM), Agriculture, Nature Management and Food Security (LNV), Transport, Public Works and Water Management (V&W), Education, Culture and Science (OCW) and Economic Affairs (EZ). Other involved stakeholders are regional and local governments, the private sector and NGOs. Consortium partners include nationally and internationally recognised scientific institutes, securing the international position of the consortium. The programme has a total budget of 90 million Euro (2004 – 2011). All institutes below participate in this programme.

3.7.1 Contribution to improved understanding of current and historical climate

The Royal Netherlands Meteorological Institute (KNMI [62]) is digitizing and archiving of national and international historical observations. It is also co-organizer of WMO workshop on data rescue for the Mediterranean area (RAVI and RAI). It contributes to national and international research to the reconstruction of instrumental and proxy series into high quality paleoclimate observational time series.

National Institute for Coastal and Marine Management (RIKZ [63]) is operating the North Sea Monitoring Network covering the Dutch Continental Shelf (wave buys, fixed sea level monitoring stations, temperature). It also runs a chemical monitoring programme (22 offshore ship based stations (32x/year temperature, salinity, nutrients, micro pollutants etc.) and combined biological monitoring programme (phytoplankton, zoo-plankton, (shell-) fish, birds etc.).

Rijkswaterstaat, Ministry of Economic Affairs: Under the National Offshore Mining Act oil and gas exploration production platforms monitor and distribute data on waves, sea level, temperature, wind etc. A yearly morphological survey and coastline monitoring (dune height and bathymetry up-to 20 m) is carried out as well.

EuroGoos, Rijkswaterstaat: See SEPRISE (Sustained, Efficient Production of Required information Services [64]) for real time oceanographic data, Pan-European infrastructure for Ocean & Marine Data Management (SEDANET [65]) for historical data and North West Shelf Operational Oceanographic System (NOOS [66]) for North sea monitoring and modelling capacity.

National Institute for Public Health and the Environment (RIVM [67]) is operating the National Air Quality Monitoring Network.

Netherlands Environmental Assessment Agency (MNP [68]) coordinates the History Database of

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61 http://www.klimaatvoorruimte.nl/pro3/general/start.asp?i=0&j=0&k=0&p=0
62 http://www.knmi.nl
63 http://www.rikz.nl
64 http://www.eurogoos.org
65 www.seadatanet.org
66 www.noos.cc
67 http://rivm.nl
68 http://www.mnp.nl/en/index.html

the Global Environment (HYDE [69]). It presents not only (gridded) time series for the last 300 years of population and land use, but also various other indicators such as GDP, Value Added, Livestock, Private Consumption, GHG emissions, and Industrial production data.

3.7.2 Contribution to improved understanding of climate impact

KNMI developed and published national climate scenarios 2050 focussed for impact analysis, adaptation and spatial planning. It organises national and international conferences on understanding and impact of and adaptation to climate change.

RIKZ: Coastal research programme (local and large scale coastal dynamics related to sea level rise).

Energy Research Centre of the Netherlands (ECN [70]) is partner in international projects such as CarboEurope, NitroEurope, ICOS.

RIVM is also contributing to international observation networks for ground based remote sensing of atmospheric composition EARLINET, NDACC.

TNO Built Environment and Geosciences made various studies on the relation of climate change/ groundwater.

The International Groundwater Resources Assessment Centre (IGRAC [71]) contributes to improved understanding of climate impact through (1) Inventory 'Climate Change and Groundwater'. (2) Initiative with Cooperative Programme on Water and Climate (CPWC) to set up a Task Force 'Groundwater and Climate Change'.

The Wageningen University and Research Centre - ALTERRA (WUR-ALTERRA [72]) – is providing observation and archiving of phenological data (Nature's Calendar).

The National Research Programme Climate changes Spatial Planning (CcSP) main objective is to offer the Dutch government, the private sector and other stakeholders a clustered, high-quality and accessible knowledge infrastructure on the interface of climate change and spatial planning, and to engage in a dialogue between stakeholders and scientists in order to support the development of spatially explicit adaptation and mitigation strategies. The programme is organised in five main themes: climate scenarios, mitigation, adaptation, integration and communication. Sectors include biodiversity, agriculture, fisheries, fresh water, coastal areas, transport on land and water, sustainable energy production, business, finance/ insurance and governmental strategies.
The Ministry of Housing, Spatial Planning and the Environment (VROM) is responsible for the coordination of the national adaptation strategy [73]. The Dutch Government has initiated a National Programme for the Adaptation of Space and Climate (ARK). A report was published in

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69 http://www.mnp.nl/hyde/
70 http://ecn.nl
71 http://www.IGRAC.nl
72 http://www.alterra.wur.nl
73 http://www.verkeerenwaterstaat.nl/english/

2006. An English summary is available on the Internet [74]. It presents the national strategy to climate proof the spatial planning in the Netherlands.

MNP coordinates Emission Database for Global Atmospheric Research (EDGAR [75]) information system. This is a joint project of research institutes in the Netherlands, Italy and Germany. It stores global emission inventories of direct and indirect greenhouse gases from anthropogenic sources including halocarbons and aerosols both on a per country and region basis as well as on a grid.

3.7.3 Contribution to identification of gaps and deficiencies

3.7.3.1 In data and observations

The Royal Netherlands Meteorological Institute (KNMI) is responsible for the operation of national networks for weather and climate monitoring. It is also contributing to international monitoring networks VOS, ARGO and AMDAR, as well as to the development of satellite instruments and retrieval techniques for atmospheric composition, aerosol and cloud monitoring. KNMI is also contributing to observations at the Cabauw 200 m tower observatory, including a BSRN station (see also CESAR below). KNMI is developing a national implementation plan together with national institutes mentioned below. KNMI also contributes to the GCOS Cooperation Mechanism. KNMI is responsible for collecting, quality controlling and identifying and filling gaps of observational time series and subsequent sustainable archiving in the National Observational Database. Homogenisation of data sets and individual time series is done in cooperation with COST-ES0601.

EuroGoos, Rijkswaterstaat: see NOOS strategic plan (see NOOS).

Cabauw Experimental Site for Atmospheric Research (CESAR [76]) is an observational facility with a comprehensive set of remote sensing and in-situ equipment to characterize the state of the atmosphere, its radiative properties and interaction with the land surface, for the study of physical and chemical processes, climate monitoring and validation studies. It is a co-operation between Delft University of Technology, KNMI, RIVM, ECN, TNO, ESA-ESTEC and WUR.

Energy Research Centre of the Netherlands (ECN) is monitoring atmospheric composition (continuous vertical gradients of CO2, CH4, N2O, SF6, Halocarbons, H2), and aerosols(size distribution, size resolved chemical composition, cloud forming properties, radiative properties).

The Royal Netherlands Institute for Sea Research (NIOZ [77]) is running Multidisciplinary observations for oceanographic research.

RIVM is monitoring atmospheric composition (greenhouse gases) and vertical profiles (water vapour, aerosols and cloud-aerosols, UV radiation, and tropospheric and stratospheric ozone).

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[74] http://www.programmaark.nl/Internationaal/Downloads_GetFileM.aspx?id=19401

[75] http://www.mnp.nl/edgar/

[76] http://www.cesar.observatory.nl

[77] http://www.nioz.nl

The Institute for Inland Water Management and Waste Water Treatment (RIZA [78]) is monitoring river discharges, water temperature and water quality.

The TNO Built Environment and Geosciences is monitoring groundwater level data, groundwater quality. Data and groundwater models are stored in the DINO-system. The DINO-system is the central storage site for geo-scientific data on the shallow and deep Dutch subsurface and resorts under the DINO-programme, aimed at maintaining and improving the National Geological Database in the Netherlands.

IGRAC is contributing to the GGMS (Global Groundwater Monitoring System).

The Utrecht University, Institute for Marine and Atmospheric Research (UU-IMAU [79]) is monitoring ice-caps and glaciers.

The Wageningen University and Research Centre – ALTERRA (WUR-ALTERRA) – is monitoring soil parameters and land-use (change) and land bound GHG emissions.

3.7.3.2 In stakeholder data

At KNMI relations with stakeholders are well established, and are being further developed. KNMI is maintaining an inventory of user needs concerning data on climate change, climate desk for stakeholder questions about climate (change), and is also giving presentations for groups of stakeholders, etc.

With regard to CESAR stakeholders are climate modellers, water boards, space agencies and industries. The relationships are either in place, or will be developed.

ECN has identified stakeholders. However, they need to be convinced that the data will matter.

At TNO Built Environment and Geosciences through the current DINO programme users and stakeholders are involved in the data acquisition and dissemination process.

IGRAC has an inventory of existing monitoring networks to be used for GGMS.

With regard to CcSP stakeholders are the national and local government representatives, scientists, land managers, water boards and private companies.

Wageningen University and Research Centre - ALTERRA (WUR-ALTERRA): Stakeholders are climate modellers, land managers, water boards and space agencies. The relationships are either in place, or will be developed.

3.7.3.3 In capacity needs, especially at regional and national levels

At KNMI pilot projects with stakeholders to supply and use climate data, climate desk for questions about climate (data), internet application for time series for the future, and preparation of 'climate atlas' contributes to the identification of gaps and deficiencies in capacity needs.

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[78] http://www.rijkswaterstaat.nl/rws/riza

[79] http://www.phys.uu.nl/~wwwimau/

At CESAR stakeholders can participate in the CESAR Advisory Board, which is the discussion forum to address these issues.

At ECN: through workshops where national, industry, EU and UNFCCC are involved.

At TNO Built Environment and Geosciences: through the current DINO programme users and stakeholders are involved in the data acquisition and dissemination process.

IGRAC: Workshop on GGMS at IGRAC in October 2007.

3.7.4 Ways to improve technical infrastructure

CESAR: Database operation, development of new technologies for atmospheric observation to reduce gaps in climate knowledge, including space and ground based instruments, improving representation of physical processes in climate models.

ECN: Network optimisation, capacity building in Eastern Europe, higher network density, data quality, submission to GAW.

RIVM: Development of international networks for atmospheric profiling (EARLINET, NDACC, GALION).

TNO Built Environment and Geosciences: On-going research programme to improve data acquisition, data storage and data distribution. Focus on sensor networks and Sensor Web Enablement (SWE).

IGRAC: Development of the web-based monitoring application.

Wageningen University and Research Centre - ALTERRA (WUR-ALTERRA): Data are managed and made accessible at national and European level.

3.8 United Kingdom

3.8.1 Contribution to improved understanding of current and historical climate

Met Office Hadley Centre (MOHC), funded by the Ministry of Defence and Defra is involved in a variety of climate-change related EU research projects e.g. PRUDENCE, CarboEurope, CarboOcean, SCOUT-3, DYNAMITE, NitroEurope and EURORISK. Aims of Met Office Hadley Centre are described on the Internet [80].

Defra on behalf of the UK government and devolved administrations- Climate Data Programmes: Part of the Defra funded UKCIP08 climate scenarios programme (involving the UK Climate Impacts Programme and Met Office Hadley Centre) will include a historic climate data component. Observed data for temperature will be available from 1961-2000 at daily level and will be available through the Met Office website.

[80] http://www.metoffice.gov.uk/research/hadleycentre/about.html

Defra in conjunction with NERC and the Australian Government launched the Advanced Along-Track Scanning Radiometer (AATSR) on the ESA satellite Envisat in 2002. AATSR measures global Sea Surface Temperature (SST) from space. Validation of the data has confirmed the accuracy of the instrument and its ability to detect climatic trends in the ocean. Data from AATSR, in conjunction with measurements from previous instruments (ATSR-1 and ATSR-2) will provide a SST record of approximately 15 years.

