GLOBAL CLIMATE OBSERVING SYSTEM

WMO IOC of UNESCO UNEP ICSU

WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

GEF Global Environment Facility

UNDP

REPORT OF THE GCOS REGIONAL WORKSHOP FOR CENTRAL ASIA ON IMPROVING OBSERVING SYSTEMS FOR CLIMATE

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FOREWORD

The GCOS Regional Workshop for Central Asia, which is described in this report, is the start of a regional process. GCOS looks forward to working with the principal stakeholders in the region, building on national, regional, and international efforts, to improve systematic observations for climate. We plan to do so in part through working collaboratively with the countries of the region in the development of a Regional Action Plan.

During the workshop, we made progress in identifying national and regional needs for climate as they relate to climate policies, national activities, and sustainable development. We also identified a range of deficiencies in current systems and determined some key regional priorities. We began discussion of developing a Regional Action Plan that can serve as a vehicle to articulate the needs and priorities of the region and bring these needs and priorities to the attention of the Parties to the United Nations Framework Convention on Climate Change and prospective donor agencies. We also began a discussion of a way forward that includes a resource mobilization strategy without which no Action Plan can succeed.

In the process, it is essential that we seek support for the plan from your national authorities and regional bodies. GCOS will work with you, but the plan needs to be yours – regionally focused, regionally motivated, and regionally owned. GCOS values your participation in the Regional Workshop for Central Asia and looks forward to working with you as we seek to improve systematic observations in the region.

I wish to express my appreciation to the Government of Kazakhstan for its hospitality and the fine reception that we all enjoyed in Almaty. I also wish to thank Mr Tursynbek Kudekov, Director of Kazhydromet, for his efforts and those of his staff, which were a major factor in the success of the workshop. I look forward to future collaboration.

Alan Thomas
Director, GCOS

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EXECUTIVE SUMMARY

The Global Climate Observing System (GCOS) held its Regional Workshop for Central Asia in Almaty, Republic of Kazakhstan, from 24 to 26 May 2004. GCOS organized this seventh workshop in its Regional Workshop Programme in collaboration with the Republican State Enterprise "Kazhydromet." The Global Environment Facility/United Nations Development Programme (GEF/UNDP) provided support, with additional funding provided by Japan and the United Kingdom. The goals of the workshop were: (1) to assess the contribution of the region to GCOS baseline networks; (2) to help participants understand guidelines for reporting on observations to the UNFCCC; (3) to identify national and regional needs and deficiencies for climate data (including needs for assessing climate impacts and conducting vulnerability and adaptation studies; and (4) to initiate the development of Regional Action Plan for improving climate observations. The proposed Regional Action Plan will contribute to regional and global efforts to detect climate change, monitor the climate system, plan for and adapt to the impacts of climate variability and climate change and, at the same time, enhance the abilities of nations in the region to address their domestic requirements for climate data and services.

In context-setting, opening remarks, Dr Alan Thomas (Director, GCOS Secretariat) outlined the history and rationale underlying the GCOS Regional Workshop Programme. He stressed the urgent need to enhance systematic observations of the atmospheric, oceanic, and terrestrial components of the global climate system and emphasized that the workshop represented the first step towards the development of a GCOS Regional Action Plan for Central Asia to address identified needs. He encouraged participants to contribute actively to the identification of key regional deficiencies and needs related to GCOS and to propose related, high-priority initiatives for inclusion in the Regional Action Plan. He pointed out that the completion of an Action Plan would provide a solid basis for resource mobilization efforts to achieve significant improvements in climate-related infrastructure, systems, and capacities in the region.

Subsequent workshop presentations and plenary discussions addressed both user needs for climate observations and the status, deficiencies, and needs of atmospheric, oceanic and terrestrial observational networks, including their related telecommunications, data management, data exchange, and archiving systems. Presentations placed substantial emphasis on the vital issue of resource mobilization requirements and strategies and also addressed a number of crosscutting topics. During their deliberations, workshop participants highlighted the following issues and deficiencies that require high-priority attention during the development of a GCOS Regional Action Plan:

- Given the important role played by observational data in areas such as early warning, disaster preparedness, and detection of climate change, it is desirable to increase the visibility of observational activities within national governments and internationally and to initiate an assessment of risk of countries to natural disasters, seasonal and inter-annual variability, and climate change.

- Improving GSN and GUAN in the region is a high priority issue. It is necessary to recover silent GUAN and GSN stations in the region with assistance provided to operators through WMO's Voluntary Cooperation Programme or from other sources.

- The situation for mountain stations in the region has become critical. In view of the importance of climate observations in mountain regions, a project on rehabilitation of mountain stations should be initiated with wide use of automatic weather stations.

- A need exists for further development of the GAW network, in particular with regard to including measurements of aerosol optical depth, precipitation chemistry, and greenhouse gases.

- A need exists to improve climate data collection, quality assurance, data exchange, data management, and archiving. It is important to develop a regional strategy and to plan for climate data rescue (using the best technology available) and historical data collection.

- There is a real need to establish an Arctic Ocean Observing System on an international basis (e.g., within framework of the International Polar Year 2007-2008) to obtain data in support of climate modeling and prediction and to assist nations in improving their capabilities to manage coastal and marine environments.

- Hydrological networks and related infrastructure in Central Asia must be enhanced to support more timely and accurate prediction of drought, floods, and water resource availability for socio-economic activities. It is necessary to optimize the network of hydrological stations in countries, to restore hydrological posts on major rivers, including transboundary ones, and to provide existing posts with modern equipment.

- Changes in the levels of lakes located in Central Asia and in the Caucuses, such as Balkhash, Issyk-Kul, Sevan, and others, are representative indicators of climate change. Unfortunately the former system for observing hydro-meteorological parameters has been largely paralyzed or destroyed. It is therefore necessary to rehabilitate the existing hydrological networks at lakes and reopen hydro-meteorological stations on lakes.

- Great attention should be given to glacier monitoring since the state of glaciers is an indicator of climate change. All-year-round glaciological observing should be resumed at some of the existing stations, and alpine zone glacier-sphere monitoring (3000-3,200 m above sea level) should be established. In addition to glacier monitoring, this should include monitoring of all other ice forms. A project on glacier monitoring should be included in the Action Plan.

- If hydrological stations on major rivers, lakes, and sea coasts and glacier and permafrost monitoring networks can be closely linked, this would help countries resolve their problems regarding availability of water resources and provide a substantial contribution to GCOS and GTOS.

- Many GCOS requirements can only be met in a practical and cost-effective manner by the use of space-based observations. Although virtually all countries in Central Asia have some capability to acquire and utilize satellite data, it is necessary to review the state of their existing capabilities and develop a project proposal to enhance the use of satellite data for climate monitoring and prediction.

- Training in the application of the PRECIS (Providing Regional Climates for Impacts Studies) model is important to all countries in the region in planning for adaptation to climate variability and climate change.

- A need exists to develop a resource mobilization strategy for the region, noting that poverty reduction and economic development are among the current priorities of donor institutions.

- Climate information (in traditional and non-traditional senses) should be used both for assessment and for adaptation purposes. In view of the large number of existing problems in the region, it is desirable to determine fields where national problems are overlapping with regional and global ones and to prepare a list of high priority issues. This list should include cross-cutting national, regional, and global needs; relationships between natural disasters and climate change; and requirements of the IPCC, UNFCCC and WMO.

- A network of focal points for the Regional Baseline Climate Network (RBCN), and especially for the GSN and GUAN networks, should be established. This will ensure the correct identification of stations in these networks and their operation according to expected standards. After a validation process, the same focal points would become points of contact for the operation of stations in their host countries. These focal points could assist in analysis of the causes of problems at stations.

- Within individual countries, coordination should be improved among agencies that are engaged in climate data collection or related data management and exchange, and among agencies that are users of data and derived products. The establishment of National GCOS Committees in some countries in Central Asia is appropriate.

- Coordination among the nations of Central Asia should be improved through a network of regional coordinators. Such network would facilitate the acquisition, exchange, processing, and application of climate system data to meet GCOS and regional needs.

At the conclusion of the workshop, Dr Thomas outlined the next steps in the development of a GCOS Action Plan for the region. It was agreed that a small, broadly representative, drafting team would be created to prepare a draft Regional Action Plan and that this draft Plan would then be circulated to all workshop participants for critical review and comment prior to being finalized. The final version of the GCOS Regional Action Plan for Central Asia would be presented to the Subsidiary Body for Scientific and Technological Advice (SBSTA) of the Conference of the Parties to the United Nations Framework Convention on Climate Change and also published on the GCOS web site.

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OPENING CEREMONY

The GCOS Regional Workshop for Central Asia was officially opened by Mr T. Kudekov, the Director-General of Kazhydromet and Permanent Representative of Kazakhstan with WMO. Participants included directors of National Meteorological Services and National Climate Change Coordinators from the countries of Central Asia as well as a number of observing system experts from both within and outside the region. Following the speech of Mr Kudekov, opening addresses were made by Dr A. Thomas, Director of the GCOS Secretariat, and Dr Z. Takenov, Resident Representative of the UNDP in Kazakhstan.

SUMMARY OF WORKSHOP PRESENTATIONS AND DISCUSSION

THEME 1: SETTING THE CONTEXT
Chair: Mr Tursynbek Kudekov (Kazhydromet)

In his opening presentation Dr Alan Thomas (GCOS Secretariat) set the stage by providing an overview of GCOS (see Annex 3). He emphasized the goals of the programme and main areas of GCOS activity. Dr Thomas pointed out that although GCOS did not make observations or generate data products itself, it did stimulate, encourage, coordinate, and otherwise facilitate the taking of the needed observations by national and international organizations in support of both their own requirements and of common goals. He introduced the purpose of workshop by noting that the United Nations Framework Convention on Climate Change (UNFCCC) had recognized the importance of research and systematic observation. Dr Thomas indicated further that the UNFCCC Conference of the Parties (COP) had noted that high quality data for climate-related purposes are not available in many instances due to inadequate geographic coverage, quantity, and/or quality of the data produced by current global and regional observing systems. Most of the problems occur in developing countries, where lack of funds for modern equipment and infrastructure, inadequate training of staff, and the high costs of continuing operations are often major constraints.

