# WORLD CLIMATE NEWS

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## DROUGHT AND DESERTIFICATION

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World Meteorological Organization

Weather • Climate • Water

# Calendar

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**Arusha, United Republic of Tanzania**
International Workshop on Climate and Land Degradation

**18–20 December 2006**
**Geneva, Switzerland**
Expert Meeting of Climate Change and Water Resources

**18–19 January 2007**
**Geneva, Switzerland**
Eighth session of EC Advisory Group on Climate and Environment (EC-AGCE)

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**Honolulu, Hawaii, USA**
Nineteenth session of the WCRP GEWEX Scientific Steering Group

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WMO International Conference on "Secure and Sustainable Living: Social and Economic Benefits of Weather, Climate and Water Services"

# Foreword

Drought and desertification are recognized as major environmental problems in many regions. More than 250 million people are directly affected by desertification. In addition, some one billion people in more than 100 countries are at risk. These people include many of the world's poorest, most marginalized and politically weak citizens. Hence combating desertification is an urgent priority in global efforts to ensure food security and the livelihoods of millions of people who inhabit the drylands of the world.

Sustainable development of countries affected by drought and desertification can come about only through concerted efforts based on a sound understanding of the different factors that contribute to land degradation. Climatic variation is one such factor. It is more important to address climate, an underlying driver of land degradation, than try to address only the consequences of land degradation. For example, the development and adoption of sustainable land management practices is a major solution to the problem of land degradation in the drylands but these practices can be accurately assessed only with a knowledge of climate resources and the risk of climate-related natural disasters.

Given the importance of the interactions between climate and desertification, WMO gave priority to this area and its action plan to combat desertification was first adopted in 1978 at the thirteenth session of the Executive Council of WMO. WMO continues to encourage the increased involvement of National Meteorological and Hydrological Services as well as regional institutions in addressing issues of relevance to the United Nations Convention to Combat Desertification (UNCCD), especially those stipulated in Articles 10 and 16 to 19 of the Convention. WMO's programmes, in particular the Agricultural Meteorology Programme and the Hydrology and Water Resources Programme, support these efforts.

As part of its implementation activities for the International Year of Deserts and Desertification (IYDD), WMO, in collaboration with the UNCCD Secretariat, is organizing an International Workshop on Climate and Land Degradation in Arusha, Tanzania, during 11-15 December 2006. I am confident that the workshop will help promote the use of weather and climate information for sustainable land management to arrest land degradation.

(M. Jarraud)
Secretary-General

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# Desertification, poverty and sustainable development

by Ndegwa Ndiang'ui, UNCCD Secretariat

Poverty is both a cause and a consequence of desertification. Indeed this vicious circle affects not only peoples but also the economies of affected countries. The first victims of desertification are the prime resources of fertile soil, vegetation cover and agricultural crops. Over time, the productive capacity of land diminishes, and populations that depend on them become predisposed to poverty. Land is the only source of insurance for most rural communities.

The root causes of environmental degradation are therefore clearly associated with poverty, globalization and inequality in the socio-economic arena, including the debt burden. Sustainable development cannot be realized if a country is faced with a crippling debt burden, since resources that could be used for development have to be used for debt repayment. Developing countries that are also affected by drought and desertification are disadvantaged in the global economic arena, where their products do not fetch good prices. This leads to over-exploitation of natural resources.

To address this scenario, multi-stakeholder, concerted action is required. The United Nations Convention to Combat Desertification (UNCCD) presents an important platform for action through its participatory and bottom-up character. The issues of poverty and environmental degradation can be concretely addressed through effective implementation of UNCCD at the local level, where preventive and corrective, as well as developmental measures can easily take root among the affected communities. The Convention also seeks to reshape development aid by engaging multilateral and bilateral aid providers through partnerships with the recipient countries. In Africa in particular, partnership agreements are being developed through consultative processes, involving national governments and key financial resource providers. The multilateral agency-driven initiatives for poverty reduction in developing countries should serve as frameworks for the multi-stakeholder involvement in resource mobilization. Partnership agreements need to be arrived at during consultative meetings and dialogues that aim to help affected countries reduce poverty.

The International Year of Deserts and Desertification (IYDD) represents a critically important opportunity to reflect and act on the recommendations of the World Summit on Sustainable Development (WSSD). During its meeting in Johannesburg, South Africa, in 2002, WSSD recognized the crucial linkage between desertification and poverty, and acknowledged UNCCD as one of the tools for poverty eradication. The Convention seeks to create a dynamic, coordinated process that links the environmental dimension of desertification with a broader socio-economic framework, and results in conditions that support self-sustained livelihoods in dryland areas. The main frameworks in this process are national action programmes to combat desertification, supported by sub-regional and regional action programmes. The Convention combines environmental protection, land improvement and the fight against soil erosion with poverty eradication through its sustainable development focus, thus contributing to the realization of the Millennium Development Goals. It offers advantages as an instrument that can prevent food insecurity through the sustainable development of rural areas, and that can reduce the need for emergency relief. The effective implementation of the Convention can reduce displacement of people and pressure on urban communities by the rural poor and prevent forced migrations to other countries. It is a tool to prevent conflict over scarce resources; the critical factor in preventing resource-based conflicts is to enable local people in resource-poor areas to intensify agricultural production, better manage their pastoral areas, agree joint programmes for the sustainable management of trans-boundary natural resources and diversify their livelihoods without degrading the environment. It emphasizes decentralized decision-making structures as an important prerequisite for sustainable resource management; it may thus turn into a driving force behind decentralization.