Defra also supports research to ensure the UK meets its legal international reporting requirements to the EU Monitoring Mechanism, the UNFCCC and the Kyoto protocol.

A considerable amount of climate-related research is funded by other Government bodies, including the Scottish Executive, Welsh Assembly, Department of Environment (Northern Ireland), Forestry Commission, Environment Agency, Scottish Protection Agency and the statutory conservation agencies. Systematic observations in the UK and its overseas territories are made by a number of national agencies and organisations.

Natural Environment Research Council (NERC): Climate change (predicting and mitigating the impacts) was identified as one of three science priorities in the current strategy (2002-2007). NERC's new strategy [81] includes the theme “Climate system", which seeks to improve predictions, reduce and quantify uncertainties. All of NERC's research centres and most collaborative centres have particular research foci in climate change.

3.8.2 Contribution to improved understanding of climate impact

Met Office Hadley Centre (MOHC), funded by the Ministry of Defence and Defra is involved in a variety of climate-change related EU research projects e.g. PRUDENCE, CarboEurope, CarboOcean, SCOUT-3, DYNAMITE, NitroEurope and EURORISK.

Defra funds the UK Climate Impacts Programme (UKCIP [82]), to provide a coordinated framework for assessing current and future climate change impacts (as well as identifying potential adaptation strategies in the UK). UKCIP advises stakeholders and provides tools to decision makers to help them in making adaptation decisions. This includes national climate scenarios and involvement in impacts studies done by others. Defra has also undertaken various internal research projects looking at the impacts of current and historical climate. For example, Defra's Climate and Energy Science and Analysis division funded a study looking at the economic effects of the 2003 heatwave which completed in 2006 (search for GAO1075 [83]).

Defra on behalf of UK government – Marine Climate Change Impacts Partnership (MCCIP [84]): MCCIP produces an annual report card detailing the latest evidence of the current impact of climate change on the marine environment around the UK.

Defra: 5 linked "Fast Track" projects provided estimates of the implications of climate change at the global scale. Effects of climate change and population growth on human health, natural vegetation, agriculture, the coastal zone and water resources were investigated.

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81 http://www.nerc.ac.uk/about/strategy/

82 http://www.ukcip.org.uk/

83 http://randd.defra.gov.uk/

84 http://www.mccip.org.uk/arc/default.htm

Defra also supports research to ensure the UK meets its legal international reporting requirements to the EU Monitoring Mechanism, the UNFCCC and the Kyoto protocol.

A considerable amount of climate-related research is funded by other Government bodies, including the Scottish Executive, Welsh Assembly, Department of Environment (Northern Ireland), Forestry Commission, Environment Agency, Scottish Protection Agency and the statutory conservation agencies. Systematic observations in the UK and its overseas territories are made by a number of national agencies and organisations.

The Tyndall Centre for Climate Change [85] is a joint programme of NERC, EPSRC and ESRC, with support from other government departments. It was set up in 2000, "to research, assess and communicate from a distinct trans-disciplinary perspective, the options to mitigate, and the necessities to adapt to, climate change, and to integrate these into the global, UK and local contexts of sustainable development."

Natural Environment Research Council (NERC): Climate change (predicting and mitigating the impacts) was identified as one of three science priorities in the current strategy (2002-2007). NERC's new strategy includes the theme “Climate system", which seeks to improve predictions, reduce and quantify uncertainties. All of NERC's research centres and most collaborative centres have particular research foci in climate change.

Engineering and Physical Sciences Research Council (EPSRC): EPSRC's 2005-08 delivery plan has several strands which contribute to climate change research. E.g. energy technologies for the 21 century will have a focus on technologies to reduce or remove the reliance on fossil fuels [86].

Economic and Social Research Council (ESRC): One of 7 key research challenges in the Strategic Plan [87] 2005-2010 is "Energy, the environment and climate change".

Biotechnology and Biological Science Research Council (BBSRC): Supports climate change related research in response to proposals for individual projects. Several BBSRC sponsored institutes are active in research into impacts of climate change on the function and behaviour of plants, animals and soils.

3.8.3 Contribution to identification of gaps and deficiencies

3.8.3.1 In data and observations

Defra on behalf of UK government: UK Global Environmental Change Committee (GECC) subgroup on observations [88]. Key role is to identify and track current activities at national and international level and to consider future requirements.

The Environment Research Funders' Forum (ERFF [89]) brings together the UK's major public

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85 http://www.tyndall.ac.uk/

86 http://www.epsrc.ac.uk/CMSWeb/Downloads/Publications/Corporate/DeliveryPlan200708.pdf

87 http://www.esrc.ac.uk/ESRCInfoCentre/Images/Strategic_Plan_2005-10_tcm6-12995.pdf

88 http://www.ukgecc.org/dvl_Observation.htm

89 http://www.erff.org.uk/

sector sponsors of environmental science. ERFF seeks to maximise the coherence and effectiveness of UK environmental research funding. ERFF recently completed a review of environmental monitoring in the UK [90].

The MCCIP annual report card includes a description of the uncertainty related to different observations and future projections and suggests areas where further research is needed to understand the effect of climate change on the marine environment.

NERC, EPSRC, ESRC, and BBSRC all have wide consultation on strategy development.

3.8.3.2 In stakeholder data

ERFF: Workshop and wide consultation.

UKCIP works with a wide range of stakeholders, from government, business and research communities to advise them on how they should prepare for climate change, including impacts that are already being felt. In addition to a number of regional scoping studies, UKCIP has identified sectoral areas where knowledge of impacts of, and adaptation to, climate change is more premature and related this information to Defra to inform future decisions on research funding.

The MCCIP incorporates a range of marine stakeholder organisations concerned about the impacts of climate change. MCCIP has been set up as a response to gaps identified in the report 'Charting Progress: an Integrated Assessment of the State of UK Seas' and its primary aims are to streamline the transfer of marine climate change knowledge to policy advisors and decision makers [91].

UK Energy Research Centre (UKERC): At the BA Festival of Science, the University of Oxford, supported by UKERC, hosted a debate on Limits to Growth – can the climate cope with our continuing use of fossil fuels? What social, economic and political dimensions should we consider?

NERC: A range of activities are carried out at different levels. NERC seeks to ensure representation of a range of stakeholders on its various decision making bodies.

EPSRC: Joint initiative with UKCIP to bring together industry stakeholders and academic researchers to address the impacts of climate change in the built environment through the programme "Building Knowledge for a Changing Climate".

3.8.3.3 In capacity needs, especially at regional and national levels

MOHC: Example activities include:

- PRECIS (Providing Regional Climates for Impact Studies), a regional climate modelling system developed at the MOHC. Since 2003, PRECIS workshops have been held in the UK, Cuba, Bhutan, Brazil, India, Turkey, Argentina, Belize, Malaysia and Ghana [92]. Funding for

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90 http://www.erff.org.uk/about/organisation/workgroup/rescoor-envmon.asp

91 http://www.mccip.org.uk/summaryaims.html

92 http://precis.metoffice.com/Training_courses_and_workshops.html

development, collaboration and training materials have come from Defra, DfID and the UNDP.
- ENSEMBLES (Ensemble-based prediction of climate changes and their impacts) is funded by EU and MOHC funding streams. Coordinated by the MOHC, research aims to quantify uncertainty long-term prediction of climate change.
- International collaboration for IGBP (International Geosphere-Biosphere Programme), to develop the understanding necessary to respond to climate change.

As part of the UKCIP08 climate scenarios programme, a user consultation process has been undertaken which has investigated what users need in terms of current and future climate data. Results of this consultative process are available on the Internet [93].

MCCIP: The annual report card (ARC) synthesises the previous year's work, covering the following key questions:
- What is the current state of scientific understanding of marine climate change in our oceans and seas?
- What changes have been observed and what could happen in the future?
- How much of this is hard fact and how much is interpretation?

The high level statements presented in the ARC are supported by more detailed reports from each contributing scientists and the ARC is also peer reviewed.

Defra: Results were reported in a special edition of Global Environmental Change, volume 14, April 2004.

3 year collaborative project between Defra and the Chinese Ministry of Science and Technology investigated the impacts of climate change on Chinese agriculture. A second 3-year phase was launched in 2005 [94]. Defra funded a collaborative project with the Indian Ministry of Environment and Forests (MOEF), to assess impacts of climate change on sea level variability, water resources, forests, agriculture, health, energy, industry and transport infrastructure [95].

NERC: The NERC data policy details the commitment to support the long-term management of data so that data collection using NERC funds are available for the long-term.

3.8.4 Ways to improve technical infrastructure

MOHC: Example activities include:
- PRECIS, which can be easily applied to any area of the globe. This allows developing countries to generate their own detailed local climate predictions, without the need for supercomputers or individually developed modelling software.
- The Technical Support Unit (TSU) hosted by the Met Office, which supports IPPC activities.

Defra on behalf of the UK government and devolved administrations – Climate Data Programmes: Defra awarded a contract to the British Atmospheric Data Centre in 2006 to take over the running of three web interfaces allowing users to access and manipulate climate data;

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93 http://www.ukcip.org.uk/scenarios/ukcip08/consultation.asp

94 http://www.ami.ac.cn/sino%5Fuk/

95 http://www.defra.gov.uk/environment/climatechange/internat/devcountry/india.htm#impacts

the LINK site for Hadley Model data [96], Data Distribution Centre for IPCC model data [97] and a new site to disseminate the UKCIP08 scenarios which is under construction. A major part of this contract is investigating user requirements and making subsequent improvements to the way this data is presented and packaged. Although this contract mainly relates to climate model data there is a component of observed climate data which is included.

MCCIP: The annual report card (ARC) synthesises the previous year's work, covering the following key questions:

- What is the current state of scientific understanding of marine climate change in our oceans and seas?
- What changes have been observed and what could happen in the future?
- How much of this is hard fact and how much is interpretation?

The high level statements presented in the ARC are supported by more detailed reports from each contributing scientists.

NERC: NERC has a data management coordinator and a series of NERC data centres [98]. NERC is developing a NERC Data Grid to provide seamless access to NERC data.

[96] http://badc.nerc.ac.uk/data/link/

[97] http://www.ipcc-data.org/

[98] http://www.nerc.ac.uk/research/sites/data/

PAPER NO. 8: RUSSIAN FEDERATION

ПРЕДСТАВЛЕНИЕ РОССИЙСКОЙ ФЕДЕРАЦИИ ПО НАЙРОБИЙСКОЙ ПРОГРАММЕ РАБОТЫ В ОБЛАСТИ ВОЗДЕЙСТВИЙ, УЯЗВИМОСТИ И АДАПТАЦИИ К ИЗМЕНЕНИЮ КЛИМАТА

Каким образом работа Росгидромета может способствовать более глубокому пониманию текущей и прошлой динамики климата и ее воздействия, включая выявление пробелов и недостатков в данных и результатах наблюдений, с учетом потребностей заинтересованных кругов в данных, необходимости укрепления потенциала, особенно на региональном и национальном уровнях, и путей совершенствования технической инфраструктуры.

Федеральная служба по гидрометеорологии и мониторингу окружающей среды (Росгидромет) является уполномоченным федеральным органом исполнительной власти по гидрометеорологии и мониторингу окружающей среды в Российской Федерации – стране - члене ВМО.