Decision 5/CP.5 in 1999 invited the GCOS Secretariat, in consultation with relevant regional and international bodies, to organize regional workshops to facilitate improvements in observing systems for climate. Dr Thomas outlined expected outcomes of the workshop and hoped that one of the major outcomes of the meeting would be development a regional strategy—a Regional Action Plan—to identify high priority observing system needs for the region for use as the basis for seeking funding to address these needs. The first steps in developing such a plan could be taken at this workshop, and a draft version of the plan could be prepared and circulated for approval by perhaps October 2004.

In the second presentation of the opening session, Ms Olga Pilifosova (UNFCCC Secretariat) drew the attention of participants to several articles of the UN Convention on Climate Change and to various resolutions and recommendations of the UNFCCC Conference of the Parties (COP) and Subsidiary Body for Scientific and Technological Advice (SBSTA) (See Annex 4). She pointed out that the Convention had stated that Parties shall support international efforts to strengthen systematic observation, taking into account the needs of developing countries for improving their capacities to participate in systematic observation. She also noted that COP and SBSTA have endorsed a three-tiered approach to address observing system deficiencies in developing countries, including first, organization of regional workshops and development of specific proposals to address deficiencies in climate observing networks; second, the preparation of detailed observing system reports as part of national communications; and third, the preparation by GCOS of an adequacy report to assess the current status of climate observing systems and to help guide the efficient expenditure of resources. These three approaches are linked and should lead to defined priorities for actions and practical outcomes that will result in concrete project proposals directed at different donors, including the Global Environment Facility (GEF). Ms Pilifosova further emphasized that SBSTA had made a direct link between regional workshops and the project proposals that have been developed thanks to these workshops. SBSTA also invited the Subsidiary Body for Implementation (SBI) to take note of the need to fund those aspects of proposals relating to the global system and to consider at future sessions possible financial implications of such needs, including in its guidance to GEF, the financial mechanism of the Climate Convention. She emphasized that this made the role of regional workshops more important and meaningful. She also mentioned that the COP believed that it is important that as many countries as possible undertake national reports on the status of their observing systems. Individually and collectively, these reports will provide essential information that can be used for the preparation of final synthesis report(s) to guide in upgrading climate observing systems. Ms Pilifosova indicated that *UNFCCC REPORTING GUIDELINES ON GLOBAL CLIMATE CHANGE OBSERVING SYSTEMS* have been developed with the help of the GCOS Secretariat to guide national reporting on climate observations.

In the final presentation of the introductory session, Prof. Paul Mason (Chairman of the GCOS Steering Committee) made an overview of the Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the UNFCCC (See Annex 5). The goals of this report were to determine what progress has been made in implementing climate observing networks and systems since the first report, define the degree to which these networks meet scientific requirements, and assess how well these current systems, together with emerging methods of observation will meet the needs UNFCCC. Prof Mason briefed the participants on the main conclusions given in the report concerning, in particular, the present status of the implementation of global climate observing systems and the necessity to achieve global coverage and climate-quality observations for the variables that are essential to ensure that the needs UNFCCC and Intergovernmental Panel on Climate Change (IPCC) for systematic climate observations are met. He also reviewed the conclusions of the report that related to effective data exchange and access, application of the GCOS Climate Monitoring Principles, additional networks for impact assessment, and the development of adaptation strategies. Prof. Mason outlined specific actions to improve the adequacy of atmospheric, oceanic, and terrestrial networks and briefed participants on the integrated approach that was identified in the report, to be used in the preparation of climate products. To conclude the first part of his presentation Prof. Mason outlined a few recommendations addressed to nations in the Adequacy Report regarding further development of global observing systems. In the second part of presentation Prof Mason expressed his thoughts regarding the preparation of a Regional Action Plan, noting that such a plan could be an important step in designing and implementing a climate observing system that can meet national, regional and global needs.

The plenary discussion that followed the above presentations centered on the following points:

- Timeliness and importance of the GCOS Regional Workshop for Central Asia;
- The need to develop a Regional Action Plan as an instrument for improving climate observing networks in the region and to show to governments why improvements are important and should be funded;
- Difficulties experienced by National Meteorological Services (NMSs) in maintenance and development of observing networks and in undertaking climate research (lack of funding and qualified staff, obsolete equipment, decreasing size of networks).

THEME 2: USER NEEDS FOR CLIMATE OBSERVATIONS
Chair: Mr Tursynbek Kudekov (Kazhydromet)

Mr Ivan Skuratovich (Hydrometeorological Centre, Belarus) made a presentation on observational data requirements for disaster preparedness and reduction of damage from natural disasters of hydro-meteorological origins (see Annex 6). Mr Skuratovich introduced the classification of natural disasters of hydro-meteorological origin used in CIS countries, described the main duties of NMSs regarding the prevention and mitigation of impacts of natural disasters, including monitoring of natural disasters, preparation of weather forecasts and early warnings, and their dissemination. He then identified the observational data required for these activities and formulated recommendations that would help NMSs carry out activities on prevention and mitigation of natural disasters in a more effective way.

Observational data needs for agriculture and drought monitoring were considered in the presentation of Mr Akmurat Ibraimov (Turkmenhydromet) (see Annex 7). He emphasized that with the development of agriculture in the region, in particular cotton production, requirements for hydro-meteorological observational data had increased. Agriculture has become one of the main users of climate information, particularly in desertified areas. However, the analysis of the status of observational networks in support of agriculture made in Mr Ibraimov's presentation shows that at present most hydro-meteorological networks are experiencing problems due to obsolete equipment, lack of telecommunication, and lack of trained personnel. Mr Ibraimov highlighted the urgent requirements for investment in observational networks and in upgrading telecommunications. He recommended providing existing stations with modern equipment, developing a space-based component to assess vegetation in desertified areas, improving monitoring of the Aral Sea and Amuy-Darya River, and development of a method of river discharge prediction for Central Asia as one of the main components of a drought prediction system.

Dr Alexander Zaitsev (IPCC consultant) presented a review of current IPCC activities and informed participants about available IPCC products, such as IPCC Assessment Reports, Synthesis Reports, Summaries for Policy-Makers (SPM), and Special Reports (see Annex 8). The latter have often been issued in response to UNFCCC requests. He briefed participants on high priority areas for action regarding systematic observations in SPMs that include reversal of the decline of observational networks in many parts of the world; expanding the observational foundation for climate studies by providing accurate, long-term, consistent data; reconstruction of past climate periods; improvement of observations of the spatial distribution of greenhouse gases and aerosols. Dr Zaitsev pointed out that present the IPCC has started work on its Fourth Assessment Report and that this should be completed in 2007. Some of the unique features that will be included in this report include the following crosscutting themes: Uncertainty and Risk, Integration of Mitigation and Adaptation, Article 2 of the UNFCCC and Key Vulnerabilities, Sustainable Development, Regional Integration, Water, and Technology. In conclusion, Dr Zaitsev mentioned that the IPCC Secretariat was responsible for publishing and disseminating IPCC Reports to the wider scientific and policy-making community, including translation of SPMs into official UN languages.

In the closing presentation of this Theme, Dr Michael Glantz (NCAR, USA) introduced a "hotspots" concept with some explanation as to why society needs climate information. By climate information Dr Glantz meant climate science, impact policy, and ethics. He also defined hotspots as locations or activities of interest to a group or organization where the trend of human interactions with the environment is considered adverse to the sustainability of an ecosystem or the human activities dependent on it. As a hotspot intensifies, it becomes more costly to address and difficult to control, and it becomes more threatening because there is less time to act effectively. Based on this concept, Dr Glantz gave several examples of water quality, arid lands, and deforestation hotspots; made a comprehensive analysis as to why society should have an interest in hotspots; and suggested what is needed to address them (vulnerability reduction, adaptation, mitigation or prevention of adverse environmental changes, reduction of uncertainty, etc.). In the case of climate change, Dr Glantz pointed out that climate-related hotspots would involve the usual list of climate anomalies, including drought, floods, fires, and severe weather. Climate is important for hotspots, because under "usual" climate conditions, adverse impacts on the environment may be of the creeping kind (low grade, but cumulative) and this type of impact is hard to detect during early stages.

Climate change can also create new hotspots. Dr Glantz outlined possible approaches to minimizing losses that apply in hotspot cases, including "riding the variability curves" from season to season that give opportunities to make perfect forecasts and which would allow people to prepare well in advance for shifts in climate conditions (for example, by altering seasonal fishing pressure on fish stocks). Another approach is hotspot identification and monitoring, leading to early warning of adverse changes to the environment. In this connection Dr Glantz introduced the notion of foreseeability. His advice to GCOS was to focus on areas of concern in order to avoid new hotspots. Dr Glantz described the process of creeping environmental change and his "Rates and Processes" initiative.

Dr Glantz also introduced six concepts (see Annex 9) that are relevant for decision makers to consider in addressing early warning of impending adverse changes in environmental conditions. Such concepts are especially relevant to drylands areas, which comprise such a large proportion of Central Asia. These include: 1) the notions of problem climates and problem societies and how they interact, 2) the idea of creeping environmental problems leading to adverse thresholds of change, 3) the concept that drought follows the plow, especially in relation to the use of marginal lands, 4) the notion of forecasting by analogy, thus facilitating learning through past experiences, 5) the concept of early warning systems, including both strengths and limitations of these systems, and 6) the precautionary principle, a principle that provides a rationale for decision making under conditions of uncertainty.