The Convention offers the opportunity to establish synergies or linkages with other major treaties including the UN Convention on Climate Change, the Convention on Biological Diversity and regional agreements such as New Partnership for Africa's Development and the ACP-EU Partnership Agreement of Cotonou. It is an effective instrument for coordinating financial resources from multiple sources, with the aim of maximizing benefits for dryland communities. Combating desertification is a step towards an holistic approach to development in which environmental, economic, social and political dimensions are given their proper priorities.

# Desertification, drought and the role of WMO

Deserts have been inhabited in some parts of the world for millennia. The term desertification, however, has always been an elusive concept. Desertification is defined in the United Nations Convention to Combat Desertification (UNCCD) as "land degradation in the arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities" (this definition excludes the hyper-arid lands). Furthermore, UNCCD defines land degradation as a "reduction or loss, in arid, semi-arid, and dry subhumid areas, of the biological or economic productivity and complexity of rain-fed cropland, irrigated cropland, or range, pasture, forest, and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as: (i) soil erosion caused by wind and/or water; (ii) deterioration of the physical, chemical, and biological or economic properties of soil; and (iii) long-term loss of natural vegetation". This definition, which is now being used worldwide to describe desertification and its impacts, leads to the need to consider carefully the two-way interactions between climate and desertification.

More than 250 million people are directly affected by land degradation. In addition, some one billion people in more than 100 countries are at risk. These people include many of the world's poorest, most marginalized and politically weak citizens. Hence combating land degradation is an urgent priority in global efforts to ensure food security and improve the livelihoods of millions of people who inhabit the drylands of the world.

## Climate and desertification

Climate has a major impact on dryland soils, vegetation, water resources and human land use. Dryland flora and fauna suffer from the constraints of large diurnal and seasonal variations in temperature and even greater yearly vagaries in rainfall and soil moisture. There is a strong correlation between plant biomass and rainfall, since rainfall influences vegetation production, which in turn controls the spatial and temporal occurrence of grazing. Both field observations and remote sensing data have confirmed large spatial variations in dryland plant density and biomass, as well as equally important temporal fluctuations in biomass in response to seasonal and interannual fluctuations in rainfall. Failure of rainfall, especially over several seasons, can lead to loss of vegetative cover on the soil and hence land degradation.

Loss of vegetation due to anthropogenic pressures, such as overgrazing, over-cultivation and deforestation, can propagate further land degradation via land surface-atmosphere feedback. This occurs when a decrease in the vegetation reduces evaporation and increases the radiation reflected back to the atmosphere (albedo). The consequent reduction in cloud formation and rainfall causes a feedback which further reduces vegetation. Large-scale experiments, in which numerical models of the general circulation have been run with artificially high albedos over desert areas, have suggested that a large increase in the albedo of subtropical areas should reduce rainfall, but the quantitative effects in actual situations have not yet been firmly established. Some of the models also suggest changes in rainfall in other areas. Another feedback mechanism that has been investigated concerns surface roughness. It has been suggested that the elimination of tall trees and shrubs in the desertification process reduces surface roughness. Numerical modelling indicates that such a change towards a smoother surface should diminish rainfall in some areas, and increase it elsewhere. The processes are complex but the effects may be large.

## Role of WMO

Given the importance of the interactions between climate and desertification, WMO has given major priority to this area and its action plan to combat desertification was first adopted in 1978 at the thirtieth session of the Executive Council of WMO. It has gone through several revisions. Priority areas for attention include: enhanced observing systems at national, regional and international levels; promoting the mitigation of the effects of drought and desertification through effective early warning systems; supporting and strengthening the capabilities of Members and regional institutions; and improved applications of meteorological and hydrological data.

WMO participated in the activities of the International Panel of Experts on Desertification and made contributions which were incorporated in the draft of the International Convention to Combat Desertification. WMO participated in all the sessions of the Intergovernmental Negotiating Committee to elaborate an International Convention to Combat Desertification in those countries experiencing serious drought and/or desertification (INCD). The UNCCD entered into force on 26 December 1996 and several articles and topics mentioned in UNCCD, in particular Articles 16 to 19, are directed to WMO and the NMHSs. These topics, which are within the mandate of WMO, include:

- Promotion of systematic observation, collection, analysis and exchange of meteorological, climatological and hydrological data and information;
- Drought planning, preparedness and management;
- Research into causes and effects of drought and climate

variations as well as into the possibility of long-term climate prediction with a view to providing early warning of drought; and

- Capacity-building in the relevant fields of drought and climate, including transfer of knowledge and technology.