Роль Росгидромета как национальной гидрометеорологической службы (НГМС) в более глубоком понимании текущей и прошлой динамики климата и ее воздействия, включая выявление пробелов и недостатков в данных и результатах наблюдений, с учетом потребностей заинтересованных кругов в данных, необходимости укрепления потенциала, особенно на региональном и национальном уровнях состоит в следующем:

1. Климатические наблюдения. В Российской Федерации наблюдения за климатом и его изменениями проводятся Росгидрометом в рамках реализации Конвенции ВМО, по программам ГНС ВСП (GOS WWW) – Глобальной Наблюдательной Системой Всемирной Службы Погоды, ГСА ВСП (GAW WWW) - Глобального Наблюдения за Атмосферой Всемирной Службы Погоды, ГСОН (GOOS) – Глобальной Системы Океанических Наблюдений, ГСНС (GTOS) – Глобальной Системы Наблюдений за Сушей. Российский сегмент ГНС ВСП состоит из 1627 станций, в т.ч. 454 станции входят в состав реперной климатической сети (РКС). Приземная сеть наблюдений в составе Глобальной системы наблюдений за климатом (ГСНК) включает 135 станций (25 станций РА-6 и 110 станций РА-2). Региональная опорная климатическая сеть (РОКС) включает 238 станций, аэрологическая сеть –105 станций, в том числе 12 станций ГСНК (из общего количества 163 станций по земному шару), озонометрическая сеть – 27 станций ГСА, мониторинг концентрации парниковых газов (углекислый газ и метан) осуществляется на 2 станциях (Териберка и Новый порт) ГСА. Актинометрические наблюдения ведутся на 191 метеостанциях, гидрологические наблюдения на реках, озерах и водохранилищах на 3085 пунктах, высотные наблюдения пограничного слоя атмосферы – на 1 станции (300-м мачте в Обнинске), наблюдения за снежным покровом в горных районах Северного Кавказа на 3 снеголавинных станциях и 8 постах.

Развитие и расширение наблюдательных сетей и программ наблюдений способствует лучшему пониманию состояния климата в настоящем, прошлом и будущем. Плотность наблюдательной сети в Российской Федерации в силу физико-географических особенностей не равномерна (максимум на Европейской части страны, и минимально в Сибири, на Арктическом побережье). Развитие автоматических, дистанционных способов измерений позволяет производить наблюдения за климатом в отдаленных и труднодоступных местах (горные районы, акватория моря, полярные области, малонаселенные районы вечной мерзлоты). В 2006 году началась активная фаза реализации проекта "Модернизация и техническое перевооружение учреждений и организаций Росгидромета", выполняемого за счет займа Всемирного банка. Проектом предусматривается:

- техническое перевооружение 1600 наземных станций основной и дополнительной сети. При этом на 28 станциях, проводящих измерения параметров солнечной радиации и имеющих длительные ряды наблюдений, устанавливается современное оборудование и приборы регистрации потоков солнечной радиации. Создается одна опорная актинометрическая станция BSRN и заменяется эталон единицы энергетической освещенности солнечного излучения;

- внедрение на труднодоступных метеорологических полярных станциях (включая ранее закрытие полярные станции), передающих информацию в международный обмен, автоматизированных метеорологических комплексов или автономных автоматических станций в северном исполнении;
- установка на труднодоступных и радирующих станциях комплексов оборудования передачи данных по радио и через спутник (радиостанция в комплекте с антенной и блоком питания) и устройств энергообеспечения;
- оснащение части станций датчиками для измерения мощности экспозиционной дозы излучения.

2. Исследования. В систему Росгидромета входят 17 НИУ, с определенным профилем научно-исследовательской работы, в том числе по вопросам изучения климата: мониторинг климата, оценка последствия влияния изменения климата на природную среду и экономику (ИГКЭ, www.igce.comcor.ru), прикладная климатология, климатическое моделирование, наблюдения за парниковыми газами (ГГО, www.mgo.rssi.ru), климат Арктики и Антарктики (ААНИИ, www.aari.nw.ru), климат водных бассейнов рек и озер (ГГИ, www.hydrology.ru), климат океанов (ГОИН, www.oceanography.ru), создание и ведение баз данных, оценка экстремальности климата (ВНИИГМИ-МЦД, www.meteo.ru), исследования озонового слоя Земли (ЦАО, www.cao-rhms.ru/).

В 2006 году НИУ Росгидромета был введен в действие web-сайт "Изменения климата России", предназначенный для предоставления информации о климате и изменениях климата различным пользователям и прежде всего исследователям, использующим климатические данные в своей работе Интернет-портал предоставляет удаленному пользователю возможность дистанционного доступа к современным данным мониторинга климата и к результатам климатического моделирования, содержащим сценарные прогнозы ожидаемых изменений климата для назначенного пользователем периода в интересующем его регионе.

На Интернет-сайте Росгидромета ежегодно размещается доклад об особенностях климата на территории Российской Федерации за прошедший год (www.meteorf.ru), подготовленный НИУ Росгидромета для информирования широкого круга пользователей. В 2006 году НИУ Росгидромета был подготовлен стратегический прогноз изменений климата Российской Федерации на период до 2010-2015 гг. и их влияния на отрасли экономики России.

В стратегическом прогнозе представлен наиболее вероятный прогноз ожидаемого к 2010–2015 гг. состояния климата Российской Федерации и ее регионов, а также сформулированы рекомендации по первоочередным адаптационным мерам, направленным на предотвращение (снижение) потерь от отрицательных и на повышение экономического эффекта от благоприятных последствий климатических изменений по регионам и субъектам Российской Федерации применительно к отраслям экономики. Стратегический прогноз был направлен в федеральные и региональные органы власти, а также представлялся на различных российских и международных совещаниях и конференциях.

В 2006 году НИУ Росгидромета был разработан электронный атлас "Климат морей России и ключевых районов Мирового океана" по гидрометеорологическому и гидрофизическому состоянию Балтийского, Баренцева, Японского, Охотского, Каспийского и Черного морей. Завершено формирование единого массива данных приземных метеорологических измерений на российских антарктических станциях за весь период инструментальных измерений. Определены параметры реакции климата Антарктики на изменения концентрации парниковых газов в атмосфере на основе

моделей климата и натурных данных. Организован мониторинг антарктических экосистем на отдельных наземных полигонах. Выполнены расчеты будущих изменений климата на территории России и сопредельных регионов в XXI веке, обусловленных ростом парниковых газов в атмосфере. Был подготовлен первый вариант электронной версии научно-прикладного справочника по климату России, подготовлен ряд региональных справочников по климату.

Ученые Росгидромета принимают участие в научно-исследовательских проектах климатических программ ВМО, ЮНЕСКО, ЮНЕП, в работе МГЭИК.

3. Взаимодействие с потребителями. Одной из задач Росгидромета является содействие повышению эффективности хозяйственной деятельности в «климатозависимых» отраслях экономики (авиации, морском, речном транспорте, ТЭКе, сельском хозяйстве, энергетике, строительстве и т.д.) за счет предоставления обширной метеорологической и климатологической продукции и специализированного обслуживания. Для достижения этой цели Росгидромет при взаимодействии с заинтересованными организациями - потребителями погодно-климатической информации проводит различные научные исследования. В 2006 году была выполнена оценка последствий возможных изменений климата в XXI веке для технических систем (строительство, энергетика, ТЭК, наземный транспорт) и ЖКХ. Разработана современная технология обеспечения технических секторов экономики специализированной климатической информацией. Росгидрометом регулярно проводятся совещания-семинары по вопросу совершенствования специализированного гидрометеорологического обслуживания отраслей экономики, в том числе климатической информацией. На таких мероприятиях обсуждаются информационные продукты, которые могут быть предоставлены Росгидрометом для снижения погодно-климатических рисков производственной деятельности в этих отраслях экономики. В 2006 году в г. Архангельске состоялось совещание совещания «Специализированное гидрометобеспечение нефтегазовой отрасли» (http://www.sevmeteo.ru/news/2007/07/03/641.shtml). В Российской Федерации появляются новые сферы занятости, где очевидна потребность в климатической информации, но конкретные виды информационной продукции пока находятся в стадии исследований – это такие отрасли как туризм, страхование. В сентябре 2007 года в г. Нижний Новгород состоялся семинар по вопросам адаптации к изменениям климата, на котором обсуждались региональные проблемы адаптации к изменениям климата на примере Нижегородской области.

4. Взаимодействие со СМИ. Традиционно, НГМС имеют тесные связи со средствами массовой информации и, таким образом, играют уникальную роль в широком распространении знаний о климате через средства массовой информации – прессу, радио, телевидение и Интернет. Росгидромет регулярно проводит брифинги, круглые столы по вопросам изменения климата, реализации РКИК ООН и Киотского протокола в Российской Федерации, участвует в подобных мероприятиях, организованных другими организациями. В 2006-2007гг. Росгидромет был организатором регионального брифинга по IV Оценочному докладу МГЭИК. На регулярной основе в СМИ публикуются статьи ведущих ученых Росгидромета.

5. Укрепление потенциала. Подготовка кадров. Росгидромет осуществляет многолетнее сотрудничество с высшими учебными заведениями, где которые готовят специалистов-климатологов. В организациях Росгидромета студенты проходят производственную практику. Специалисты Росгидромета повышают свои профессиональные знания в области климата в институте повышения квалификации Росгидромета (www.meteorf.ru/srv/ipk/index.htm), а также в 12 аспирантурах НИУ Росгидромета.

[Unofficial translation]

SUBMISSION OF THE RUSSIAN FEDERATION ON THE NAIROBI WORK PROGRAMME ON IMPACTS, VULNERABILITY AND ADAPTATION TO CLIMATE CHANGE

The Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet) is an authorized federal body of executive power on hydrometeorology and environmental monitoring of the Russian Federation – the member-state of the WMO.

The role of Roshydromet as a national hydrometeorological service (NHMS) in more profound understanding of the past and on-going climate dynamic and its influence, including the revelation of gaps and deficiency in data and results of observations also taking into the consideration the needs for data among the stakeholders, the necessity for capacity-building, especially at regional and national levels, is in the following:

1. Climatic observations. The monitoring of climate and its dynamic in the Russian Federation is carried out by Roshydromet in the framework of implementation of the WMO Convention and according to the programmes GOS WWW – Global Observation System of World Weather Watch, GAW WWW – Global Atmosphere Watch of World Weather Watch, GOOS – Global Ocean Observation System, GTOS – Global Terrain Observation System. The Russian segment of GOS WWW consists of 1627 stations, including 454 stations of reference climatic network (RCN). The ground-based network formed on the basis of Global Climate Observation System includes 135 stations (25 RA-6 stations and 110 RA-2 stations). The Regional reference climatic network incorporates 238 stations, Upper-air network – 105 stations, including 12 GCOS stations (from the total of 163 stations worldwide), the Ozonometrical network numbers 27 GAW stations, monitoring of the greenhouse gases concentration is conducted on 2 GAW stations (Teriberka and Noviy Port). The actinometrical observations are carried out on 191 weather stations; hydrological monitoring on rivers, lakes and reservoirs is conducted on 3085 posts, the high-altitude observations of atmosphere boundary – on 1 station (300 m tower in Obninsk), and the snow blanket observations in mountain areas of the Northern Caucasus is conducted on 3 snow avalanches stations and 8 posts.