The main points discussed in Theme 2 were the following:

- Natural disasters of hydro-meteorological origin should be considered in the context of climate vulnerability and taken into account during the preparation of the Regional Action Plan.
- There is inadequate national funding to maintain observing networks in support of agrometeorology. In particular, many stations used for monitoring drought are no longer operational or have obsolete equipment or lack qualified staff.
- "Hotspots" represent a valid concept that can provide added-value in the context of early warning for some processes affecting biodiversity and desertification.
- Climate information (in traditional and non-traditional senses) should be used both for assessment and for adaptation purposes. In view of the large number of existing problems in the region, it is desirable to determine fields where national problems are overlapping with regional and global ones and to prepare a list of high priority issues. This list should include cross-cutting national, regional, and global needs; relationships between natural disasters and climate change; and requirements of the IPCC, UNFCCC and WMO, in particular WMO's Voluntary Cooperation Programme (rehabilitation of observing stations, provision of consumables, etc.)

THEME 3: ATMOSPHERE: STATUS, DEFICIENCES AND NEEDS
Chair: Mr Muratbek Bakanov (Administration on Hydrometeorology, Ministry of Ecology and Extraordinary Situations, Kyrgyz Republic)

Dr Eduard Sarukhanian (GCOS consultant) presented the status of the implementation of the GSN, GUAN and RBCN networks in the region (see Annex 10). First, he gave a short review of the criteria used to select stations in these networks. He then described the current regional status of these networks on the basis of the results of monitoring carried out by the GSN and GUAN Monitoring Centers, the CBS Lead Centers for GCOS, and World Weather Watch (WWW) monitoring results. Dr Sarukhanian indicated that these data showed that the performance of GSN, GUAN and RBCN in this region, as well as in others, had not yet achieved the level that is needed. There are a variety of reasons for this. First, observing stations in synoptic networks in some cases do not forever remain in operation. The NMSs may make changes in the operation or locations of their stations. Errors have existed in the identification of stations and their altitudes. Equipment has become obsolete and supplies have become prohibitively expensive for some operators. Synoptic stations may not prepare and send the monthly summary bulletins (CLIMAT and CLIMAT TEMP) upon which the primary monitoring activities are based. Thus, some stations are identified as “silent” for GCOS purposes when in fact they are operating on a fairly regular schedule as synoptic stations. It has been reported for some time that roughly 40% of the stations in GSN and GUAN are “silent”, although more recent analysis indicates that the networks are actually working somewhat better. In addition, network stations are generally not achieving target performance requirements.

Dr Sarukhanian pointed out that one important action that could be taken would be to establish a network of regional focal points for validation of GSN and GUAN stations in individual countries. He stressed that another serious deficiency in the implementation of GCOS networks so far has been the lack of historical data from many stations. The National Climatic Data Centre (NCDC) in Asheville is responsible for building a permanent data base of GSN daily and monthly data submissions, along with the appropriate station metadata history, and for providing free and open user access to this information via their web site. Historical data are important to individual countries, to the region as a whole, and to the global climate community. To solve the existing problems Dr Sarukhanian proposed to initiate a project on the improvement GSN and GUAN in the region. This project would help to rehabilitate “silent” GUAN stations and increase the number of CLIMATE and CLIMATE TEMP messages from the region. He also suggested that a project on collection of historical data from GCOS networks in Central Asia be launched.

The next presentation, made by Mr Nail Sagdeev (Glavhydromet, Uzbekistan), described the status of mountain climate observations in the region (see Annex 11). Mr Sagdeev indicated that meteorological stations in mountain areas were points of background monitoring of environmental pollution. The role of these points has become more important because of environmental pollution and increased CO_2 concentration in the atmosphere. They are also important sources of information on hazards phenomena, such as floods, mudflows and avalanches. Regarding the present status of these networks, Mr Sagdeev pointed out that the majority of mountain stations were installed and equipped in the 1970s and 1980s. Only a few have been equipped with modern computers and none have modern communication facilities.

The state of snow-measuring observations in mountains (needed for the accurate estimation of water resources in the region now and in the future) has also worsened. Without such information the quality of hydrological forecasting has deteriorated considerably. Observations of snow cover depth have ceased in almost all NMSs. Airborne gamma-surveys of snow-water equivalent have also ceased, and the number of the airborne snow surveys of snow reserves in mountains, as well as of surface snow surveys, have been reduced. Economic difficulties have had a negative effect on the provision of hydro-meteorological networks of the NMSs with the equipment, instruments, spare parts, and materials. The financing of NMSs in the region is insufficient for the construction, repair, and maintenance of hydro-meteorological observing stations, not to mention the restoration of closed stations in mountain areas. Mr Sagdeev concluded that due to these difficult conditions, many stations were not able to provide information that could be used for weather forecasts, for warnings of severe weather, or for studies of river regimes, environmental pollution, or climate change. The evaluation and reconstruction of the existing network of mountain stations is a matter of high priority.

The data rescue issue was considered in the presentation by Ms Olga Bulygina (VNIGMI-MCD, Russian Federation) (see Annex 12). She described techniques and ways of saving historical data from Central Asia, depending on different specific conditions in the countries of the region. Ms Bulygina drew special attention to matters related to resolving gaps in historical data, increasing data quality, and decreasing data heterogeneity. She showed that data rescue closely related to data management, and in this connection she pointed out that Roshydromet was prepared to provide CIS countries in Central Asia with software packages, including PERSONA-MIS, Cliware, and CLICOM, through Voluntary Cooperation Programme (VCP) channels. Ms Bulygina concluded that high priority should be given to data rescue issue because if data can be found and saved, it would be much easier to form historical data sets by using special software packages and disseminating them among collecting centers.

The last presentation under Theme 3 was made by Dr John Miller (Air Resources Laboratory, NOAA, USA) (see Annex 13). He started his presentation by giving some history of the Global Atmosphere Watch (GAW) and a description of its composition. Then he briefed the participants on the state of the GAW in Central Asia. He requested workshop participants to give the latest information on the GAW network in their countries, including information on station location, measurement programmes, and central laboratories, in order to update the GAW Information System. Dr Miller pointed out that the GAW programme in the region has begun to make important contributions. In this respect he proposed a review of further measurements that could be made to contribute to the GAW programme. Measurements that should be considered include aerosol optical depth, precipitation chemistry, and measurements of selected trace gases. He also suggested that each country in the region should name a GAW Contact Person to interact with the WMO Secretariat and other parts of the GAW infrastructure.

The following points relating to atmosphere observing networks and data rescue were highlighted during the discussion:

- Improving GSN and GUAN in the region was recognized as a high priority issue. It was stressed that it is necessary to recover two GUAN stations in the region (Ashgabat and Ostrov Vrangelja) with assistance provided to operators through VCP or from other sources. It was noted that the Government of Turkmenistan was prepared to bear the operational costs of the upper-air station in Ashgabat once it is back in operation.
- It was also noted that the Russian Federation recently revised its portion of the GSN, increasing the number of CLIMAT messages from Russian territory.
- Participants from Azerbaijan, Georgia, and Mongolia expressed the willingness of their countries to include some of their upper-air and surface stations in GUAN or GSN if they could receive logistic or financial support. In this connection, the representativeness of the station and its location for climate observations were emphasized as main criteria for inclusion in GCOS.
- The need for improved coordination between GCOS Monitoring Centers, station operators, and on-site personnel was expressed. This would enable resolution of

operational problems as quickly as possible. In view of this, the recommendation to establish a network of focal points for validation of GSN and GUAN stations in individual countries was endorsed.

- Data rescue and collection of historical data was also recognized as a matter of high priority. It was stressed that the first step in this process should be the saving of data archives. This would require financial support, and the World Bank, UNFCCC, and other potential sources of funding were mentioned in this respect. The preparedness of the Russian Federation to provide CIS countries in Central Asia with software packages was noted with deep appreciation. Several participants expressed urgent needs for such packages.
- It was stressed that the situation for mountain stations has become critical. In view of the importance of climate observations in mountain regions, a project on rehabilitation of mountain stations should be initiated with wide use of automatic weather stations (AWSs).
- Further development of the GAW network was emphasized, in particular with regard to including measurements of aerosol optical depth, precipitation chemistry, and greenhouse gases. A need for regular calibration of ozonometric instruments was expressed.

THEME 4 OCEANS: STATUS, DEFICIENCIES, AND NEEDS

Chair: Mr Sohrab Shiraliyev (National Hydrometeorological Department, Ministry of Ecology and Natural Resources of Azerbaijan)

A presentation on the Arctic Ocean and its role in climate was given by Prof. Nikolai Smirnov (RGGMU, AARI, Russian Federation) (see Annex 14). He highlighted the role of polar regions in the overall climate system, and in particular, the role of the Arctic Ocean as an area from which cold air masses penetrate to middle latitudes and have impacts on the weather and climate in Central Asia. Prof Smirnov pointed out that Arctic Ocean sea level is an indicator of atmospheric and oceanic circulation, and as result, of climate variability. Since the polar regions, as long-term observing and model calculations have shown, are the most sensitive to climate change, climate change studies of the Arctic Ocean are very useful for understanding the nature of climate change, and, in particular changes that have been observed in recent years. Prof Smirnov emphasized that for this purpose it is necessary to have a long-term climate observing system operating in the Arctic. Unfortunately, in the last 10 years there has been a sharp reduction of the number of hydro-meteorological observing stations along the Arctic Ocean coast. He indicated that up to two-thirds of sea level measurement stations have been closed, together with the simultaneous deterioration of the quality of observations at the remaining stations. Standard hydrological sections in arctic seas in summer and ice surveys from aircraft along North Sea Route have been stopped. In light of the above, it is very difficult to carry out climate monitoring of the Arctic Ocean. The needs and urgency of such monitoring were confirmed by some examples given in the presentation showing that the well-known phenomenon of “global warming” had no evident signal in the Arctic Ocean. Comparison of the extreme temperature recurrence frequencies during warming periods in the 1930s – 1940s and in the 1990s shows that during the 1930s – 1940s the temperature anomaly recurrence both in winter and in summer was higher. As was indicated by Prof Smirnov, global warming was not confirmed by the analysis of changes in other variables such as sea-ice coverage, precipitation, or river discharge in the Arctic. He concluded that in the light of the above circumstances, it is very important to establish an observing system in the Arctic Ocean to monitor climate variations in this area and to obtain more data for understanding the nature of climate change.