WMO participated in the seven sessions of the Conference of Parties to UNCCD held so far. WMO has also produced three information brochures: *Climate, Drought and Desertification* (WMO-No. 869) for COP-1; *Early Warning Systems for Drought and Desertification: Role of National Meteorological and Hydrological Services* (WMO-No. 906) for COP-3; and *Climate and Land Degradation* (WMO-No.989) for COP-7. These initiatives helped ensure inclusion of important climate-related issues in the Convention and in issuing appropriate guidelines to all NMHSs regarding activities to be carried out towards implementation of the Convention. WMO also participated in the work of the UNCCD Ad Hoc Panel on Early Warning Systems and the Consortium of Partners on the Survey of Networks for Desertification.

# WMO programmes

WMO contributes to the fight against drought and desertification through its Agricultural Meteorology Programme, Hydrology and Water Resources Programme, and other scientific and technical programmes.

## Enhanced observing systems at national, regional and international levels

WMO provides an international framework for collaboration in all meteorological and hydrological research areas that are vital to provision of effective early warning systems for drought. The geographical coverage and around-the-clock nature of the Global Observing System, the analytical capability of the Global Data Processing System, and the ability to disseminate warnings through the Global Telecommunications Systems form the basis of early warning for meteorological and hydrological-related phenomena. The establishment of the new WMO Space Programme has enhanced access and utilization of satellite data, products and services throughout WMO. WMO hosts the Secretariat of the new Global Earth Observation System of Systems (GEOSS) which should enhance the availability of improved observations to combat desertification.

## Promoting effective early warning systems

Early warnings serve as an essential and important alert mechanism for combating land degradation; warnings of climate-related disasters are becoming feasible from weeks to seasons in advance. WMO's World Climate Programme will continue to issue routine statements on the state of El Niño or La Niña which, through the NMHSs, can alert governments to ensure preparedness against the impacts of El Niño-related anomalies. WMO's new major programme on Natural Disaster Prevention and Mitigation will provide the focus for the consolidation of its efforts in the area of early warning and for taking new initiatives in this area in collaboration with other organizations.

## Enhancing climate prediction capability

Climate prediction capability is being enhanced around the world through the Climate Variability (CLIVAR) project of the World Climate Research Programme (WCRP) and through implementation of the WMO Climate Information and Prediction Services (CLIPS) project, which is designed to promote the use of climate information and prediction services, capacity building, multi-disciplinary research and the development of new applications.

## Implementing risk management applications

WMO is implementing improved risk management applications including hazard mapping, agroclimatic zoning and the establishment of partnerships that are essential tools for land use and preparedness planning. WMO's Agricultural Meteorology Programme (AGMP) gives high priority to activities to combat desertification and addresses several issues relating to drought such as meteorological aspects of drought processes, indices for assessment of droughts, drought probability maps, operational use of agrometeorology for crop and pasture production in drought-prone areas, agrometeorological inputs and measures to alleviate the effects of droughts. In the area of flood forecasting and management, WMO's Hydrology and Water Resources Programme is implementing the Associated Programme for Flood Management (APFM) in collaboration with the Global Water Partnership, in the context of integrated water resources management.

## Strengthening regional institutions with drought-related programmes

Initiatives taken by WMO to address the critical issue of droughts in Africa and South America led to the establishment of the Regional Centre for Agricultural Meteorology and Hydrology (AGRHYMET) and the African Centre of Meteorological Applications for Development (ACMAD), both located in Niamey; the WMO-supported IGAD Climate Prediction and Applications Centre (ICPAC) and the SADC Drought Monitoring Centre (DMC) for Eastern and Southern Africa located in Nairobi and Harare respectively

## International Workshop in Arusha

The UNCCD COP-7 (Nairobi, Kenya, October 2005) welcomed WMO's offer to organize and find the necessary funding for an International Workshop on Climate and Land Degradation. This workshop, co-sponsored by WMO and the UNCCD Secretariat, will be held 11-15 December 2006 in Arusha, Tanzania. The workshop aims to bring together experts in the area of climate and land degradation presenting state-of-the-art papers, real world applications and innovative techniques for combating land degradation, and offering recommendations for effectively using weather and climate information for sustainable land management. The programme is designed to engage all the participants in discussions and develop recommendations for all organizations involved in land management practices, in particular the National Meteorological and Hydrological Services. Proceedings of the workshop will be published by WMO and UNCCD. As requested by COP-7, WMO, in cooperation with the UNCCD Secretariat, will present the findings of the workshop at the eighth session of the COP to be held in Spain during the latter half of 2007.