The development and expansion of observation networks and programmes favours better understanding of climate conditions in the past, present and future. The density of observation networks in the Russian Federation depends on its geographical features and thus is not even (with the maximum in the European part and minimum in Siberia and the Arctic coast of the country).

The development of automated and remote methods of measurement makes it possible to conduct the climate monitoring in remote and difficult-of-access areas (mountain, water and polar areas and sparsely populated regions of permafrost). In 2006 the project “Modernization and technical re-equipment of Roshydromet agencies and organizations” came to its active phase. It has been implemented due to the lending from the Worldbank. The project provides the following:

- technical re-equipment of 1600 ground-based stations of major and supplemental network. 28 stations observing and measuring the parameters of sun radiation and thus having the long-term databases are being equipped with modern sun radiation registration devices. One reference actinometrical station BSRN is being built and the standard of sun radiation energetic illumination unit is being changed.
- installation of data transferring equipment and energy supplies on distant and difficult-of-access stations (including formerly closed stations), which transfer data to the international exchange networks, installation of automated meteorological complexes and autonomous stations.
- installation of data transferring equipment (via satellites) on remote wireless stations (radio station with antenna and power supply) and energy supplying devices.
- equipment of several stations with sensors to survey the output of radiation exposure dose.

2. Research. The Roshydromet system includes 17 scientific research institutes (SRI) with definite profiles of research including the following climate issues: monitoring of climate, estimation of impacts of climate change on the environment and the economy (Institute of Global Climate and Ecology, www.igce.comcor.ru), applied climatology, climatic modelling, greenhouse gases observation (Main Geophysical Observatory, www.mgo.rssi.ru), climate of the Arctic and Antarctic regions (Arctic and Antarctic Research Institute, www.aari.nw.ru), climate of water basins of rivers and lakes (State Hydrological Institute, www.hydrology.ru), climate of oceans (State Institute of Oceanography, www.oceanography.ru), creation and support of databases, estimation of climate extremity (All-Russian Institute of Hydrometeorological Information – World Data Center, www.meteo.ru), and the research of the ozone layer of Earth (Central Aerological Observatory, www.cao-rhms.ru/).

In 2006 the Internet site “Climate Changes in Russia” was promoted by Roshydromet. The site provides information on climate and its changes to different users and on the first-hand to scientists who use climatic data in their research work. The internet portal provides access to up-to-date data on climate monitoring and to the results of climate modelling, which contain the standard forecasts of climatic changes in the selected region and chosen period of time, for the remote users.

The report on past year climate peculiarities on the territory of Russia (www.meteorf.ru) prepared for the wide reference of users is put on the Roshydromet site annually. In 2006 the Strategic prediction of climate change expected in Russia and its impact on sectors of the Russian national economy for the period of up to 2010-2015 was prepared by the Roshydromet.

The strategic prediction contains information on the most probable climatic conditions on the territory of the Russian Federation and its regions by 2010-2015 and recommendations on primary adaptation measures in order to eliminate (minimize) the losses from the negative as well as to maximize the economic effect from the positive impacts of climate change in different regions of Russia in conformity with various branches of the economy. This strategic prediction was sent to the federal and regional government bodies, and also was presented on various Russian and international meetings and conferences.

In 2006 Roshydromet developed an electronic atlas “The Climate of Russian Seas and Key Areas of the World Ocean” that represents the hydrometeorological and hydro-physical conditions of the Baltic, Barenc, Japan, Okhotsk, Caspian and the Black seas. The forming of a uniformed database of ground-based meteorological measurements of Russian Antarctic stations for the whole period of instrumental measurements was completed. The parameters of Arctic climate reactions to the change of greenhouse gases concentration in the atmosphere were determined on the basis of various climate models and field data. The monitoring of arctic ecosystems was organized on several field stations. The estimations of future climate changes caused by the increasing concentration of greenhouse gases in the atmosphere on the Russian territory and border regions in the 21st century were also conducted. The first electronic version of scientific and applied reference book on climate of Russia as well as series of regional climate reference books were prepared.

The scientists of Roshydromet take part in scientific and research projects of climatologic programmes of the WMO, UNESCO, UNEP and in the work of IPCC.

3. Cooperation with consumers. One of the Roshydromet objectives is to assist the efficiency of economic activities in climate-dependant sectors of economy (aviation, maritime and river transport, energy, agriculture, construction, etc.) through the representation of extensive meteorological and climatological products and specialized services. For this purpose Roshydromet in association with various interested organizations – consumers of weather-climatic data – carry out scientific research. In 2006 the assessment of possible impacts of climate change for the technical systems (construction, energy, heat and power sector, transport) and households in the 21st century was conducted. The modern technology of providing the technical sectors of the economy with specialized climatic information was developed. Roshydromet conducts meetings and seminars devoted to such issues as improving and upgrading of the specialized hydrometeorologic services to the economy sectors, including the climatic information, on the regular basis. Such meetings are usually dedicated to the information products, which may be presented by Roshydromet in order to minimize the climatic risks for production activities in these sectors of the national economy. In 2006 the conference “The Specialized hydrometeosurvey for the oil and gas sector” took place in Arkhangelsk (http://www.sevmeteo.ru/news/2007/07/03/641.shtml).

New areas of employment, where the need for climatic information is evident, appear in the Russian Federation. These fields are tourism and insurance, however the distinct informational products are still at the stage of research. In September 2007 the conference on climate change and adaptation was held in Nizhniy Novgorod, the main issues for discussion were the regional aspects of adaptation to the climate changes by the example of Nizhegorodskaya oblast.

4. Cooperation with the mass media. Traditionally, the NHMS have tight interconnections with the mass media, and thus have a unique role in spreading knowledge about the climate via press, radio, television and internet. Roshydromet regularly holds briefings and round-tables on the various aspects of climate change, realization of the UNFCCC and Kyoto Protocol in the Russian Federation, participates in similar events held by other organizations. In 2006-2007 Roshydromet hosted the

regional briefing on the IPCC Fourth Assessment Report. The articles of the leading scientists of Roshydromet are regularly published in the press.

5. Capacity-building. Education and training. Roshydromet has a long-term cooperation with the institutes of higher education, where specialists-climatologists are trained. Students of Roshydromet organizations attend special trainings. Specialists of Roshydromet improve their professional skills and knowledge in the field of climatology in the institute of improvements of professional skills of Roshydromet (www.meteorf.ru/srv/ipk/index.htm) as well as in 12 post-graduate SRIs.

PAPER NO. 9: UZBEKISTAN

The view of the Republic of Uzbekistan on how the WMO Member States could contribute to improved understanding of current and historical climate and its impacts

The Republic of Uzbekistan supports the activities of the UNFCCC Secretariat on the implementation and further development of the Nairobi work program on impacts, vulnerability and adaptation to climate change.

As WMO Member State the Republic of Uzbekistan can contribute to improved understanding of current and historical climate and its impacts by the following means:

- **restoration, updating and equipping** with the up-to-date instruments and equipment of the **existing network of hydrometeorological observations** at the national level and improvement of collection, management and use of data at the regional level. As the main water resources have transboundary structure and the snow reserves data requests for water forecasts in region then the regional exchange with observation data is needed. Realization of all these measures in the required scope is feasible only with the foreign financial investments;
- removing **of identified gaps and lacks** in data of observations and carrying out the activities on preservation and restoration of data which require the analysis of data of previous years using metadata for the completing of observation data records. This work can be done in the framework of special project as it requires scientific development work for the creation of methodological base;
- completing satisfaction **of the stakeholders' needs in data** which is feasible with creation of the regional data bases (data subjected to international exchange via WMO should be accessible in the regions online);
- **capacity-building**, both methodically and practically, creating methodological principles of the up-to-date data collection and storage and the technical support of its realization. The practical way means of national capacity-building of the qualified experts until the international class which is feasible by the organization and conduction of the training courses for the upgrading of qualification with the application of the best practice and advanced experience in the field of data management for the specialists of the national hydrometeorological services.

The **improved understanding of current and historical climate and its impacts** by the specialists of the national hydrometeorological services will be facilitated by the possibility of their participation in the international regional projects with involvement of data of the social-and-economical consequences of climate variability and dangerous phenomena related to climate. We think that it is expedient to provide for the overall support to the projects of «Case Study» type with special emphasis on the studying of the social-and-economical consequences of climate change.

PAPER NO. 10: GLOBAL CLIMATE OBSERVING SYSTEM

The Role of Observations in Support of Adaptation: The GCOS[1] Contribution to the Nairobi Work Programme (In Cooperation with the WCRP and WMO)

Executive Summary

Adequate high-quality observations of climate and climate-related variables are essential if adaptation to climate change is to be based on deliberate planning leading to better adaptation policies. Good observations acquired over extended periods make possible an understanding of the frequency of extreme events as well as average climate conditions. They thereby contribute to better planning and decision making related to agriculture, coastal zone management, water resources management, health, tourism, and disaster risk management.

Observations also play a key role in initializing models to enable weather forecasting and longer range statistical predictions of seasonal, inter-annual, and decadal climate. While observations provide a factual basis for assessing current climate change and an indication of shorter term future change, climate models provide a basis for improved guidance and an ability to assess possible climate change over longer time scales. Global climate models are vital because a global scale is essential to represent the complex interactions and processes of the climate system. Regional models using boundary conditions derived from global models are an important supplement, as they provide much higher resolution projections about changes at the regional and national scales at which adaptation responses will be considered. Statistical downscaling models are another way to provide the needed regional detail and are viewed by some as currently a more reliable approach. Such models can, however, only be used when detailed regional observations are available. Thus, regional models--and adaptation responses--require denser observing networks than needed for global models. The companion paper submitted by the World Climate Research Programme (WCRP) discusses in more detail the issues and needs related to using regional models and other downscaling techniques for providing greater spatial detail in climate projections.

Whether in conjunction with models or otherwise, an important GCOS objective is to ensure that climate observations are used to maximum benefit to support adaptation. *At the present time, in many countries neither the quality nor quantity of observations needed by global and regional models is adequate to support and verify climate models so as to allow the reliable projections needed for adaptation purposes. In order to meet adaptation needs, models will need to be improved and observation networks and data use will need to be strengthened, especially in vulnerable areas.*

To address the need for observations required for adaptation under the Nairobi Work Programme, the GCOS Steering Committee recommends the development and implementation of a programme of regional workshops concerned with three important linked activities. A series of three workshops in each of ten regions would be organized to take these activities forward. The first activity would assess the adequacy of global and regional climate observations for determining regional climate trends and for adaptation planning. The second would use the available observations to evaluate the adequacy and reliability of regional climate models for adaptation needs and provide qualified projections of likely future changes in climate at the regional level. And the third, which would include policy-level representation, would consider the assessments provided by the first two workshops and provide advice on how model outputs could best be used to develop effective adaptation strategies. These activities are discussed in more detail in the final section of this paper.

[1] See Annex for background on the Global Climate Observing System (GCOS).

The proposed programme of activities is aligned with the mission of GCOS to promote the availability and quality of climate observations needed to support research and the provision of climate services. Since observations, research, and services are interlinked, a joint programme is suggested involving GCOS, the World Climate Research Programme (WCRP), and the WMO World Climate Programme (WCP). This programme would, in addition, draw on the expertise of key interested bodies, such as the main numerical modeling centres. Other key participants, including space agencies and global data analysis centres, would be engaged in ensuring that the best possible data are available to support the programme. The UNFCCC/SBSTA may wish to be directly involved in helping to organize the final set of workshop activities, which would be more policy-oriented, and which would consider possible adaptation responses to expected regional climate change. The GCOS Steering Committee believes that this activity would help ensure attention to observation and data record needs, make available the latest climate projections, provide research programmes with advice on model limitations, and give an improved regional understanding of, and capability for, using both data records and model projections in support of adaptation planning.