Discussion after Prof Smirnov’s presentation raised the following points:

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- It is necessary to acquire more data in order to confirm or reconsider the "global warming" phenomenon and understand the nature of current climate change.
- There is a real need to establish an Arctic Ocean Observing System on an international basis to obtain data in support climate modeling and prediction and to assist nations in improving their capabilities to manage coastal and marine environments.
- It was noted that recently the WMO and ICSU jointly proposed to initiate an International Polar Year (IPY) in 2007-2008, and that the IPY Outline Science Plan already includes a proposal to establish an Arctic Ocean Observing System.

THEME 5: TERRESTRIAL OBSERVATIONS: STATUS, DEFICIENCIES, AND NEEDS

Chair: Mr Sohrab Shiraliyev (National Hydrometeorological Department, Ministry of Ecology and Natural Resources of Azerbaijan)

The first presentation in this session addressed hydrological observations and was made by Mr Berik Baymagambetov (Kazhydromet) (see Annex 15). He pointed out that development of hydrological networks in Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan reached a peak in the 1980s when the network consisted of 506 hydrological posts on rivers, lakes, and seacoasts. Hydrological networks in these countries have served for various purposes, in particular for water resources assessment because the amount and quality of water is a serious issue for sustainable development in this region. Mr Baymagambetov indicated that a significant reduction of hydrological posts in these states occurred at the end of the last century. Stations for observing mudflows, hydrological observations, and water cadastre units were liquidated. Water balance studies and observation of hard flows were stopped. By 2004 the network of hydrological posts had been reduced by an average of 45% in all the Central Asian states indicated above. In order to improve the current status, he recommended restoration of hydrological posts operations on major rivers, including transboundary ones, provision of existing posts with modern hydrological instruments and equipment, reactivation of the operations of water-balance stations, and exchange of hydrological data and cadastre publications, especially for transboundary water reservoirs.

A short presentation concerning hydrological observations at sea was done by Mr Heinz Weiss (Swiss Aral Sea Mission). He briefed participants on the state of the Aral–HYCOS project, which has been implemented by the NMSs of Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan. One of the main purposes of the project is to improve the monitoring, processing and dissemination of hydrological data for the assessment and integrated management of water resources in Aral Sea basin. Mr Weiss mentioned that participants of the project were going to collaborate with other national, regional and international programmes (e.g., GCOS) in modernization, rationalization, and improvement of the distribution of hydrological information. One of the expected results of the project will be the installation of a real-time hydrological network, including 35 hydrological and10 meteorological stations.

The status, deficiencies, and needs of glacier monitoring in Central Asia and the Caucuses was considered in the presentation of Prof Igor Severskii (Institute of Geography, Ministry of Education and Science, Republic of Kazakhstan) (see Annex 16). He indicated that there are two main reasons for glacier monitoring in Central Asia. The first is that mountain glaciation is one of the most vivid indicators of climate change. The second is that glaciers are one of the major sources of water in the countries of the region. The share of melted glacier water in the region's annual river flows is around 30%, and their share in the summary river flows during the vegetation period often exceeds 50%.

Prof Severskiy also described glacier monitoring in Central Asia from the time of the International Geophysical Year (IGY) in 1957–1958 until the 1980s. The data acquired during this period served as a basis for compiling a Glacier Catalogue for mountainous countries. These data were summarized in numerous scientific publications and in the World Snow and Ice Resource Atlas (1997). In the early 1990s field studies practically stopped, and continuous all-year-round glaciological-climatic observations remained only at the Kazakhstan Institute of Geography, located at Tuyuksu Glacier on the Zailiiskii Alatau northern slope. As regards the development of the glaciological-climatic network in the mountains of Central Asia, Prof Severskiy recommended establishing alpine zone glacial sphere monitoring, which, apart from glaciers, would include all other ice forms – snow cover, wind and avalanche snow, river ice, ice crust, and subterranean ice. Ice and more than 50% of the snow resources located in the alpine zone (3000-3,200 m above sea level) are the major sources of water for the rivers of the region.

The presentation of Dr Sergey Marchenko (Geophysical Institute, University of Alaska, USA) addressed the state of permafrost monitoring in the region (see Annex 17). Dr Marchenko mentioned that the Global Terrestrial Network for Permafrost (GTN-P) was established in 1999 to provide long-term field observations of the active layer and of the permafrost thermal state that are required to determine present permafrost conditions and to detect changes in permafrost stability. Dr Marchenko emphasized that permafrost measurements are particularly important for determining the long-term terrestrial response to surface climate change. Permafrost monitoring for climate change includes measurements of temperature profiles in perennially frozen ground and of the thickness and temperature of the overlying active layer (seasonally thawing and freezing soil). He indicated that Central Asia is the largest area of alpine permafrost in the world, and that at present, there are some 30 GTN-P monitoring sites at high elevation in Kazakhstan, Mongolia, and China that are observing active layer thickness/temperature and permafrost temperature. For further development of the GTN-P, Dr Marchenko recommended continuing its expansion in Central Asia, equiping existing boreholes with modern sensors and loggers, and establishing new sites (without borehole drilling) for monitoring the near-surface ground temperature regime at different altitudes and landscapes. He also indicated that a database should be developed and continually improved by combining the collection and analysis of long-term instrumental observational data with the data on spatial distribution of permafrost, ground ice, and glaciation. He also recommended that an alpine permafrost and ground-ice conditions map should be compiled for the Tien Shan, Pamir, and Altai mountains of Central Asia, using existing geomorphic, hydro-meteorological, geocryological, and borehole data and aerial and satellite images.

Plenary discussion of terrestrial observations followed the presentations. However, before the general discussion there were two additional presentations, one made by Prof. Valentin Meleshko (MGO, Russian Federation) and a second by Prof. Renhe Zhang (Academy of Meteorological Sciences, China) concerning the contributions of Russia and China respectively to the implementation of GCOS networks. Prof. Meleshko provided participants with information regarding the Russian contribution to GSN, GUAN, and GAW and related to satellite, oceanographic, and hydrological observations and the permafrost-monitoring network. Prof Zhang informed the workshop that China had developed a national GCOS Implementation Plan and that GCOS national activities were coordinated with this Plan. He gave a description of the Chinese components of GSN, GUAN, GAW, GTOS, and other networks contributing to GCOS and operated by various agencies. He noted that a National Committee on GCOS was established to coordinate these activities.

During general discussion the following main points were raised:

- Hydrological networks and related infrastructure in Central Asia must be enhanced to support more timely and accurate prediction of drought, floods, and water resource availability for socio-economic activities. It is necessary to optimize the network of hydrological stations in countries and to restore the hydrological posts on major rivers, including transboundary ones, and to provide existing posts with modern equipment.

- Changes in the levels of lakes located in Central Asia and in the Caucuses, such as Balkhash, Issyk-Kul, and Sevan, are considered as representative indicators of climate change. Unfortunately, as a result of political changes in the region, the former system for observing hydro-meteorological parameters has been largely paralyzed or destroyed. It is therefore necessary to rehabilitate the existing hydrological networks at lakes and reopen hydro-meteorological stations on lakes Balkhash, Issyk-Kul, and Sevan.
- Regarding the Caspian Sea, the Governments concerned (Azerbaijan, the Islamic Republic of Iran, Kazakhstan, the Russian Federation, and Turkmenistan) have already established a Coordinating Committee on Hydrometeorology and Monitoring of Pollution in the Caspian Sea (CASPCOM). The Committee has developed an Integrated Programme on Hydrometeorology and Monitoring of the Environment in the Caspian Sea Region (CASPAS) that would contribute to the establishment of a regional system for the monitoring and exchange of relevant information on the state of the environment. It is also necessary to enhance the Aral–HYCOS project.
- Great attention should be given to glacier monitoring since the state of glaciers is an indicator of climate change. All-year-round glaciological observing should be resumed at some of the existing stations and alpine zone glacial sphere monitoring (3000-3,200 m above the sea level) should be established, which, in addition to glacier monitoring, should include monitoring of all other ice forms.
- It was noted that the government of the Kyrgyz Republic has supported the initiative of the NMS to rehabilitate the glacier-monitoring network in that country. It was recognized that to use rationally donor's assistance, it is necessary to prepare a project indicating which stations must be recovered, where new stations should be opened, etc. It would be desirable to have guidance on developing and operating a glaciological network for countries where glaciological monitoring has not been widely developed.
- It was also recognized that if hydrological stations on major rivers, lakes, and seacoasts and glacier and permafrost monitoring can be closely linked, this would help countries resolve their problems regarding availability of water resources and provide a substantial contribution to GTOS and, therefore, to GCOS. In this connection, the coordinating role of the Global Earth Observation System of Systems (GEOSS) was mentioned. It was stressed, however, that the main coordinating role between GTOS and GCOS belongs to the UNFCCC and IPCC as major climate data users.