Further information at http://www.wmo.int/web/wcp/agm/wocald/

# Climate and land degradation

Climatic variations are recognized as one of the major factors contributing to land degradation. Only when climate resources are paired with potential management or development practices can land degradation potential be assessed and appropriate mitigation technologies developed. The use of climate information must be applied in developing sustainable practices because climatic variation is one of the major factors contributing to or even acting as a trigger to land degradation. There is a clear need to consider carefully how climate induces and influences land degradation. The most important climatic factors for determining areas at risk of land degradation and potential desertification are rain and wind.

The variability and extremes of rainfall such as droughts and flooding can both lead to soil erosion and land degradation. If unchecked for a period of time, this land degradation can lead to desertification. The interaction of human activity on the distribution of vegetation though land management practices and seemingly benign rainfall events can make land more vulnerable to degradation. These vulnerabilities become more acute when the prospect of climate change is introduced.

Wind erosion causes moderate to severe land degradation across the drylands of the world and there is evidence that the frequency of sand and dust storms (SDS) is increasing. SDS are hazardous weather events that cause major agricultural and environmental problems in many parts of the world. These storms are costly at local level and they can accelerate land degradation, causing serious environment pollution and large-scale destruction to ecology and the living environment. In regions where long dry periods associated with strong seasonal winds occur regularly, vegetative land cover does not sufficiently protect the soil, and the soil surface is disturbed due to inappropriate management practices, wind erosion can be a serious problem.

One method to mitigate land degradation and climate change is through carbon sequestration. This is done by transferring atmospheric $CO_2$ into secure long-term storage so it is not immediately re-emitted. This can be done through judicious land use and recommended management practices such as mulch farming, conservation tillage, agroforestry and diverse cropping systems, cover crops and integrated nutrient management, including the use of manure, compost, improved grazing, and forest management.

*Land degradation from water erosion in Bulgaria*

Source: M.V.K. Sivakumar

# RANET-Africa

In Africa, climate and weather play a vital role in sectors such as agriculture, health, water management, disaster mitigation, energy production and environment. Recent technological and scientific advances have provided a wide variety of climate and meteorological observations, products and forecasts that can be used to improve the management of key economic sectors sensitive to meteorological events. Such information when received on time can be of great value for managing disasters and increasing productivity, and particularly for mitigating negative impacts on economies and reducing human vulnerability.

Since 1999, the African Centre of Meteorological Applications for Development (ACMAD) has been developing a project for meteorological and environmental data dissemination to rural communities in conjunction with development partners. It is an integrated rural communication system that uses Radio and Internet technology (RANET-Africa) to disseminate development information produced by national, regional and international services and organizations to rural communities. The process has also helped strengthen the capacity of National Meteorological and Hydrological Services (NMHSs) and related institutions by installing demonstration equipment and providing training to beneficiaries.

RANET achievements include:

- 84 community radios installed in Niger as a network that broadcasts vital information to rural communities in local languages;
- similar networks of community radios are being developed in Chad, Kenya, Senegal, Uganda and Zambia as pilot activities to the programme.

The overall objective is to develop an expanded network of RANET-Africa to cover the entire African continent in an effort to reduce poverty, improve health and strengthen sustainable development in African countries.

# How NMHSs can initiate the RANET programme

The first step that an NMHS should take is to determine the community or communities that require RANET and which also have a high chance of success. The NMHS should also secure the resources necessary either from its own budget or through resource mobilization. The criteria to consider in determining the site are:

- The beneficiary community should have limited resources but not so limited as to hinder project implementation;
- The community must be motivated, willing to contribute cash, in-kind support, labour or land and be able to volunteer participants for animation of radio programmes;
- The presence of active community grassroots organization and development partners such as NGOs;
- Suitable topography for installation of a radio antenna;
- The community must serve a relatively dense population to make it cost-effective.

The next step is to form a steering committee of administrators and partners to provide leadership to the RANET project. They could include:

- The directors and other relevant staff from the NMHS, NGOs and government departments;
- National and local political leaders;
- Community religious and customary leaders;
- Leaders of farmers and other associations.

It is beneficial to form a multidisciplinary team of experts to help in the production and dissemination of information products, raise awareness, coordinate project activities, and monitor, evaluate and develop strategies for sustaining activities beyond the project cycle. They could include meteorologists, hydrologist, agronomists and health experts.

The next step is  to hold a workshop of all stakeholders in which the RANET concept is internalized and a general strategy of implementation agreed.