1. The Need for Climate Observations for Adaptation

The issue of adaptation to climate change is not new,[2] and, as the inevitability of man-made climate change has become more certain, it has become increasingly important to the achievement of the ultimate objectives of the UNFCCC. It is now recognized that the Earth's climate is generally warming and is likely to continue to warm. Hence adaptation to climate change will be necessary no matter how successful countries are at reducing greenhouse gas emissions. Mitigation and adaptation are now seen as necessary and complementary approaches to dealing with the challenge of climate change.

Climate information, such as precipitation and land cover data, is essential for planning purposes in a wide variety of human activities. These include water resources management, agriculture, energy supply planning, and planning involving the built environment. Moreover, climate information is essential for optimal economic development even in the absence of a human impact on climate. For example, it is evident from the impacts associated with current climate that many societies are not well organized to cope with extreme events such as droughts and floods. Added to the challenges to planning posed by the current natural climate and its variability, societies now face the challenge of adapting to a changing climate.

Both natural and human systems will be required to adapt to climate change. Societies and nature may have to cope with various changes, including rising sea levels, more frequent or intense droughts and floods, periods of extreme temperature, and precipitation. The consequences may include changes in water supplies; impacts on agriculture, human health, and energy production; disruption of ecosystems; and changes in many climate-sensitive natural resources.

Good observations acquired over extended periods make possible an understanding of both the frequency of occurrence of significant extreme events and also the identification of climate trends in such extremes and in average conditions. Thus, if current climate trends are continued, these observational records provide an important basis for considering short term adaptation. In contrast, climate models provide a basis for improved guidance and an ability to assess possible climate change over longer time scales. The use of climate models does not, however, reduce the need for observations. The observational climate record is essential to

[2] See, for example, U.S. Congress, Office of Technology Assessment, *Preparing for an Uncertain Climate* (Washington, DC: U.S. Government Printing Office, October 1993).

underpin climate models and, where that observational record is lacking, the information on both the planning needs in the current climate as well as measures of the reliability of projections of climate will also be lacking. Thus, in order to understand and adapt to these potential changes, there is a need to ensure an adequate quantity and quality of climate observations. Without adequate climate observations, confidence in future projections is limited and substantial resources could be wasted by implementing adaptation policies that may prove unreliable. Additionally, without planned adaptation and development of appropriate strategies that build in societal resilience to climate perturbations, disruptions and losses from extreme events can be expected to rise steadily. The African Development Bank, the World Bank, and others have already recognized the potentially significant costs associated with either a failure to respond to climate risk or with responding inappropriately, and these organizations are beginning to consider how to "climate proof" their investment portfolios.

The management of current climate risks and adaptation to climate change are thus intimately linked: both require the same high-quality data. It is evident that many countries lack the capacity to manage current climate risks effectively. They lack adequate historical records, and many of the historical climate records they possess are not computerized, and thus effectively unavailable for use. It is equally clear that these countries may not be able to devise effective strategies to adapt to future climate change because of the lack of the available data records to support the development and verification of the models needed to provide future climate projections. The GCOS Second Adequacy Report[3] sought in its chapter on the scientific rationale to explain these issues and to consider overall needs for climate observations in support of the UNFCCC. The Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC[4] (IP) considered all UNFCCC needs for systematic observation, including the support to adaptation noted here, and provided a plan for meeting them. This plan notes that regional models and adaptation strategies require denser observing networks than needed for global models, but that the measurements needed on a regional scale can be limited to those variables of direct relevance to climate impacts. As noted in the IP, adequate observations of both global and regional scales are equally essential for use in weather and disaster warnings and in supporting other environmental services that allow society to best cope with the prevailing climate.

It is also important to mention the use of the same observations in initializing models to enable weather forecasts and extended-range statistical forecasts of seasonal, inter-annual, and even decadal variations in climate. Significant economic value is associated with planning that is based on weather and longer period forecasts. The global exchange of data to support such forecasts and the international dissemination of the resulting forecasts are primary functions of the WMO. The adverse affects of longer time scale climate change will often be felt through extreme weather events, and such forecasts allow important short term actions to avoid some of the impacts of these events.

2. Climate on Global and Regional Scales

The climate in any region is the result of a complex set of processes taking place in the global climate system that involves the atmosphere, the land surface, and the oceans. The starting point for climate projections is thus usually a global model. The check on the ability of global climate models to represent the earth system involves inevitably global scale measurements of all 44 Essential Climate Variables (ECVs) considered in the Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC. This ability to verify the performance of global models over as long a time scale as possible is critical, and, in regions where this

[3] Global Climate Observing System, *Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the UNFCCC* (GCOS-82) April, 2003.

[4] Global Climate Observing System, *Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC*, (GCOS-92), October 2004.

global scale check on past model performance is not possible or where it suggests errors, the basis for projections is lacking.

Global models further enable the synthesis of observations through data assimilation into physically consistent gridded products. With initial conditions, these can be used to give predictions of seasonal climate variations that are of value in tactical responses to climate extremes.

In most regions of the globe the climate varies on shorter length scales than those described in current global models, and this is especially so in regions containing coast lines, large water bodies, and mountains. The finer scale regional projections that deal with these features and are needed for adaptation are usually provided through the use regional models, “statistical downscaling” models, or (ideally) both. Regional models are dependant on global models for their large-scale patterns of change but add much higher resolution model responses to regional geographic features. The projections of regional models, like those of global models, need verification over the past century and especially over recent decades. Statistical downscaling models require good regional data on key atmospheric surface variables to establish past relationships between atmospheric observation analyses and then use these relationships with global model projections to add the regional details. This approach provides an important alternative to regional models and is viewed by some as currently a more reliable approach. Such models are also recommended as an additional check on results from regional models but can, however, only be used when detailed regional observations are available. Furthermore if such data are not available, then although regional models can be applied, they cannot be adequately verified. With both approaches, good regional observations are fundamental to achieving regional projections that can be viewed with any confidence.

For the purposes of achieving regional projections the ideal of detailed measurement and use of all ECVs on a fine regional scale may be too challenging to achieve in most regions and perhaps is not cost effective. The hope is that measurement of a smaller number of key variables on finer national and regional scales will suffice and will be realistically attainable by all countries. These include the key atmospheric surface variables, such as precipitation, temperature, humidity, and wind speed and direction; ocean features such as sea surface temperature, sea ice, and sea level rise; and a range of terrestrial variables, such as land cover, streamflow, and glacier characteristics. In the case of ocean and terrestrial variables this need for detail also applies to global scale needs. It is fortunate that satellite observations, if maintained, should, with needed *in situ* support, meet some of the needs. In the case of the key atmospheric surface variables *in situ* measurements are essential and cannot be replaced. In view of these needs, it is unfortunate that, in many developing countries, capacity remains deficient for undertaking the needed observations in sufficient quantity and quality and for transforming them into records that can meet regional model verification needs. The deficiencies are both in the recovery of irreplaceable historical records, in the adequacy of current observing systems, and in data archiving and access capabilities. These deficiencies are in urgent need of remediation if the Nairobi Work Programme is to succeed.

The Global Climate Observing System (GCOS; see Annex) has a special role to play in helping to ensure that the observations necessary to adapt to climate change, and thus to promote sustainable development, are available. The GCOS is built on the WMO World Weather Watch (WWW), the WMO Global Atmosphere Watch (GAW), the Global Ocean Observing System (GOOS) led by the Intergovernmental Oceanographic Commission (IOC), and the Global Terrestrial Observing System (GTOS) led by the Food and Agriculture Organization (FAO). It supports the World Climate Research Programme (WCRP), which promotes research into how to optimize and utilize observations and analyze them into gridded fields appropriate for use as initial conditions for model-based projections. Research into improved models, data assimilation, observation simulation experiments, data processing, and model validation and

improvement will help in the development of new products for routine use. The GCOS also supports the World Climate Programme (WCP), which is implemented through WMO constituent bodies, such as the Commission for Climatology, to assist National Meteorological and Hydrological Services in maintaining the end-to-end process of data collection, data management, product generation, and service provision. [5]

3. Adaptation, the UNFCCC, and Systematic Observation

Article 4 of the 1992 UN Framework Convention on Climate Change (UNFCCC) commits Parties to the Convention to cooperate in preparing for adaptation to the impacts of climate change. In December 2004, however, the Conference of the Parties (COP) requested its Subsidiary Body for Scientific and Technological Advice (SBSTA) to develop a structured five-year programme of work on impacts, vulnerability, and adaptation to climate change (Decision 1/CP.10). This programme was adopted at COP-12 in November 2006 and renamed the Nairobi Work Programme in honor of the city in which it was approved.

The 2006 Nairobi Work Programme identified *data and observations* as one of the nine areas of work related to adaptation needs to be undertaken in the next five years and indicated that activities in this area were to be undertaken in line with the objectives in the Annex to Decision 2/CP.11. A related area of work included in the Nairobi Work Programme addressed *climate modeling, scenarios, and downscaling*.

In the data and observations section of the Nairobi Work Programme GCOS, WMO, and other relevant organizations were specifically invited to indicate "how their work could contribute to improved understanding of current and historical climate, and its impacts, including the identification of gaps and deficiencies in data and observations, stakeholder data and capacity needs, especially at regional and national levels, and ways to improve technical infrastructure." In the climate modeling, scenarios, and downscaling section, relevant organizations were asked to provide similar information, e.g., on how their work contributed to the development, availability and use of climate models, and development of, access to, and use of, climate change scenarios, especially those that provide subregional and regional specificity, including data downscaled from general circulation models.

4. The GCOS Strategy and Interaction with the UNFCCC

The GCOS strategy is to build on and strengthen climate-relevant observing systems. The GCOS Secretariat[6] seeks to initiate and facilitate activities, especially in developing countries, that lead to improvements in undertaking and making use of climate observations. In recent years, the GCOS Secretariat has undertaken several major initiatives both in line with this strategy and responsive to the needs of the UNFCCC. The GCOS Steering Committee delivered the first and second reports on the adequacy of the global observing systems for climate in 1998 and 2003, respectively, and prepared the IP in 2004 in response to the needs identified in the Second Adequacy Report. These documents were prepared in cooperation with the sponsors of GCOS and other GCOS partners and benefited from open review and comments through the UNFCCC SBSTA. The GCOS Steering Committee also oversaw the execution, at the invitation of the COP, of the GCOS Regional Workshop Programme (RWP) between 2000 and 2006.

The IP focuses on global-scale actions needed to improve global observing networks measuring 44 ECVs in atmospheric, oceanic, and terrestrial domains. For the key networks concerned, it also notes the additional regional observation needs that are important to impacts

[5] See World Meteorological Organization, Climate Information for Adaptation and Development Needs, WMO No. 1025, 2007.
[6] In this document, the term GCOS Secretariat is used to denote the actions of the GCOS Secretariat working under the guidance of the GCOS Steering Committee with assistance from panel members, experts, and national representatives.

and adaptation. Overall, some 131 needed actions are specified, and Parties and coordinating bodies with particular responsibilities are identified. If the IP is fully implemented,[7] those global observations of the ECVs, and their associated products, will be available to assist Parties in meeting their responsibilities under Articles 4 and 5 of the UNFCCC. Implementation of the IP will also provide many of the essential observations needed by the World Climate Research Programme and Intergovernmental Panel on Climate Change, including those needed for:

- Characterizing the state of the global climate system and its variability;
- Monitoring the forcing of the climate system, including both natural and anthropogenic contributions;
- Supporting attribution of the causes of climate change;
- Supporting prediction of global climate change; and
- Enabling the characterization of extreme events important in impact assessment, the assessment of risk and vulnerability, and adaptation.