THEME 6 CROSSCUTTING TOPICS

Chair: Mr Gennadi Kojoyan (Hydrometeorology and Environmental Monitoring Agency, Armenia)

Dr Geoff Jenkins (UK Met Office) opened the session with an overview of the PRECIS regional climate model (see Annex 18). He emphasized that the PRECIS model (the Hadley Centre's portable regional climate model) was a "state of the art" regional model that will run efficiently on a fast personal computer and produce fine-scale outputs suitable for use in climate impact and adaptation studies. The PRECIS model provides improved representation of smaller scale climatic patterns and influences and of extreme events, including the effects of topography, islands, tropical cyclones and hurricanes. The major features of the model, its operating requirements, and its application to the development of future climate scenarios were described. In its present form, the model satisfactorily represents monthly mean temperature patterns and monthly mean precipitation. Dr Jenkins pointed out that the PRECIS system will provide users with a detailed climate change scenario which can be used to investigate impacts. However, it is important that uncertainties in the scenarios are fully understood, so that adaptation options can be properly designed to reflect these. The first uncertainty arises from our lack of knowledge of future emissions. The second uncertainty is associated with our incomplete understanding of the climate system and our inability to model it perfectly – so called “science” or “modelling” uncertainty. This can be quite large in some regions of the world, as shown in the IPCC Third Assessment report. The remaining uncertainty in scenarios is due to the natural variability of the climate system. We do not know if natural variability will act in the same direction as human-made climate change in a particular future period and location, and hence accentuate it, or act in the opposite direction and hence reduce its effects. This uncertainty can be quantified by running the global model a number of times with different initial conditions, and driving the PRECIS regional model with each of these global predictions. It is clear from the above that several experiments with PRECIS will be required in order to take account of these uncertainties. Dr Jenkins noted that the PRECIS model is available on DVD and will be supplied free of charge to developing countries to assist them in developing the climate scenarios needed for impact and adaptation studies at the national level. He stressed, however, that completion of a training course was required to operate the model. There is a plan to organize further courses in 2005 with groups of countries in other parts of the world.

Mr Yoshiro Tanaka (WMO Secretariat) next briefed participants on the new major WMO programme on space activities (see Annex 19). He pointed out that the WMO Space Programme, established by the Fourteenth Meteorological Congress, included the expanded space-based component of the World Weather Watch’s (WWW) Global Observing System (GOS), with appropriate R&D environmental satellite missions. The main purpose of the WMO Space Programme, he stated, is to coordinate environmental satellite matters and activities throughout all WMO programmes and to give guidance to these and other multi-sponsored programmes on the potential of remote sensing techniques in meteorology, hydrology and related disciplines, as well as in their applications. Regarding satellite observation for climate, Mr Tanaka indicated that space-based observations are essential and have impacts for climate monitoring and climate research activities. For climate research, the value of space missions comes mostly from the capability to produce globally integrated, high quality, reliable data products requiring merged analysis of measurements from the whole constellation of operational and research/demonstration earth observation satellites, complemented and validated by data from in situ observing networks. The WMO Space Programme, together with the Committee on Earth Observation Satellites (CEOS), maintains a database that contains information on such things as user observational requirements, space agency missions, instruments on a mission, and parameters observed by space/surface-based instruments.

In the discussion followed the presentations the following main points were highlighted:

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- The usefulness of the PRECIS model for regional climate prediction was expressed. The wide distribution of this model among countries in Central Asia, in particular among countries with varying climates, was highly recommended.
- It was noted with appreciation that the Hadley Centre is planning to organize one-week training courses on model utilization with groups of countries from various parts of the world in 2005.
- It was also noted that many GCOS requirements can only be met in a practical and cost-effective manner by the use of space-based observations. In particular, only satellite remote sensing can provide consistent areal observational coverage over both individual regions and the entire globe. Satellite observations provide spatial coverage, while in-situ observations provide essential “ground truth” for satellite data, in addition to their own intrinsic value and length of record.

- It was recognized that although virtually all countries in Central Asia have some capability to acquire and utilize satellite data, it would be necessary to review the state of their existing capabilities and develop a project proposal to enhance the use of satellite data for climate monitoring and prediction.

THEME 7: RESOURCE MOBILIZATION

Chair: Mr Gennadi Kojoyan (Hydrometeorology and Environmental Monitoring Agency, Armenia)

A presentation on resource mobilization was delivered by Mr James Williams (GCOS consultant) (see Annex 20). The purpose of this presentation was to help workshop participants better understand how resources might be mobilized to meet identified priority needs in Central Asia. Mr Williams discussed the size of flows of international development assistance to Central Asian countries related to GCOS objectives. He also identified possible donors, and development partners who may be able to provide support to address climate observing system needs in Central Asia and strategies that might be successful in approaching these organizations. He provided participants with the data on flows of official development assistance along with the ten top funding sources for countries in Central Asia. He showed that the most promising financial donors in this region appear to be Japan, the USA, IDA, Germany, and the European Commission. He pointed out that when approaching donors it is vitally important to be aware of their priorities and to tailor resource requests to these priorities. In this context, he noted that the OECD's long-term development agenda places priority on reducing poverty and supporting economic growth, with associated goals relating, among others, to education, health, women, and good government. As issues, environment and sustainable development were near the bottom of the priority list. Mr Williams also stressed that donors were, to an increasing extent, providing assistance to national governments without specifying how it should be used. This development meant that NMS and the climate community must develop much closer relationships with their own nation's finance ministries.

During the discussion on this topic the participants emphasized the following points:

- Coordination among countries in the planning and implementation of GCOS projects is vitally important because it gives an opportunity to donors to provide assistance in a centralized way.
- Project evaluation should be taken into account when developing project proposals. It should address: (1) the results to be expected from the project, (2) the potential for learning from it, (3) possible follow-on projects, and (4) consistency of projects. It was stressed that proposals should be as concise and as brief as possible.
- Heads of NMSs must work actively with their governments to show them the benefits that can be gained by the economy from the proper use of weather and climate information. Illustrating the benefits would help NMSs receive the requested funding.

THEME 8: FIRST STEPS IN DEVELOPING A REGIONAL ACTION PLAN

Chair: Dr Eduard Sarukhanian (GCOS Consultant)

On the final day of the Workshop the main item was consideration of the draft Framework Document to assist in preparation of the Regional Action Plan. Dr Thomas, Director of the GCOS Secretariat, delivered the opening remarks on this theme by outlining some major considerations in developing a GCOS Regional Action Plan. He also mentioned that one of the reasons for this workshop was to enable consultations between experts and representatives of countries on how better to meet GCOS needs and to strengthen cooperation between National Climate Change Coordinators and NMSs. He noted that the Regional Action Plan should take into consideration the outcome of these consultations and discussions. Another criteria is that the Plan should be balanced between three domains: atmospheric, oceanic, and terrestrial. Dr Thomas reiterated that, from a GCOS perspective, systematic observations encompassed climate system observations, data management and data exchange infrastructure, and the production and dissemination of climate products to users. He then briefly drew attention to several key issues stressed by workshop participants, including the need to enhance visibility, to improve coordination, to enhance and sustain the performance of GSN and GUAN stations, and to pursue improvements in data management, data exchange, and data rescue.

After these introductory remarks Dr E. Sarukhanian, GCOS consultant, presented a synthesis of the framework document prepared to assist in the preparation of a GCOS Regional Action Plan for Central Asia. He briefly outlined the structure and contents of the document, stressing that its intent was to help workshop participants shape their own Regional Action Plan by providing a proposed structure and some preliminary text for consideration. He drew attention to questions included in the document, noting that these were intended to encourage participants to contribute actively to the planning process. He then urged participants to identify the key thrusts that should be included and to agree on the structure and content of the document.

The discussion following this presentation was focused on ideas concerning the preparation of the Regional Action Plan:

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- The Framework Document was recognized as a good basis for development of a Regional Action Plan. It was proposed to update its introduction to emphasize the connection between climate change and economic development in the light of conclusions made in the presentation on resource mobilization. This would make the Plan more attractive to funding agencies. The introduction should also emphasize a specific role for GCOS in integrating the observing systems the three different domains: atmospheric, oceanic, and terrestrial.
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- The Regional Action Plan should include several projects related to the improvement GSN and GUAN, development of a regional climatological network, in particular a network of mountain stations and the extension of GAW in the region by inclusion of measurements of aerosol optical depth and precipitation chemistry.
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- In respect to terrestrial observations, it was suggested that project proposals should cover hydrological observations on major rivers and large lakes in the region as well as on the coasts of the Caspian and Aral seas, and rehabilitation of the glaciological monitoring network and extension of GTN-P in Central Asia.
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- Regarding oceanographic observations, it was thought that development of an Arctic Ocean Observing System would be appropriate in this context. However, it was recognized that this project is planned to be implemented in the framework of the International Polar Year, 2007-2008, initiated by WMO and ICSU. Rehabilitation of tide-gauges along the Asian coast of the Pacific Ocean, as well as inclusion of tide-gauge stations of the Caspian Sea in GLOSS, would be highly desirable.
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- It was stressed that enhancing overall data quality and improving data management, data exchange, databases and archives, and facilitating user access to data must be one of the priorities in the operations of the above networks. In view of this, it was recognized that the Regional Action Plan should include a project related to data rescue and collection of historical data.
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- It was emphasized that in course of preparation and implementation the above projects attention should be given not only to closed stations but also to operational ones, in particular with respect to their observational programmes. It will be necessary to extend monitoring to cover all types of observations and to provide monitoring results through a special bulletin. It may be useful to establish a monitoring centre in the region.
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- As a result of Workshop discussions, some changes should be made in the draft GCOS Implementation Plan, which was distributed to countries for comments.

In the concluding session Dr Thomas made provided some information on resources mobilization in support of regional projects. He mentioned three possible sources of support: the UNFCCC, support from the newly established GCOS Cooperation Mechanism (mainly focused now on GCOS baseline networks), and support from current WMO Programmes (e.g., VCP). Speaking on the process of preparing the Regional Action Plan for Central Asia, Dr Thomas indicated that GCOS planned to convene a small, well-balanced, writing group of approximately 10 people to prepare a first draft. He also indicated that his office, along with regional partners, would facilitate and support the planning and writing process. Noting that the draft plan would address high-priority issues identified during the workshop, Dr Thomas encouraged participants to submit related project proposals, to give thought to potential sources of funding to implement these projects, and to take ownership of the development and implementation of the Regional Action Plan for Central Asia that would be developed. He indicated that the draft Plan prepared by the writing group would be distributed to all workshop participants for review and comment prior to its finalization. The final Action Plan would be presented to SBSTA and placed on the GCOS web site. In closing, Dr Thomas reiterated the need for a GCOS Regional Action Plan to be sharply focused on the highest priority needs and deficiencies.