Source:
Samuel W. Muchemi, Scientific Officer, Public Weather Services Division, Applications Programme Department, WMO

# Drought monitoring …

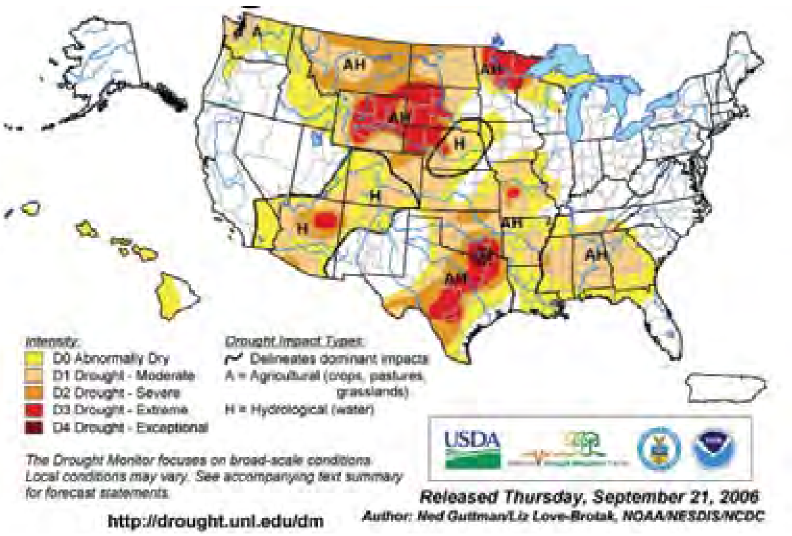
Drought is a natural hazard that results from a deficiency of precipitation from expected or "normal" that, when extended over a season or longer period of time, is insufficient to meet the demands of human activities and the environment. Drought must be considered a relative, rather than absolute, condition and it occurs in virtually all climate regimes.

There are numerous natural indicators of drought that can be monitored routinely to determine drought onset, end and spatial characteristics. Severity must also be evaluated in frequent time steps. Effective drought early warning systems must integrate precipitation and other climatic parameters with water information such as stream flow, snow pack, ground water levels, reservoir and lake levels, and soil moisture into a comprehensive assessment of current and future drought and water supply conditions.

To monitor drought and provide early warning requires a comprehensive and integrated approach. The collection of climatic and hydrological data is fragmented between many agencies or ministries in most countries but the analysis of climate and water data is most effective when it is coordinated under a single authority. This authority can be a single agency or ministry or an interagency authority that is responsible for analysing data and producing useful end products or decision-support tools for delivery to users. Stakeholders must be involved from the early stages of product development to ensure the information will serve their diverse needs in terms of timing and content. A delivery system should reflect the needs of this diverse clientele. A combination of Internet, extension, and print and electronic media delivery may be required.

Monitoring and early warning systems to date have typically been based on a single indicator or climatic index. Recent efforts to improve drought monitoring and early warning have provided new early warning and decision-support tools and methodologies in support of drought preparedness planning and policy development. The lessons learned can be helpful models for countries to follow as they try to reduce the impacts of future droughts. An effective monitoring, early warning and delivery system continuously tracks key drought and water supply indicators and climate-based indices, and delivers this information to decision makers. This allows for the early detection of drought conditions and timely triggering of mitigation and emergency response measures, the key ingredients of a drought preparedness plan.

# … in the United States




Until recently, a comprehensive, integrated drought monitoring, early warning and delivery system did not exist in the United States. In 1999, a partnership emerged between the National Oceanic and Atmospheric Administration (NOAA), the US Department of Agriculture (USDA) and the National Drought Mitigation Center (NDMC) at the University of Nebraska-Lincoln to create the United States Drought Monitor (USDM). USDM is maintained on the NDMC website at http://drought.unl.edu/dm/.

USDM integrates information from multiple parameters and sources to assess the severity and spatial extent of drought on a weekly basis. It is a blend of objective analysis and subjective interpretation but is not intended to be a forecast. Because no single definition of drought is appropriate in all situations, agricultural and water planners and others must rely on a variety of data or indices that are expressed in map or graphic form. The authors of USDM rely on several key indicators and indices, such as the Palmer Drought Index, the Standardized Precipitation Index, stream flow, vegetation health and soil moisture. Ancillary indicators (such as the Keetch-Byram Drought Index, reservoir levels, river basin snow water equivalent and pasture conditions) are integrated to create the final map. Early drafts of the map are emailed to field experts to provide ground truth for the patterns and severity of drought. USDM depicts which sectors are experiencing direct and indirect impacts, using the labels A for agriculture and W for water supplies. USDM has been widely accepted and is used by diverse users to track drought conditions; it has also been used for policy decisions on eligibility for drought assistance.

## … the Horn of Africa …

The Greater Horn of Africa (GHA) is prone to extreme climate events such as droughts and floods. In an effort to minimize the negative impacts of these events, WMO and UNDP established a regional Drought Monitoring Centre (DMC) in Nairobi and a sub-centre in Harare in 1989 that covered the eastern and southern African sub-region. In 2003, DMC in Nairobi became a Specialized Institution of IGAD and was renamed the IGAD Climate Prediction and Applications Centre (ICPAC). The participating countries include Burundi, Djibouti, Ethiopia, Eritrea, Kenya, Rwanda, Somalia, Sudan, Tanzania and Uganda. ICPAC is charged with the responsibility of climate monitoring, prediction, early warning and applications for the reduction of climate-related risks in the GHA.