The actions in the plan have been adopted by many subsidiary bodies of the GCOS sponsors and by other partners, and some encouraging progress has been made. Progress in ensuring coverage in developing countries has also occurred but remains perhaps the greatest challenge.

The GCOS RWP was supported by the Global Environment Facility (GEF), the United Nations Development Programme (UNDP), and contributions from a number of developed countries. It was designed to bring together key stakeholders in developing regions to both explain observation related needs and benefits and to facilitate the establishment of Regional Action Plans (RAPs). In all, ten regionally-endorsed RAPs were completed with the assistance of the GCOS Secretariat. Although the primary focus of the RAPs is on needed improvements in the components of global-scale networks within each of the ten regions, the RAPs also address more region-specific concerns and recognize the importance of improving observations for regional as well as global needs. Although some valuable progress has been made to date, most of the observing system improvement projects contained in the RAPs have not yet been implemented, or have been implemented only in piecemeal fashion, due to lack of resources.

The Climate for Development in Africa Programme (ClimDev Africa), the first major follow-up initiative to the GCOS Regional Workshop Programme, was envisaged originally as an initiative to mobilize the resources needed in Africa to implement the several GCOS RAPs for African subregions. In working with development partners, however, as well as with sectoral users of climate information, the programme has evolved into an integrated programme addressing needs in four separate but associated areas: climate observations, climate services, climate risk management, and national policies related to climate in Africa. The ultimate objective of the programme is to promote sustainable development and achievement of the Millennium Development Goals (MDGs) through better management of climate risks. Implementing improvements in climate observing networks at both global and regional scales is fundamental to, and underpins, the three other programme elements. Thus, improved observing networks will enable the development of improved sector-specific climate services, including more reliable climate projections. Improved regional climate projections will assist climate risk management and more effective adaptation to climate change. Establishing strengthened observing networks in other regions through development of initiatives similar to ClimDev Africa is part of the long-term GCOS strategy. These will both help to implement the priority needs set out in the GCOS Regional Action Plans and respond to observational requirements for adaptation.

[7] Although progress on measuring many ECVs has been made, estimates of the annual incremental costs to fully implement all actions amount to over $630 million.

The proposed initiative described in the final section of this document is consistent with the overall GCOS strategy and the respective strategies of the WCRP and the WCP. It also encourages those actions in the IP with particular relevance for adaptation, and is a logical follow-on activity to the GCOS Regional Workshop Programme.

5. The Actions Needed

Actions needed to support reliable model projections of climate that can assist climate risk management and adaptation planning fall into three broad classes:

1. Support for GCOS global-scale networks. Adequate global-scale data are required for testing and verification, and thus improvement of global climate models. The output of global models is subsequently required to drive regional models. All Parties to the UNFCCC benefit by ensuring that sufficient global data are available to allow global models to produce reliable projections of future climate.

2. Support for additional finer scale networks dealing with variables critical for adaptation. In particular, support is needed for regional and national meteorological networks for obtaining precipitation, temperature, humidity, wind speed, and other adaptation-related data at high frequency. These data form the basis of the description of prevailing climate and the record of past climate.

3. Support for analysis and research leading to more reliable model results, particularly at regional scales, and for effective use of such results in adaptation policy development. Analysis and research is needed in at least four related activities:

    - In placing historical climate records in computer readable form and extending existing observation time series;
    - In recovering and reprocessing of historical observations to create reliable climate data records;
    - In the improvement and application of regional models and the use of data to verify models and in the application of statistical downscaling models;
    - In the use of model outputs in practical applications.

It is evident that improvements in global and regional networks (classes 1 and 2 above) will be advanced through vigorous commitment to the Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC and of GCOS Regional Action Plans. The Implementation Plan works with the mandates and responsibilities of the various bodies which coordinate the activities of individual countries in implementing and operating the respective observing systems. These include the WMO Global Observing System, the IOC-led GOOS, and the FAO-led GTOS. These key observations, if fully provided, would provide benefits not only to adaptation, but also to the many other applications which they serve, such as weather forecasting and ocean and terrestrial environmental services. These additional application areas are indeed in many cases the most immediate users of the data.

The willingness to make global scale data available for research use is implicit in the above needs. This availability of global data has improved slowly, but, as noted in a recent GCOS report to the UNFCCC,[8] it remains less than adequate.

As with global-scale data, regional and national data should also be *available* for research and analysis if regional model development and projection is to progress. Pragmatically, progress

[8] See Global Climate Observing System, *Analysis of Data Exchange Problems in Global Atmospheric and Hydrological Networks*, GCOS-96, February, 2005.

and improvement is still possible with regional models using data from only those regions for which they are made available. However, in regions in which Parties do not make regional data records available, there is a risk that climate modellers will not be fully aware of regional scale deficiencies. All Parties are therefore encouraged to make their data available. At the least, it is vital for Parties not sharing data to undertake their own verification of output from models in their region and advise modellers of any limits that may be identified. Verification is, however, a matter for careful checks on the data records and the statistical reliability of the comparisons that can be made. Open research community use of data is best. The general actions discussed in this section lead to some specific recommendations in the final section.

Specific Recommendations

Support for achieving the needed improvements to climate observations would be assisted by rigorous assessment of the value of observations for use in adaptation applications. The RWP has built useful planning around such needs but did not have the scope to significantly strengthen capacity in the use of the data.

Given this background and the need to consider adaptation, consideration should be given to the establishment of a workshop programme concerning the use available records in the assessment of global and regional projections of climate. Such a programme would be of great value to policy and planning activities in each region. It would serve to provide information of immediate use in adaptation. An inevitable and important consequence of this work would be an assessment of the adequacy of currently available climate observations. The workshop programme would thus encourage needed improvements in global and regional observing networks, the rescue of existing historical data that are not now in useable form, and the free exchange of data for adaptation and other climate purposes. Activities would build on the previous GCOS Regional Action Plans and on such progress as has been possible to date. A key benefit to each region would also be improved capacity to use model based outputs in designing effective adaptation strategies. The scope of the overall activity extends beyond the remit of GCOS, and GCOS is pleased to have been able to develop this proposal in cooperation with WCRP and WCP. The GCOS, WCRP, and WCP secretariats have made a concerted effort to develop an integrated programme of activities, as is reflected in the companion WCRP paper focusing on climate modeling, scenarios, and downscaling.

This approach would require a significant, multi-year effort, to be carried out at the regional level. The effort could consist of three workshops in each of ten regions.[9]

The first workshop, which would be carried out under the primary management and coordination of GCOS and in collaboration with WCRP and WMO's WCP, would:

a) Assess the adequacy of national and regional networks for detection of climate variability and trends and use available national and regional records, and available global assessments of climate change, to help provide an assessment of regional climate change;

b) Assist developing countries and regions to assemble the available regional climate records required for the verification and use of regional climate and statistical downscaling models (this would include regional meteorological data for the past few decades and relevant satellite data, including information on aerosols, sea surface temperature, sea ice, land cover, and albedo);

c) Assess data deficiencies and the difficulties and weaknesses of regions to provide the required regional and global data, thus following up the GCOS Regional Workshop Programme to secure initiation of needed observations and data records; and

[9] The regions could be the same ten regions addressed in the GCOS Regional Workshop Programme.

d) Encourage the recovery of available valuable historical data that are not in a form useable by global and regional models.

The second workshop, which would proceed under the primary management and coordination of the WCRP, with contributions from WCP and GCOS, would:

a) Use the assembled climate records from the first workshop and work with regional experts in all regions to help assess the capability of regional models to simulate the climate record to the present day; and

b) Use available regional models and, when practical, statistical downscaling models (and, implicitly, results from global models) to undertake projections of climate change in each region and use the evidence of model performance over past decades to qualify the reliability of these projections.

Organization for the third and final workshop would need wider representation and would need to involve experts from the GCOS, WCRP, WCP, and SBSTA communities in particular. It would be policy oriented and would bring together representatives of the user community and impact and adaptation experts to:

a) Consider how global and regional climate projections and their qualifications could best be used to develop effective adaptation strategies; and

b) Build regional capacity to use climate model projections in the design of adaptation policies.

From the perspective of GCOS it is considered that this activity would help ensure attention to observation and data record needs, make available with qualification the latest climate projections, provide research programmes with advice on model limitations, and give an improved regional understanding of, and capability for, using both data records and model projections in supporting adaptation. While the GCOS, WCRP, and WCP communities have expertise to contribute to these needs, implementation of this programme will not be possible with available resources. As with the GCOS regional workshops, this programme will require the provision of financial or other assistance. The GCOS, WCRP, and WCP Secretariats would welcome being involved in the elaboration and implementation of this programme and/or of other activities that respond to the needs of the Nairobi Work Programme.

ANNEX

The Global Climate Observing System (GCOS)

The mission of GCOS is to ensure the availability and quality of the atmospheric, oceanic, and terrestrial data needed for climate system monitoring, research, prediction, impact assessment, and response actions. Such data, obtained both *in situ* and from space, are required by a wide variety of users for:

- Climate system monitoring;
- Climate change detection and attribution;
- Research to improve understanding, modelling and prediction of the climate system;
- Operational climate prediction on seasonal-to-interannual timescales;
- Assessment of the impacts of, and vulnerability and adaptation to, natural climate variability and human-induced climate change;
- Applications and services for sustainable economic development; and
- Requirements of the UNFCCC and other international conventions and agreements.

GCOS is sponsored by the World Meteorological Organization (WMO), the International Oceanographic Commission (IOC) of UNESCO, the United Nations Environment Programme (UNEP), and the International Council for Science (ICSU). The GCOS programme is being progressively implemented by its sponsors through coordination and strengthening of the climate-relevant components of their individually and jointly sponsored observing systems. These systems include WMO's World Weather Watch and Global Atmosphere Watch and the jointly sponsored Global Ocean Observing System (GOOS) and Global Terrestrial Observing System (GTOS). For satellite observations, the Committee on Earth Observation Systems (CEOS) and the Coordination Group for Meteorological Satellites (CGMS) play an important coordination and facilitation role in GCOS implementation. The GCOS Steering Committee and Secretariat participate in the Group on Earth Observations (GEO) mechanism to ensure the coordinated development of GCOS as part of the Global Earth Observation System of Systems (GEOSS).

The observing systems that comprise GCOS operate and serve climate observing needs at global, regional, national, and local scales. These needs for the Essential Climate Variables (ECVs), identified in the Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (IP), are in turn used to support the many climate and climate-related products that are needed for the wide range of climate and other applications in numerous climate-sensitive socioeconomic sectors. The GCOS Secretariat aims to facilitate actions that help developing countries establish and use the observations needed to support achievement of the Millennium Development Goals.

The overall guidance for the development and implementation of GCOS is provided by a Steering Committee which advises the GCOS sponsors and those responsible for their component systems and programmes. It is assisted by three scientific panels (focusing on atmospheric, terrestrial, and oceanic observations respectively) and a small Secretariat. A key challenge in the GCOS strategy is to mobilize resources to address the considerable observing system needs in all countries. It will be primarily at the national level that the GCOS will need to be implemented if the adaptation agenda is to succeed.