The following recommendations were endorsed by Workshop:

1. In order to improve coordination at national and regional levels, it is recommended to establish a network of focal points for the RBCN, and especially for the GSN and GUAN networks. This will ensure the correct identification of stations in these networks and their operation according to expected standards. After a validation process, the same focal points would become the points of contact for the operation of the stations in their host countries. These focal points could assist in the analysis of the causes of problems at stations in their countries.

2. Within individual countries, coordination should be improved among agencies that are engaged in climate data collection or in related data management and exchange, or that are users of data and derived products. The establishment of National GCOS Committees in some countries in Central Asia would be appropriate.

3. Coordination among the nations of Central Asia should be improved through a network of regional coordinators. Such network would facilitate the acquisition, exchange, processing and application of climate system data to meet GCOS and regional needs.

4. It is recommended that an assessment of risk of countries to natural disasters, seasonal and inter-annual variability, and climate change be initiated.

The Workshop identified a number of projects to be developed and implemented in the region to meet GCOS needs and nominated experts who would be responsible for preparation of brief project proposals for inclusion in the draft Regional Action Plan. They are as follows:

Atmospheric observations

Project No 1. Improving the GCOS Surface and Upper-Air Observing Networks in Central Asia Ms O.Abramenko (Kazhydromet) and Dr E.Sarukhanian (GCOS consultant)

Project No 2. Saving of meteorological observational data and collection of historical data from GSN stations Ms O.Bulygina (VNIGMI-MCD, Roshydromet)

Project No 3. Enhancement of the GAW network in Central Asia by inclusion of aerosol and precipitation chemistry measurements Dr S.Chicherin (MGO, Roshydromet)

Terrestrial observations

Project No 1. Improving hydrological networks along major rivers in Central Asia, including rehabilitation of high-mountain stations in the Aral Sea basin
Dr S. Myagkov and Mr N. Sagdeev (Glavhydromet, Uzbekistan)

Project No 2. Adaptation of hydrological observing networks on the lakes of Central Asia for climate change assessment Prof. V.Vuglinsky (State Hydrological Institute, Roshydromet)

Project No 3. Development of the glaciosphere monitoring network in Central Asia
Prof. I. Severskii (Institute of Geography, Kazakhstan)

Project No 4. Expanding the permafrost monitoring network in Central Asia
Dr S. Marchenko (University of Alaska, USA)

Satellite-based observations

Project No 1. Improving the application of satellite information and products in Central Asian countries for climate purposes
Ms T. Burtseva (Scientific and Research Centre on Space Hydrometeorology PLANETA, Roshydromet)

CLOSING CEREMONY

Mr T. Kudekov, Director of Kazhydromet, officiated at the workshop closing ceremony. He expressed thanks to all participants for active participation in the workshop, in particular to the lecturers whose comprehensive and valuable presentations will help countries in Central Asia find ways to improve their observing systems and meet GCOS needs. He gave his special thanks to the GCOS Secretariat for the excellent organization of the workshop. Dr Alan Thomas, Director of the GCOS Secretariat, in his turn, expressed his appreciation to the host country for its excellent facilities and for the warm hospitality provided to the workshop participants. He also expressed the hope that that the process started in Almaty would continue and that it would lead to the preparation of an effective GCOS Regional Action Plan for Central Asia.

Annex 1

GCOS Regional Workshop for Central Asia
Almaty, Kazakhstan 24-26 May 2004

Agenda

DAY 1

8:00-9:00 **Registration of Participants**

9:00-9:45 **Opening Ceremony**

9:45-10:00 **Break**

10:00-11:30 **Theme 1 Setting the context**

1. Overview of GCOS—A. Thomas, Director, GCOS (20)
2. The UNFCCC and Systematic Observations—O. Pilifosova, UNFCCC (20)
3. A Review of the 2nd Adequacy Report and Developing a Regional Action Plan
   P. Mason—Chair, GCOS Steering Committee (40)
4. Discussion (10)

11:30-11:45 **Break**

11:45-13:45 **Theme 2 User Needs for Climate Observations**

1. Observational Needs for Disaster Preparedness—I. Skuratovich (25)
2. Observational Needs for Agriculture and Drought—A. Ibraimov (25)
3. The IPCC: Main Activities and Products—A. Zaitsev (25)
4. Observational Needs for Adaptation to Climate Change—M. Glantz (25)
5. Discussion and Workshop Recommendations (20)

13:45-15:00 **Lunch**

15:00-17:30 **Theme 3 Atmosphere: Status, Deficiencies, and Needs**

1. GSN, GUAN, RBCN: E. Sarukhanian (30)
2. Mountain Climate Observations—N. Sagdeev (30)
3. Data Saving Issues—O.N. Bulygina (30)
4. Global Atmosphere Watch—J. Miller (30)
5. Discussion and Workshop Recommendations (30)

18:00-20:00 **Reception**

DAY 2

9:00-10:00 **Theme 4 Oceans: Status, Deficiencies, and Needs**

1. The Arctic Ocean and Its Role in Climate—N. Smirnov (30)
2. Discussion and Workshop Recommendations (30)

10:00-10:30 **Break**

10:30-12:30 **Theme 5 Terrestrial Observations: Status, Deficiencies, and Needs**

1. Status, Deficiencies, and Needs for Hydrological Observations for Climate —B.O. Baymagambetov (30)
2. Status, Deficiencies, and Needs for Glacier Observations—I. Severskiy (30)
3. Status, Deficiencies, and Needs for Permafrost Observations—S. Marchenko (30)
4. Current State of the GCOS Observing Systems in Russian Federation-V.Meleshko (15)
5. Implementation Plan on GCOS in China- R.Zhang (15)
6. Discussion and Workshop Recommendations (30)

12:30-13:45 **Lunch**

13:45-15:45 **Theme 6 Cross Cutting Topics**

1. The Use of the PRECIS Climate Model to Undertake Regional Climate Predictions in Central Asia—G. Jenkins (30)
2. A Review of WMO Space Programme—Y. Tanaka (30)

15:45-16:15 **Break**

16:15-17:30 **Theme 7 Resource Mobilization**

1. Resource Mobilization Issues—J. Williams, United Kingdom (30)
2. Discussion (45)

DAY 3

08:30-10:30 **Theme 8 First Steps in Developing a Regional Action Plan**

1. Brief statement by A. Thomas on GCOS experience with Regional Action Plans (10)
2. An Introduction and Initial Discussion of the Framework Action Plan—E. Sarukhanian (30)
3. Review of priorities as determined during first two days and discussion of potential project proposals

10:30-11:00 **Break**

11:00-14:00 1. Discussion of potential projects--continued
2. Next steps—A. Thomas and E. Sarukhanian

14:00-14:15 **Closing ceremony**

Annex 2

GLOBAL CLIMATE OBSERVING SYSTEM

WMO IOC UNEP ICSU

КАЗГИДРОМЕТ

GCOS REGIONAL WORKSHOP FOR CENTRAL ASIA

(Almaty, 24-26 May 2004)

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Annex 3

THE GLOBAL CLIMATE OBSERVING SYSTEM AND THE GCOS REGIONAL WORKSHOP PROGRAMME

Alan Thomas
Director, GCOS

Mission of GCOS

The Global Climate Observing System (GCOS) was established in 1992 to ensure that the observations and information needed to address climate-related issues are obtained and made available to all potential users. It is co-sponsored by the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC) of UNESCO, the United Nations Environment Programme (UNEP) and the International Council for Science (ICSU). GCOS is intended to be a long-term, user-driven operational system capable of providing the comprehensive observations required for monitoring the climate system, for detecting and attributing climate change, for assessing the impacts of climate variability and change, and for supporting research toward improved understanding, modelling and prediction of the climate system. It addresses the total climate system including physical, chemical and biological properties, and atmospheric, oceanic, hydrologic, cryospheric and terrestrial processes. Although GCOS does not make observations or generate data products itself, it does stimulate, encourage, coordinate and otherwise facilitate the taking of the needed observations by national and international organizations in support of both their own requirements and of common goals.

Purpose of the Workshop

The United Nations Framework Convention on Climate Change (UNFCCC) has recognized the importance of research and systematic observation. Further, its Conference of the Parties (COP) has noted that high quality data for climate-related purposes is not available in many instances due to inadequate geographic coverage, quantity, and quality of the data produced by current global and regional observing systems. Most of the problems occur in developing countries, where lack of funds for modern equipment and infrastructure, inadequate training of staff, and the high costs of continuing operations are often the major constraints. Decision 5/CP.5 in 1999 invited the Secretariat of the Global Climate Observing System, in consultation with relevant regional and international bodies, to organize regional workshops to facilitate improvements in observing systems for climate. The central goals of the GCOS Regional Workshop programme are:

- To assess the contribution of the region to GCOS baseline networks;
- To help participants understand guidelines for reporting on observations to the UNFCCC;
- To identify national and regional needs and deficiencies for climate data (including needs for assessing climate impacts and conducting vulnerability and adaptation studies; and
- To initiate the development of Regional Action Plan for improving climate observations.

Expected Outcome

The GCOS Regional Workshop for Central Asia is designed to help participants identify deficiencies in climate observing systems and to focus their attention on developing a regional strategy to address priority needs for observing systems. Given the strong recognition by the UNFCCC Conference of the Parties (COP), a substantial opportunity now exists to obtain the support of the Parties to make much needed improvements in observing networks that will benefit not only the global concerns of COP but also national and regional purposes. GCOS would like to see participants develop a regional strategy—a Regional Action Plan—that identifies high priority observing system needs for the region and that can be used as the basis for seeking funding to address these needs. The first steps in developing such a plan can be taken at this workshop, and a draft version of the plan could be prepared and circulated for approval by perhaps October 2004. With resources limited both nationally and internationally, a regional plan for improving observing systems is practical, achievable, and fundable.