The main objective of ICPAC is to contribute to climate monitoring and prediction services for early warning and mitigation of the adverse impacts of extreme climate events on various socioeconomic sectors in the region, such as agricultural production and food security, water resources, energy and health. The early warning products enable users to put mechanisms in place for coping with extreme climate- and weather-related risks in the GHA. The Centre also promotes capacity-building for both climate scientists and users. The Centre provides regular regional climate advisories, as well as timely early warning information on evolving climate extremes and the associated impacts. Regional Climate Outlook forums are also being held before the onset of the major rainfall seasons to provide consensus climate outlooks and to develop mitigation strategies.

## … and the Mediterranean

The recently completed GCOS Regional Action Plan for the Mediterranean Basin contains projects considered to be of priority to the region as a whole. One of the 16 projects contained in this plan addresses drought monitoring, which both sides of the Basin see as critical. The project is divided into two phases, with the first focusing on the improvement and extension of an early warning system for drought in the countries bordering the southern Mediterranean. It aims to strengthen the data collection and analyses mechanisms that feed drought early warning systems in North African countries. These systems focus on production and dissemination of indicators of the structural and economic vulnerability of natural resources and populations, with particular regard to the climatic pressures to which they are subjected. A second phase will extend the system to countries bordering the north side of the Mediterranean. The Observatory of the Sahel and Sahara in Tunisia will provide overall project coordination, whereas national partner institutions will undertake specific activities. Stakeholders will include institutions responsible for meteorology, remote sensing, environment, agriculture, water resources and scientific research. As with other Action Plan projects, a key initial objective will be to obtain funding.

### Climate change, desertification and adaptation: what IPCC says

The IPCC Third Assessment Report (TAR) states that projected levels of climate change would exacerbate the continuation of land degradation and desertification that has occurred over the past few centuries in many areas. The TAR projections indicate increased droughts, higher intensity of rainfall, more irregular rainfall patterns and more frequent tropical summer drought in the mid-latitude continental interiors. The systems that would probably be most affected include those with scarce water resources, rangelands and land subsidence.

Adaptation measures can significantly reduce the adverse impacts of climate change, especially in the most vulnerable regions. Adaptations by farmers and herders in Africa have involved diversification and intensification of resource use, and more efficient management of resources such as promoting the natural regeneration of local trees and shrubs. However, the TAR noted that knowledge of adaptation and adaptive capacity is insufficient to prepare and evaluate adaptation options, measures and government policies. Although the TAR made concerted efforts to address linkages of both adaptation and mitigation to sustainable development, there was little room to discuss the direct relationship between adaptation and mitigation. This makes it difficult to set a climate change policy in which adaptation and mitigation are well integrated.

The IPCC Fourth Assessment Report (AR4), to be completed in 2007, will address the issue of adaptation in greater detail, and put more emphasis on inter-relationships of adaptation, mitigation and sustainable development.

## CLIMAT and CLIMAT TEMP reporting

CBS and GCOS have continued their joint efforts to increase the availability of climate data. Along with CBS/GCOS Expert meetings on the Coordination of the GSN and GUAN, training activities in generating and exchanging climate data have been continued for WMO regions. A series of training events started by the RA II/RA VI sub-regional Training Seminar (Moscow, November 2004) and continued by the RA I Sub-Regional Training Seminar (Casablanca, December 2005) has now been complemented by organizing the RA III Regional Training Seminar on CLIMAT and CLIMAT TEMP Reporting (Buenos Aires, 25-27 October 2006). The major goal was to address national observing network managers or coordinators with emphasis on practical exercises in generating climate reports. More than 20 participants attended. Lectures, presentations and practical exercises were given on: rules and procedures for the preparation of reports; software for the preparation of reports; CLIMAT and CLIMAT TEMP bulletins; data quality control; user experience with CLIREP software; table-driven code forms; and basics for transmission of climatological data over the GTS.

See http://www.wmo.int/web/www/OSY/Meetings/CLIMAT_BuenosAires2006/DocPlan.html

# The drought of Amazonia in 2005

Large sections of southwestern Amazonia have experienced one of the most intense drought episodes for the past 100 years. The drought severely affected the population downstream along the Amazon River main channel and its western and southwestern tributaries the Solimões and the Madeira Rivers. Navigation had to be suspended because water levels fell to historic lows. Drought conditions intensified during the dry season until September 2005 and forest fires then affected parts of southwestern Amazonia. Rains returned in October 2005 and caused flooding after February 2006. Unlike the El Niño-related droughts in 1926, 1983 and 1998, the 2005 drought did not affect central or eastern Amazonia. Neither was it ENSO-related. Rather, it was associated with the anomalously warm tropical North Atlantic, reduced intensity in northeast trade wind moisture transport into southern Amazonia during the peak summertime season, and a weakened upward motion over this area of Amazonia, resulting in reduced convective development and rainfall.