PAPER NO. 11: GLOBAL TERRESTRIAL OBSERVING SYSTEM

Global Terrestrial Observing System

Required Observations of Terrestrial Essential Climate Variables (ECVs)

Submission to the "Data and Observations" call of the
Nairobi Work Programme on Impacts, Vulnerability and
Adaptation to Climate Change.

September 2007

Prepared and submitted by the Secretariat of the
Global Terrestrial Observing System (GTOS)

Introduction

The mandate of Work item 2 "Data and observations", of the Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change, is to improve the collection, management, exchange, access and use of observational data and other relevant information on current and historical climate variability and change.

Data and observation requirements for climate-related purposes were addressed in the Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (GCOS 2004). This Plan was specifically developed to ensure the availability of global observations of the essential climate variables and associated data to meet the requirements of Parties of the UNFCCC as well as other stakeholders.

The Global Terrestrial Observing System (GTOS) has supported the preparation and realization of the GCOS implementation plan, particularly with respect to its terrestrial component and the 13 terrestrial Essential Climate Variables (ECVs): Albedo; Biomass; Fire disturbance; Fraction of absorbed photosynthetically active radiation; Glaciers and ice caps; Ground water; Lake levels; Land cover (including vegetation type); Leaf area index; Permafrost and seasonally-frozen ground; River discharge; Snow cover, and Water use. Current and historical data and information on these terrestrial as well as atmospheric and oceanic ECVs are of fundamental importance, not only for climate change impact assessment and adaptation but also for related issues such as characterizing the state of the climate system, predicting future climate change, and enabling the assessment of vulnerability and risk to climate change.

Through the Terrestrial Observation Panel for Climate (TOPC), a joint panel of the GTOS and the Global Climate Observing System (GCOS), support and coordination is being provided to the networks undertaking *in situ* observations (refer to www.fao.org/gtos/GT-NET.html). TOPC has also assisted in the preparation of the systematic observation requirements for satellite-based products for climate (GCOS 92).

To a considerable extent, the challenges involved in adaptation to climate change concern the terrestrial domain. Thus, data and observations of the terrestrial ECVs are of vital importance to the Nairobi Work Programme and related climate change response initiatives but also to various other sustainable development activities and stakeholders (please also refer to GCOS submission for additional details).

A framework for terrestrial climate - related observations

Realizing the need to develop appropriate policies to deal with climate change and based upon the GCOS Implementation Plan, the Conference of the Parties in its ninth session (Decision 11/CP.9; UNFCCC, 2003) requested the GTOS Secretariat, "*in consultation with other international or intergovernmental agencies, as appropriate, to develop a* ***framework for the preparation of guidance materials, standards and reporting guidelines for terrestrial observing systems for climate, and associated data and products"***.

In response to this request, analysis has been undertaken to identify the desirable characteristics, necessary elements, and the stakeholder requirements for an effective framework. Based on existing practices, several organizational options were identified in two categories: an intergovernmental model and an international organization model. The identified options build on mechanisms and practices previously employed to achieve an international consensus on technical matters subsequently to be adopted, and acted upon, by individual countries. Results of this work were submitted to UNFCCC SBSTA which include details on (see GTOS 2007a): the organizational options for establishing such a framework; costs of establishing and operating; mechanisms for the endorsement of standards and guidelines that would be needed for national acceptance and implementation; and an analysis of the advantages and disadvantages of the various options to allow the adequate appraisal by the stakeholders.

It is evident that such a framework is vital for generating the tools, methodologies, data, information and support required by the UNFCCC in meeting its long-term objective to stabilize greenhouse gas concentrations in the atmosphere, and for assisting member countries in meeting their requirements when confronting the effects of climate change. A further definition of the framework will be undertaken after guidance has been received from UNFCCC COP/SBSTA in December 2007.

Existing standards for terrestrial ECVs

At its 23rd Session in Montreal (November 2005), the UNFCCC SBSTA/COP requested the GTOS Secretariat to "*assess the status of the development of standards for each of the essential climate variables in the terrestrial domain*" to ensure data compatibility between the different data producers and allowing the development of harmonized regional and global data sets (GTOS 2007b).

The question of standards for the terrestrial ECVs encompasses a very broad spectrum in terms of: (i) the environmental variables involved; (ii) the geographic coverage and diversity of these variables leading to different measurement approaches; (iii) the types of documents or formats relevant to the development of standards ('standards', 'guides', 'protocols', 'guidelines'); (iv) the areas in principle requiring standardization (initial measurements, data processing, analysis, final product); (v) the need for *in situ* as well as satellite measurements for most terrestrial ECVs, requiring conceptually different approaches; and (vi) the number and dispersion of sources where information relevant to ECV standardization may be generated or archived.

Taking the above into consideration, the GTOS Secretariat, in collaboration with its partners, has undertaken a review of the available standards, guidelines, measurements and processing protocols already being used by national institutions and international organizations. The review has revealed that few definitive standards exist for the 13 terrestrial ECVs. However, guides, descriptions of measurement methods, and protocols are available in several cases that describe in detail how a specific terrestrial variable should be sampled and measured. A status report has been submitted to UNFCCC SBSTA (GTOS 2007b).

Actions needed

Given the critical importance of terrestrial ECVs to developing appropriate response to global and regional climate changes, it is evident that the above tasks are necessary to lay the foundation for a

coordinated approach. However, the key issue is the existence of programmes for the measurement, archiving, and data analysis that will yield objective information on the response of the terrestrial environment to climate variability and change. In most cases, these measurements must be made from satellite platforms and by *in situ* networks (refer to GTOS 2007b). The challenges in implementing and maintaining an overall coordinated system are considerable. Currently:

- Coordinated action has been taken by the Committee on Earth Observation Satellites (CEOS) in regards to the satellite components, as reported at SBSTA 25.
- Effective use of satellite data requires special *in situ* measurements to establish the necessary relationships between the radiation measurements and the biophysical surface properties. Coordinated measurements of this type are only gradually being established, in virtually all cases as part of research programmes.
- Several global *in situ* networks are operational. However, these networks have not been established for all the ECVs and, where established, often have incomplete coverage and/or lack the necessary financial resources to meet their objectives. The operation of individual measurement sites depends on national support which is not always available or assured over time. The need for increased support to *in situ* observations has been stated by the COP/ SBSTA previously, but in reality problems persist.
- For most terrestrial ECVs, the generation of data products with information on the changing terrestrial response to climate presently involves calibration, integration, and analysis of data from various sources. Intercomparisons of different approaches and strategies, carried out through workshops, are an important vehicle in this process.

Thus, to ensure the availability of data and information on the terrestrial response to climate, actions are needed in the following areas:

- Coordinated acquisition of satellite measurements of the individual ECVs, building upon the CEOS progress to date.
- Implementation of an international framework for *in situ* observations (refer to GTOS 2007a).
- Increased support by the Parties for making and reporting *in situ* observations for the terrestrial ECVs, within the international framework.
- Supporting national and international projects, data centres, and other initiatives addressing the generation of integrated, quality controlled products for individual terrestrial ECVs.

Specific recommendations

To make progress on the above required actions, the GTOS Secretariat recommends that the following actions are undertaken:

- Provide the political and financial support to allow the strengthening of existing *in situ* observational networks and the creation of new networks were required. This long term financial support and political commitment pertains to the five current Global Terrestrial Networks on hydrology, glaciers, permafrost, rivers, and lakes.
- UNFCCC SBSTA to support the development of a terrestrial framework by providing guidance on its preference on possible options and assisting in the realizing an initial workshop to further elaborate the desired mechanism.
- UNFCCC SBSTA to comment on and endorse the current status of the process and to review the available standards and generate the support to allow groups of experts (through workshops and correspondence) to finalize the products and recommendations.
- UNFCCC SBSTA to work with GTOS and GCOS on a procedure and funding mechanisms that recommends identification and selection of current research *in situ* programmes that are ready to move into a more sustained routine monitoring network.

- Increased support of the Parties for coordinated cross – comparison of products which are approaching an operationally useful status, e.g. land cover, leaf area index, and albedo.

Reinforcing observational *in situ* networks, ensuring data records, maintaining data harmonization and facilitating data access are all fundamental to achieving such objectives. However, there is currently a lack of national engagement and or resources, restrictive data policies, and inadequate national and international data system infrastructure. There is a need for a clear commitment from all stakeholders to commit both individually and collectively to the collection, processing and distribution of the required observations.

The Global Terrestrial Observing System strongly reaffirms its commitment to support the development of a terrestrial framework mechanism and to continue collaboration with other partners such as GCOS and stakeholders in climate change related activities, including the implementation of the Nairobi Work Programme. Nevertheless, for any system to be effective there must be the collective support by governments and international institutions as well as by other stakeholders.

References

GCOS. 2004. Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC, October 2004, **GCOS 92**, WMO/TD No. 1244.
Web link: www.wmo.int/pages/prog/gcos/Publications/gcos-92_GIP.pdf

GCOS. 2007. 107: Systematic Observation Requirements for Satellite-based Products for Climate - Supplemental details to the satellite-based component of the Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC, **GCOS-107**, September 2006
Web link: www.wmo.int/pages/prog/gcos/Publications/gcos-107.pdf

GTOS 2007a. A Framework for Terrestrial Climate-Related Observations: Implementation Options, GTOS Progress Report to the 26th Meeting of the UNFCCC SBSTA, **GTOS 48**, March 2007.
Web link: www.fao.org/gtos/doc/pub48.pdf

GTOS 2007b: Assessing the Status of the Development of Standards for the ECVs in the Terrestrial Domain, GTOS Progress Report to the 26th Meeting of the UNFCCC SBSTA, **GTOS 49**, March 2007.
Web link: www.fao.org/gtos/doc/pub49.pdf

Web links

GCOS: www.wmo.ch/pages/prog/gcos/index.php

GTOS: www.fao.org/gtos/index.html

Observational networks: www.fao.org/gtos/GT-NET.html

Terrestrial ECVs: www.fao.org/gtos/topcECV.html

UNFCCC terrestrial framework: www.fao.org/gtos/topcFRAME.html

PAPER NO. 12: INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

Potential contributions of the IPCC to the Nairobi Work Programme in the area of data and observation[1]

Submitted by the Secretary of the IPCC

Prepared by Martin Juckes, on behalf of TGICA and the IPCC Data Distribution Centre, with contributions from Richard Moss, Tim Carter, Bob Chen, Renate Christ, Xiaoshi Xing, Jean Palutikof
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1. Introduction

The IPCC contributes to the work of the UNFCCC and any specific work programme established under any of its subsidiary bodies, such as the *Nairobi Workprogramme on Impacts, Vulnerability and Adaptation to Climate Change* (NWP) mainly through the information contained in its assessment reports, special reports and technical papers. For the NWP information, guidance documents and services prepared and provided by the IPCC Task Group on Data and Scenario Support for Impact and Climate Analysis (TGICA) and the IPCC Data Distribution Centre (DDC) established under the TGICA are of specific relevance and will therefore presented in more detail in this submission.

Further useful information is provided in the Appendices to this document. This includes the approved outlines of the Working Group I and II contributions to the Fourth Assesment; within these, much information useful to the Nairobi Work Programme can be found.