Annex 4

THE UNFCCC AND SYSTEMATIC OBSERVATIONS

Olga Pilifosova
UNFCCC Secretariat

Several Articles of the United Nations Convention on Climate Change (UNFCCC) make references to systematic observations, including Article 5, which states that Parties shall support international efforts to strengthen systematic observation, taking into account the needs of developing countries for improving their capacities to participate in systematic observation.

The Conference of the Parties (COP) to the UNFCCC and its subsidiary bodies have repeatedly considered the issue of systematic observation at their sessions. The UNFCCC meetings have adopted a number of important decisions aimed at strengthening global observing systems for climate.

The major milestones are the following:

- COP became seriously interested in the global observing system in 1998. It was stimulated by a perception that the number and quality of 'atmospheric' data were declining, and that something had to be done to reverse the trend, particularly in developing countries.

- Then COP5 and the Subsidiary Body for Scientific and Technological Advice (SBSTA), in various decisions, endorsed a three-tiered approach to address the problem, namely:

- to organise regional workshops and to develop specific proposals for the purpose to address deficiencies in the climate observing networks and to identify the capacity-building needs and funding required in developing countries to enable them to collect, exchange and utilize data on a continuing basis in pursuance of the Convention;

- separate GCOS reports as part of national communications;

- and the preparation of an 'adequacy report'. This report should help guide the efficient expenditure of scarce resources.

These three approaches are obviously linked and should lead to defined priorities for actions, with **practical outcomes** that should result in formulating concrete project proposals for different donors, including GEF.

<u>Workshops.</u>

Further, after the COP5 decision, SBSTA repeated the call for this practical outcome and urged Parties to work in collaboration with the GCOS Secretariat in formulating project proposals for developing countries to address deficiencies in observational network. By this time the GCOS Regional Workshop Programme had been launched, with support from GEF and the UNDP, and one of the major tasks of these workshops was to develop Regional Action Plans containing high priority projects aimed at improving observing systems for climate.

In New Delhi in October, 2002 SBSTA made a direct link between the workshops and project proposals. It noted that regional workshops organized by the GCOS Secretariat are leading to specific proposals. SBSTA 17 invited the SBI to take note of the need to fund those aspects of the proposals relating to the global system and to consider at future sessions possible financial implications of such needs, including in its guidance to the financial mechanism of the Climate Convention.

National reports on GCOS

To guide national reporting on climate observations, *UNFCCC REPORTING GUIDELINES ON GLOBAL CLIMATE CHANGE OBSERVING SYSTEMS* have been developed with the help of the GCOS Secretariat. COP5 requested Annex I Parties (developed and EIT countries) and *invited* all Parties to provide detailed reports on systematic observation in accordance with these guidelines (on a voluntary basis for Parties not included in Annex I, i.e., developing countries).

The guidelines are a set of general instructions that outline the preferred approach for reporting to the COP of the UNFCCC on the national status of meteorological and atmospheric, oceanographic, and terrestrial observing systems.

Standard guidelines provide a format that will help the Convention secretariat and GCOS easily understand and assess the status of key observing system attributes. Standard guidelines also enable the information submitted by individual countries in national reports to be easily amalgamated or synthesized so that an overall picture of the status of global observing systems can be constructed. Decision 5 invites the Convention secretariat, in conjunction with GCOS, to develop a process for synthesizing and analysing the material submitted in national reports. Information provided using a standard format makes this task easier. Two synthesis reports have been produced: one from GCOS Secretariat, summarising findings from both available information and from reporting in accordance with the guidelines, and another, a synthesis by the UNFCCC Secretariat, summarising information provided in separate reports of 43 developed countries.

The COP believes that it is important that as many countries as possible undertake national reports on the status of their observing systems. Individually and collectively, these reports will provide essential information that can be used in making the case for upgrading climate observing systems. Moreover, the final synthesis report(s) will only be as good as the amount and quality of the information on which it is based. If few countries submit national reports, the synthesis report will be of little value as a guide for supporting future improvements in observing systems. It is especially important that countries experiencing problems in maintaining or upgrading observing systems prepare and submit reports.

THE SECOND REPORT ON THE ADEQUACY OF THE GLOBAL OBSERVING SYSTEMS FOR CLIMATE IN SUPPORT OF THE UNFCCC

Executive Summary

A first report[1] on the adequacy of the global observing systems for climate in providing the systematic climate observations required by the United Nations Framework Convention on Climate Change (UNFCCC) was submitted to the Conference of the Parties (COP) of the UNFCCC at their fourth meeting in 1998. Since then, the COP, individual Parties of the UNFCCC and various intergovernmental and international agencies have undertaken a range of actions to address the reported inadequacies. In 2001, the Subsidiary Body for Scientific and Technological Advice (SBSTA) to the COP endorsed the preparation of a second report on the adequacy of the global observing systems for climate to meet their needs and also those of the Intergovernmental Panel on Climate Change (IPCC). The goals of this Second Adequacy Report (the Report) were to determine what progress has been made in implementing climate observing networks and systems since the first report; determine the degree to which these networks meet with scientific requirements and conform with associated observing principles; and assess how well these current systems, together with new and emerging methods of observation, will meet the needs of the UNFCCC. The preparation of the Report, organized by the Global Climate Observing System (GCOS) Secretariat working in partnership with the other global observing systems[2] and on behalf of its Sponsors[3], has involved a wide range of experts from the scientific and observational communities as well as an open review process.

The authors of the Report, in consultation with the IPCC, established the scientific requirements for systematic climate observations underlying the needs of the Parties to the UNFCCC and the IPCC. Climate observations are required to:

- Characterize the state of the global climate system and its variability;
- Monitor the forcing of the climate system, including both natural and anthropogenic contributions;
- Support the attribution of the causes of climate change;
- Support the prediction of global climate change;
- Project global climate change information down to regional and national scales; and
- Characterize extreme events important in impact assessment and adaptation, and to assess risk and vulnerability.

Observations from the current climate observing systems have provided the information for many of the conclusions drawn by the IPCC on climate change and its potential impacts. They have also provided the Parties with information for understanding the implications of climate and climate variability on their societies and ecosystems. Notwithstanding the use being made of current information and the improvements made in the past few years, the IPCC has recently reported[4] that current climate observational networks are declining in many parts of the world and that additional and sustained climate observations are required

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[1] Report on the Adequacy of the Global Climate Observing Systems. GCOS-48, October 1998. Submitted to COP-4, November 2-13, 1998, Buenos Aires, Argentina. Available at http://www.wmo.ch/web/gcos/Publications/gcos-48.pdf

[2] The Global Ocean Observing System (GOOS), the Global Terrestrial Observing System (GTOS), the World Weather Watch (WWW) with its Global Observing System (GOS) and the Global Atmosphere Watch (GAW).

[3] The organizations that sponsor GCOS are: the World Meteorological Organization (WMO), United Nations Educational, Scientific and Cultural Organization (UNESCO) and its Intergovernmental Oceanographic Commission (IOC), the United Nations Environment Programme (UNEP), and the International Council for Science (ICSU).

[4] Climate Change 2001: The Scientific Basis (IPCC Third Assessment Report).

to improve the ability to detect, attribute and understand climate change and to project future climate changes.

Based on an integrated analysis of the atmospheric, oceanic and terrestrial domains according to these scientific requirements, the Second Adequacy Report concludes that there has been progress and improvement in the implementation of global climate observing systems since the first report, especially in the use of satellite information and in the provision of some ocean observations. At the same time, the Report notes that the global terrestrial networks remain to be fully implemented; the ocean networks lack global coverage and commitment to sustained operation; and the atmospheric networks are not operating with the required global coverage and quality. The Report concludes, in agreement with the IPCC, that there remain serious deficiencies in the ability of the current global observing systems for climate to meet the observational needs of the UNFCCC. The Report in its various findings documents the needs and opportunities for improvement to the global observing systems for climate. Without urgent action to address these findings, the Parties will lack the information necessary to effectively plan for and manage their response to climate change. It requires immediate action by the Parties, the UNFCCC and intergovernmental and international agencies, and will require the allocation of additional resources.

The focus of the Report is on climate variables that are both currently feasible for global implementation and have high impact with respect to the UNFCCC and IPCC requirements. Table 1 lists these Essential Climate Variables.

Conclusion:

1) **Achieving global coverage and climate-quality observations for the variables in Table 1 is essential to ensure that the needs of the UNFCCC and the IPCC for systematic climate information are addressed.**

Table 1. Essential Climate Variables that are both currently feasible for global implementation and have a high impact on UNFCCC requirements.

Domain	Essential Climate Variables	
Atmospheric (over land, sea and ice)	**Surface:**	Air temperature, Precipitation, Air pressure, Surface radiation budget, Wind speed and direction, Water vapour.
	Upper-air:	Earth radiation budget (including solar irradiance), Upper-air temperature (including MSU radiances), Wind speed and direction, Water vapour, Cloud properties.
	Composition:	Carbon dioxide, Methane, Ozone, Other long-lived greenhouse gases[5], Aerosol properties.

[5] Including nitrous oxide (N_2O), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF_6), and perfluorocarbons (PFCs).

Oceanic	**Surface:**	Sea-surface temperature, Sea-surface salinity, Sea level, Sea state, Sea ice, Current, Ocean colour (for biological activity), Carbon dioxide partial pressure.
	Sub-surface:	Temperature, Salinity, Current, Nutrients, Carbon, Ocean tracers, Phytoplankton.
Terrestrial	River discharge, Water use, Ground water, Lake levels, Snow cover, Glaciers and ice caps, Permafrost and seasonally-frozen ground, Albedo, Land cover (including vegetation type), Fraction of absorbed photosynthetically active radiation (FAPAR), Leaf area index (LAI), Biomass, Fire disturbance.	

The Report has identified a number of critical areas where immediate improvements to global observing systems for climate are required. These include providing effective access to climate data and improving its quality; achieving global coverage for *in situ* networks, particularly in the oceans and for essential climate variables in the terrestrial domain; routinely providing high-quality integrated climate products; increasing the participation of developing countries; and enhancing national, regional and international planning, reporting and coordination.