It is not clear if this drought is related to wider issues such as the impact of land use changes (deforestation, biomass burning and aerosol release into the atmosphere), or global warming trends, though decadal variability in Amazonian rainfall has been linked to a warming of about 0.5°C in the tropical North Atlantic during the past 30 years.

Author: José A. Marengo, Co-chair WCRP/CLIVAR's Variability of the American Monsoon System (VAMOS) Panel, CPTEC/INPE, Rodovia Presidente Dutra, km. 40,12630-000- Cachoeira Paulista, São Paulo, Brazil

# GEOSS update

The Global Earth Observation System of Systems (GEOSS) launched its 2006 Work Plan in the spring of 2006. Of the 95 Tasks in the Work Plan, WMO is leading and or contributing to almost one-half. Work continued during the summer and was reported at two GEO Committee meetings (Architecture and Data in July and User Interface in September). Planning has begun for the next phase of GEOSS Implementation, that is the Work Plan for 2007-09. A draft Plan was sent to Member Countries and Participating Organizations for official comment by autumn 2006. A new draft was submitted to the GEO Plenary meeting in Bonn, Germany, in November. This included the work still to be completed from the 2006 plan and a number of new tasks relating to the six-year targets set out in the original GEOSS ten-year Implementation Plan.

At the 58th meeting of the Executive Council (EC) of WMO, Members expressed their pleasure that WMO had maintained active participation in GEOSS implementation. In particular, EC noted WMO's leadership and its contribution to the GEO 2006 Work Plan tasks, including the development of GEONETCast and specific tasks related to weather, water, climate and disasters. Members of EC were reminded that GEOSS is based on the principle that existing systems contributing to GEOSS would retain their mandate and responsibilities. Thus the GEO System would be owned and operated by GEO Members while existing WMO components in fulfilling their "of Systems" role would continue to be owned and operated by WMO Members. The interoperable arrangements being developed by GEO—and to be funded by GEO Members—would provide access to WMO Members' data without adversely affecting WMO systems' functionalities or operations. To further quantify the commitment and contribution to be made to GEOSS by WMO Members, EC adopted Resolution 9.4/1 (EC-LVIII) in which all essential data as defined in WMO Resolution 40 (Cg-XII) would be made available through the to-be-defined GEO interoperable interface to the entire GEO community. Finally, EC encouraged all WMO Members to join GEO and become active participants in the GEO process.

# NASA astronaut's early career in WCRP

WCRP enthusiast Piers Sellers was the most experienced spacewalker on board *Discovery* on its July 2006 mission STS-121 to the International Space Station (ISS). It was Sellers' second spaceflight: the first was STS-112 in Atlantis in 2002 where he performed three spacewalks to help install the ISS structure. This time, four among the five-man, two-woman crew members were first-time fliers. The spacewalker's work done on the flight was critical to NASA's plans to resume assembly of the ISS in late August. It was also key to agency efforts to develop the means for astronauts to repair heat shield damage while in orbit.

On one of the three scheduled spacewalks, Sellers and Michael E. Fossum demonstrated the ability to inspect and repair a shuttle's exterior in orbit using the shuttle's arm as a platform. The spacewalk lasted seven and a half hours. "That was quite some time to enjoy another fascinating view of the Earth's energy and water cycle in action from 220 miles [354 km] altitude", Sellers told the World Climate Research Programme after having returned from the space mission.

Before British-born Sellers was selected as a NASA astronaut candidate in 1996, he was involved as a climate modeller at WCRP's Global Energy and Water Cycle Experiment (GEWEX) for about 12 years. "I was lucky enough to be working in the land-atmosphere interactions area when it really exploded into an important sub-area of climate research", Sellers recalls. After his doctorate in biometeorology at Leeds University, UK, Sellers worked at NASA Goddard Space Flight Center integrating surface-atmosphere models into Global Circulation Models (GCMs). It became clear back then, in 1983, that satellite data would be a key for getting a better grip on initialization, calibration and validation of the land-surface component in GCMs. For Sellers a "very busy and rewarding" time started when he instigated the International Satellite Land Surface Climatology Project (ISLSCP) together with Ichtiaque Rasool, Hans-Juergen Bolle and WCRP Director Ann Henderson-Sellers. "Bob Dickinson from the Georgia Institute of Technology, a pioneer in global climate modelling and professor of just about everything, was a tremendous influence and kind mentor throughout the tough early years" says Sellers.