2. Potential contributions of the IPCC TGICA

2.1 Background

The Intergovernmental Panel on Climate Change (IPCC)[2] Task Group on Data and Scenario Support for Impact and Climate Analysis (TGICA[3]; originally known as Task Group on Scenarios for Climate Impact Assessment - or TGCIA) was established following a recommendation made at the IPCC Workshop on Regional Climate Change Projections for Impact Assessment (London, 24-26 September 1996). The mandate of the TGICA[4] is to facilitate wide availability of climate change-related data and scenarios to enable research and the sharing of information across the three working groups of the Intergovernmental Panel on Climate Change (IPCC). The TGICA disseminates information in support of IPCC work, as well as IPCC "approved", "adopted," "accepted," and "supporting" material.

The TGICA established the IPCC Data Distribution Centre (DDC)[5] in 1998 to facilitate the timely distribution of a consistent set of up-to-date data and scenarios of changes in climate and related environmental and socio-economic factors for use in climate change impact, adaptation and vulnerability (IAV) studies. The intention was that the results of such studies could then feed into the IPCC assessment process. The DDC is run subject to a governance document[6] written by TGICA.

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[1] A comprehensive submission by the IPCC and a submission from Working Group II (Impacts, Adaptation and Vulnerability) on their contributions to the Nairobi work programme are available on the UNFCCC NWP website at <http://unfccc.int/3633.php>.
[2] http://www.ipcc.ch/
[3] http://ipcc-wg1.ucar.edu/wg1/wg1_tgica.html
[4] http://www.ipcc-data.org/docs/TGICA_Mandate_031207.htm
[5] http://www.ipcc-data.org
[6] http://www.ipcc-data.org/docs/TGICA_DDC_Governance_031907.htm

The DDC was originally a shared operation between the Climatic Research Unit (CRU) in the United Kingdom and the Deutsches Klimarechenzentrum (DKRZ) in Germany. In 2003 a third centre, the Center for International Earth Science Information Network (CIESIN) in the USA, joined the DDC collaboration. From February 1st, 2007, the British Atmospheric Data Centre (BADC) has replaced CRU as the United Kingdom partner.

The data provided on the DDC are accompanied by full documentation as well as separate guidelines on their potential application. Together with the ongoing work of the TGICA (including development of the DDC, IPCC-endorsed Workshops and other cross-Working Group IPCC discussions), these would appear to be highly relevant activities for supporting the aims of the Nairobi Work Programme.

2.2. Data and observations

Improving collection, management, exchange, access to and use of observational data and other relevant information on current and historical climate variability and change.

Observed climate data. The impacts of projected changes should be interpreted in the context of observed climate variability. The IPCC DDC provides monthly decadal (get_10yr_means[7]) means from 1901-910 up to 1981-1990 for these key fields: mean temperature, diurnal range, maximum temperature, minimum temperature, precipitation, wet days, vapour pressure, cloud and frost days. For convenience, these data are also available as 30-year means (get_30yr_means[8]).

Observed impacts. The TGICA has initiated an effort to document methods of assessing observed impacts and improve access to key datasets on observed impacts through the DDC

Multidisciplinary data archive management. Climate change poses challenges, which can only be answered by scientists working across the traditional boundaries between natural science, environmental science, social science, engineering and economics. This includes the exchange and integration of data across these boundaries and making the resulting interdisciplinary data and information products accessible and usable. The DDC supports this important function.

References

IPCC-TGICA, 2007: General Guidelines on the Use of Scenario Data for Climate Impact and Adaptation Assessment. Version 2. Prepared by T.R. Carter on behalf of the Intergovernmental Panel on Climate Change, Task Group on Data and Scenario Support for Impact and Climate Assessment, 66 pp. [www.ipcc-data.org]

L. O. Mearns, F. Giorgi, P. Whetton, D. Pabon, M. Hulme and M. Lal, 2003. Guidelines for Use of Climate Scenarios Developed from Regional Climate Model Experiments. [www.ipcc-data.org]

Wilby, R.L., Charles, S.P., Zorita, E., Timbal, B., Whetton, P. and Mearns, L.O., 2004. Guidelines for use of climate scenarios developed from statistical downscaling methods. [www.ipcc-data.org]

[7] http://www.ipcc-data.org/obs/get_10yr_means.html
[8] http://www.ipcc-data.org/obs/get_30yr_means.html

Appendix A: TGICA membership

Co-Chairs

Jose Marengo, Brazil
Richard Moss, USA

Members

Knut Alfsen, Norway
Nigel Arnell, UK
Elaine Barrow, Canada*
Timothy Carter, Finland
Seita Emori, Japan
Xuejie Gao, China
Ayman Farid Abou-Hadid, Egypt
Bruce Hewitson, South Africa
Tom Kram, Netherlands
Emilio La Rovere, Brazil
Rodel Lasco, Philippines
Ilena Mares, Romania
Linda Mearns, USA
John Mitchell, UK
Anthony Okon Nyong, Nigeria
Hugh Pitcher, USA
Bernard Seguin, France
Serguei Semenov, Russian Federation

*Brad Bass, Canada, is currently substituting

Ex-Officio members

Robert Chen (DDC, CIESIN)
Martin Juckes (DDC, BADC)
Michael Lautenschlager (DDC, MPI)
Martin Manning (IPCC, WGI TSU)
Leo Meyer (IPCC, WGIII TSU)
Jean Palutikof (IPCC, WGII TSU)

Support

Kristen Averyt (IPCC, WGI TSU)
Claire Hanson (IPCC, WGII TSU)
Paul Van Der Linden (IPCC, WGII TSU)

Appendix B: Supplementary tables

Table 1: Institutions contributing climate projections to the IPCC 4th Assessment Report

Institution	Country
Beijing Climate Center	China
Bjerknes Centre for Climate Research	Norway
Canadian Center for Climate Modelling and Analysis	Canada
Centre National de Recherches Meteorologiques	France
Commonwealth Scientific and Industrial Research Organisation	Australia
Max-Planck-Institut for Meteorology	Germany
Meteorological Institute, University of Bonn	Germany
Meteorological Research Institute of KMA	Korea
Model and Data Group at MPI-M	Germany
Institute of Atmospheric Physics	China
Geophysical Fluid Dynamics Laboratory	USA
Goddard Institute for Space Studies	USA
Institute for Numerical Mathematics	Russia
Institut Pierre Simon Laplace	France
National Institute for Environmental Studies	Japan
Meteorological Research Institute	Japan
National Centre for Atmospheric Research	USA
UK Met. Office	UK
National Institute of Geophysics and Volcanology	Italy

Table 2: Forcing scenarios

COMMIT	Anthropogenic forcing held constant and AD2000 levels.
PICNTL	No anthropogenic forcing
20C3M	Forcings, natural and anthropogenic, representing the 20th century
A2	SRES scenario A2
A1B	SRES scenario A1B
B1	SRES scenario B1
1PCTO2X	Increasing anthropogenic forcing 1% annually from AD2000 until it doubles, thereafter held constant.
1PCTO4X	Increasing anthropogenic forcing 1% annually from AD2000 until it quadruples, thereafter held constant.

Table 3: The chapters of the Working Group I contribution to the IPCC Fourth Assessment

1. Historical Overview of Climate Changes Science
2. Changes in Atmospheric Constituents and Radiative Forcing
3. Observations: Atmospheric Surface and Climate Change
4. Observations: Changes in Snow, Ice and Frozen Ground
5. Observations: Ocean Climate Change and Sea Level
6. Palaeoclimate
7. Coupling Between Changes in the Climate System and Biogeochemistry
8. Climate Models and their Evaluation
9. Understanding and Attributing Climate Change
10. Global Climate Projections
11. Regional Climate Projections

Table 4: The chapters of the Working Group II contribution to the IPCC Fourth Assessment

Section A.	ASSESSMENT OF OBSERVED CHANGES
1.	Assessment of observed changes and responses in natural and managed systems
Section B.	ASSESSMENT OF FUTURE IMPACTS AND ADAPTATION: SYSTEMS AND SECTORS
2.	New assessment methodologies and the characterisation of future conditions
3.	Freshwater resources and their management
4.	Ecosystems, their properties, goods and services
5.	Food, fibre and forest products
6.	Coastal systems and low-lying areas
7.	Industry, settlement and society
8.	Human health
Section C.	ASSESSMENT OF FUTURE IMPACTS AND ADAPTATION: REGIONS
9:	Africa
10:	Asia
11:	Australia and New Zealand
12:	Europe
13:	Latin America
14:	North America
15:	Polar regions (Arctic and Antarctic)
16:	Small islands

Section D.	ASSESSMENT OF RESPONSES TO IMPACTS
17.	Assessment of adaptation practices, options, constraints and capacity
18.	Inter-relationships between adaptation and mitigation
19.	Assessing key vulnerabilities and the risk from climate change
20.	Perspectives on climate change and sustainability

Table 5: Scenario data held by the IPCC DDC (CIESIN)

The following variables are tabulated as projections from the present to 2100, for a range of scenarios and using a range of models. More details are available from the CIESIN DDC web-site[9].

Primary category	**Secondary category**
Population	
GNP/GDP (mex)	
GNP/GDP (ppp, 1990 prices)	
Final Energy	Non-commercial, Solids, Liquids, Gas, Electricity, Others, Total
Primary Energy	Coal, Oil, Gas, Nuclear, Biomass, Other Renewables, Total
Cumulative Resources Use	Coal, Oil, Gas
Cumulative CO2 Emissions	
Carbon Sequestraction	
Land Use	Cropland, Grasslands, Energy Biomass, Forest, Others, Total
Anthropogenic Emissions (standardized)	Fossil Fuel CO_2, Other CO_2, Total CO_2, CH_4 total, N_2O total, SO_x total, CFC/HFC/HCFC, PFC, SF_6, CO, NMVOC, NOx

Table 6: Baseline socio-economic data held by the IPCC DDC (CIESIN).

Primary category	**Secondary category**
Population and Human Development	Total Pop. 1995; Current Pop. Density (persons/km^2) 1995; Projected Pop. Density (persons/km^2) 2025; Total Urban Pop. 1995; Urban Pop. in Coastal Cities 1980
Economic Conditions	GDP per Capita in Constant PPP ('85IN$) 1992; GDP from Agriculture (%) 1993; GDP from Industry (%) 1993; GDP from Services (%) 1993; GDP Annual Growth Rate (%) 1993
Land Cover / Use	Total Land Area 1993; Arable and Permanent Cropland 1993; Permanent Pasture 1993; Forest and Woodland 1993; Other Land 1993
Water	Water Resources per Capita (m^3) 1995; Domestic Annual Withdraws (%) 1995; Industry Annual Withdraws (%) 1995; Agriculture Annual Withdraws (%) 1995
Agriculture / Food	Irrigated Land 1993; Agricultural Labor Force 1993; Total Labor Force 1993; Cattle Stocks 1994; Sheep Stocks 1994; Goat Stocks 1994; Pig Stocks 1994; Equines (horses /mules/asses) 1994; Buffalo Stocks 1994; Camel Stocks 1994
Energy	Total Commercial Energy Consumption (PJ) 1993;

[9] http://sres.ciesin.org/final_data.html

	Traditional Fuel Consumption (TJ) 1991; Commercial Hydroelectric Consumption (PJ) 1993
Biodiversity	Known Mammal Species 1990's; Endemic Mammal Species 1990's; Known Bird Species 1990's; Endemic Bird Species 1990's; Known Plant Species 1990's; Endemic Plant Species 1990's

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