## 'Working in WCRP GEWEX was a very busy and rewarding time'

*Astronaut Piers Sellers waves to the camera in the Quest Airlock of the International Space Station prior to the start of the first scheduled session of extravehicular activity (courtesy NASA)*

ISLSCP was established to promote the use of satellite data for the global land-surface data sets needed for climate studies. Since its beginning, ISLSCP has played a key role in assessing exchange processes of energy, carbon and water between the surface and the atmosphere.

Sellers and his ISLSCP colleagues and friends designed and executed several field experiments such as HAPEX (the Hydrology-Atmosphere Pilot EXperiment) in 1986, an international land-surface-atmosphere observation programme; FIFE (First ISLSCP Field Experiment) from 1987 until 1989, to establish site-average datasets for near-surface meteorology, soil moisture, and temperature; and BOREAS (BOReal Ecosystem-Atmosphere Study) from 1993 until 1996, a large-scale international interdisciplinary experiment in the northern forests of Canada to improve understanding of how boreal forests interact with the atmosphere.

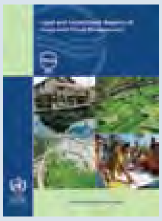
One of the main challenges of all these early experiments was to make better use of satellite data to enhance surface-atmosphere models. Soon, Sellers and his colleagues realized the importance of integrating carbon fluxes in climate models to improve future climate projections.

'My early career as climate scientist was great fun and very exciting – all we did felt so revolutionary to climate science', said Sellers, 'and almost all of it turned out to be very useful'.

# New WMO publications

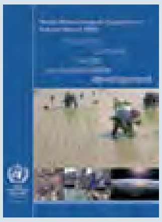
Commission for Agricultural Meteorology (CAgM)—The first fifty years (WMO-No. 999)

2006; 44 pp.
[ E ] (F and S in preparation)



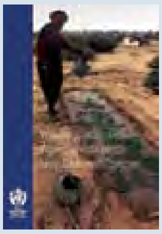
Legal and Institutional aspects of Integrated Flood Management (WMO-No. 997)

2006; x + 91 pp.
[ E ] (F and S in preparation)



Annual Report of the World Meteorological Organization (2005) (WMO-No. 1000)

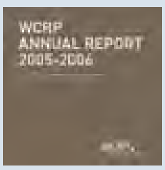
2006; iv + 84 pp.
[ E ] (F, R and S in preparation)



Weather, Climate and Water Services for the Least Developed Countries
(fold-out)

Drought monitoring and early warning: concepts, progress and future challenges (WMO-No. 1006)

2006; 24 pp.
(F and S in preparation)




WCRP Annual Report 2005-2006. New Futures: Building on Great Success. WMO/TD-No. 1349.

2006; 44 pp.
(E)

# Sand and dust storms and risk mitigation

Desertification as a process of increasing desert-like land conditions is significantly affected by human activities such as overgrazing, deforestation, surface land mining and poor irrigation techniques. Although sand and dust storms (SDS) are natural processes of soil erosion, they are highly dependent on drought and desertification conditions. In semi-arid grasslands, such as the Sahel region, dust storms have increased tenfold since the late 1960s. As a result of desertification, SDS are affecting northeast Asia nearly five times as often as they did in the 1950s; the storms are growing in intensity as well.

Dust mass emitted to the atmosphere is estimated to be about 2000 megatonnes per year. Some recent assessments indicate that approximately 10 per cent of this originates from anthropogenic activities such as agricultural land surface modification. Soil dust aerosol affects both the climate and environment. Once in the atmosphere, dust particles interact with solar and thermal radiation, and therefore the energy balance that drives weather an d climate. According to the IPPC 2001 report, there are still large uncertainties in quantifying climate forcing by atmospheric aerosols. Furthermore, dust interacts with clouds modifying their lifetime, extent and efficiency in producing rainfall. Ongoing research has not yet revealed conclusive answers. Dust also influences the biochemical cycles of both marine and terrestrial ecosystems through the deposition process. In the regions closer to deserts, mineral dust affects human and animal health, causing eye infections, and lung and cardiovascular problems. Through intercontinental dust transport, dust plumes can efficiently carry bacteria and viruses: for example, 20 times more microbes are detected in the US Virgin Islands during the days when dust arrives from the remote Sahara desert.

During the past decade, a number of advanced numerical atmospheric models for sand and dust prediction have been developed. To further reduce and mitigate the impacts of SDS, it is crucial to enhance the monitoring network and improve the accuracy of SDS forecasts. In 2004, WMO established the WWRP/GAW Sand and Dust Storm Project which initially concentrated mostly on East Asia. However, in a recent survey more than 40 WMO Member countries from different regions expressed interest in improving their capabilities to obtain more reliable SDS forecasts. In order to explore a possible extension of the Project to other geographical regions and to harmonize the activities in operational sand/dust forecasting, a WMO workshop on sand/dust forecasting is scheduled for 2007.