I. Data Considerations

There are many observations of the climate system being taken today. The Report notes many times where there are issues with respect to limited access to these observations and the problems with their quality. Addressing these issues would have an immediate and positive impact on the ability of the current global observing systems for climate to meet the needs of the Parties.

Effective Data Exchange and Access

In Decision 14/CP.4, the COP *Urged* Parties to undertake free and unrestricted exchange of data to meet the needs of the Convention, recognizing the various policies on data exchange of relevant intergovernmental and international organizations. Yet, as this Report points out repeatedly with respect to almost all of the variables, the record of many Parties in providing full access to their data is poor. Indeed, most Parties appear to be unaware of their performance in this respect.

Conclusion:

2) **Adherence by nations to the agreed policy of free and unrestricted exchange is urgently required for both *in situ* and satellite climate observations, particularly in respect of observations of the Essential Climate Variables listed in Table 1, as well as their associated climate products; and**

3) **Nations need to ensure that their observations and associated metadata for the Essential Climate Variables, including historical observations, are available at international data centres[6] for application to climate analyses.**

[6] The term "international data centre" covers the ICSU World Data Centres as well as other centres identified by GCOS and its sponsors as the organizations responsible for the storage of data for specific networks and for making it available to the

High-Quality Climate Data

One of the most important aspects of the Convention that sets it apart from most other needs for climate information is the requirement for information on change and rates of change. This requirement means the construction of data sets covering long periods (many decades if not millennia) that can be continued into the future. Such data sets must be homogeneous without extraneous and undocumented instrument or observing-system changes. The GCOS Climate Monitoring Principles[7] have been adopted by the UNFCCC as a means of ensuring such a homogeneous climate record for the future. While developed for the specific purposes of the UNFCCC, adherence to the GCOS Climate Monitoring Principles will enhance the value of the observations for all users. In many respects these principles simply represent good management practice for observing systems. Most of the Parties, in their National Reports[8], acknowledged the importance of these principles but reported that they had yet to adopt them in actual practice. It is clear from this Report that, unless these principles are adhered to, the investments being made in improving the various parts of the global observing systems for climate will be significantly undermined.

The Report has noted that satellite observations are an essential part of the global observing systems for climate for all three domains. Their contributions, though already substantial and in many cases impossible to replicate with *in situ* approaches, have not realized their full potential because the mission design parameters have not included long-term climate monitoring requirements. Many of the Earth observation missions, relevant for the climate variables, are either for research and development purposes, most of which by their very nature have a limited time horizon, or are implemented in support of weather services where the primary requirements are different. Improvements can be made by the Space Agencies' recognizing the special requirements of the UNFCCC and the importance of adherence to the GCOS Climate Monitoring Principles that have now been specifically tailored to include satellite observations.

The Report further notes that maintaining a homogeneous record requires that the operation of the individual networks be monitored on a continuous basis to ensure that standards are being maintained and that observations are being received by the designated international data centres. Such operational monitoring will ensure that problems that might affect the quality of the climate record are identified and corrected in a timely and cost-effective manner.

Conclusion:

4) **Adherence by nations to the GCOS Climate Monitoring Principles for global climate observations from both *in situ* networks and satellites is required; and**

5) **GCOS and its partners need to monitor the performance of the individual networks to ensure their continued effectiveness and the timely identification and remediation of problems that may compromise the quality of climate products.**

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users. It is implicit that these centres will adhere to GCOS data policy, apply the GCOS Climate Monitoring Principles in their operations, and implement cataloguing, auditing and reporting procedures on the availability of data.

7 See Appendix 2 of the Report.

8 The term "National Reports" includes: the summary information provided by Annex I Parties on systematic observation in accordance with the UNFCCC guidelines, as a part of their National Communications; the detailed reports on systematic observation that were invited from all Parties; and the Initial Communications from Non-Annex 1 Parties. An analysis of these reports is available on the GCOS website at http://www.wmo.ch/web/gcos/Publications/gcos-79.pdf

Data for Impact Assessment

Impact assessment and adaptation activities require information on regional patterns of climate change, variability and extreme events. These requirements cannot be met solely with observations from the GCOS baseline networks. Additional regional and national stations are required, as well as daily and/or hourly observations to establish extreme events. These networks are especially important for measurements of surface temperature, precipitation, wind and sea level. Such higher-density networks will be difficult for many countries to implement and sustain, particularly for the least-developed countries, small-island states and some countries with economies in transition.

Conclusion:

6) **Nations will need to operate climate-observing networks with a denser distribution of stations and often more frequent observations, in addition to the GCOS baseline networks, for impact assessment and the development of adaptation strategies. These regional and national networks, to the greatest extent possible, should also be operated in accordance with the GCOS Climate Monitoring Principles.**

II. Network Considerations

Specific actions to improve the adequacy of the domain networks have been identified in the Report. The necessary steps are discussed in detail in Section 6 and are summarized below.

Atmospheric Observation

The GCOS strategy for acquiring and analyzing atmospheric data is being implemented gradually, with a special emphasis on the development of GCOS baseline networks including the GCOS Surface Network (GSN) and the GCOS Upper-Air Network (GUAN). However, there are problems with the observation and exchange of many of these baseline data, and improved adherence to the GCOS Climate Monitoring Principles is required. These problems require urgent attention. Many developing countries need resources and training to resolve problems with acquisition, analysis and archival of data for climate. Increased attention is also needed to recover and access past records (both instrumental and paleoclimate reconstructions) to better establish the variability and long-term trends in climate.

Analysis of regional impacts and vulnerabilities requires high-frequency (e.g., hourly for precipitation) high-density climate observations. These high-frequency data are vital for developing information on extreme events.

To characterize global climate and to initialize and verify global climate models, there is a need to consolidate the marine-surface network. This includes the Voluntary Observing Ships (VOS) contributing to the VOSClim programme; surface-drifting buoys measuring sea-surface temperature and surface pressure; and air-sea moorings and satellites measuring surface atmospheric variables over the ocean. This need is especially important for the southern oceans and other regions where there are few shipping routes. Unbiased estimation of precipitation over the ocean requires further refinement of satellite measurement techniques together with the establishment of a reference network of ocean-surface precipitation stations on key islands and moored buoys around the globe.

Clouds and water vapour affect the Earth radiation budget and provide the strongest and most uncertain feedbacks in the climate system. Satellite observations of total solar irradiance and Earth radiation must be continued without interruption and with strict adherence to the GCOS Climate Monitoring Principles. Promising new technologies should be exploited, including for instance the use of occultation techniques and Global Positioning System (GPS)-based sensing of column water vapour.

Continuing and homogeneous observations should be made of the spatial and temporal distribution of greenhouse gases, including carbon dioxide, to help determine sources and sinks. This should be accomplished through the continued operation of the current stations, enhancement of the Global Atmosphere Watch (GAW) Global Network in selected regions, advancement of selected satellite observations, and implementation of real-time analysis and re-analysis for atmospheric composition products. In order to characterize the nature of aerosols and their radiative properties, there is a need to consolidate baseline measurements and further develop a strategy to produce long-term homogeneous observations. There is a need for improved distribution and calibration of ground-based observations to support the use of satellite data for global monitoring of ozone.

Ocean Observation

New technology, developed and proven by the ocean climate programmes of the 1990's, has allowed the ocean community to design and commence implementation of an initial ocean climate observing system that is well focused on the UNFCCC needs. The first priority is the full implementation of this system together with its associated data, analysis and product capabilities. Implementation will involve making existing *in situ* and satellite activities adhere to climate standards as well as the phased introduction of the essential enhancements. Continued support of climate research and technology programmes for the oceans is also needed to ensure efficiency and effectiveness and to promote development of capabilities for those climate variables that cannot currently be observed globally. This need is particularly acute for remote locations and for improved understanding of the ocean ecosystems and those processes that contribute to uncertainty in estimates of climate change.

Satellites are needed because they are the dominant source of ocean-surface data, with *in situ* networks providing necessary complementary information. High quality and continuity are primary requirements for satellite observations. Sustained support for remote wind, topography, sea-ice, sea-surface temperature and ocean-colour measurements remains a pressing issue.

Global deployment of the surface data-buoy array and of the Argo-float programme, in conjunction with the rest of the comprehensive surface and upper-ocean temperature and salinity networks, is needed for monitoring of heat and freshwater storage and transport, to test the ocean component in climate models, and for climate change detection and attribution.

Establishment of a sparse network of global-ocean reference stations is essential for providing the climate-quality time series required for model testing, climate change detection, calibration of air-sea flux estimates and technology development.

Enhancement and extension of the global baseline and regional sea-level network record is needed for climate change detection and the assessment of impacts.

The measurement of the state and change of carbon sources and sinks in the ocean is important for determining the nature of the global carbon cycle, for future scenario projections and for a full understanding of potential mitigation strategies.

Measurements of the full-depth ocean are a critical contribution to characterizing ocean climate variability and change, providing a capacity for monitoring the oceanic uptake of heat, freshwater and carbon dioxide and improving the chances of early identification of abrupt climate change arising from deep ocean processes. Regular, full-depth ocean surveys and surface altimetry are needed.

Terrestrial Observation

The climate observing system in the terrestrial domain remains the least well-developed component, whilst at the same time there is increasing significance being placed on terrestrial data for climate understanding as well as impact and mitigation assessment. Increasingly sound foundations exist for both the *in situ* observation networks and the space-based observing components of the terrestrial domain. Space Agencies and other organizations are generating new products, the Global Terrestrial Networks (GTNs) are being established and growing in effectiveness, and their associated international data centres are beginning to be populated with data.

Although progress is being made in product generation from Earth observation satellite data, in many cases there is no institutional responsibility for generating climate-quality terrestrial products. This needs to be rectified.

Appropriate long-term satellite records should be reprocessed to produce consistent data sets for the key terrestrial variables.

A coordinated reference network is needed for *in situ* observations of climate variables, such as carbon dioxide and the water variables, for process studies, to validate observations derived from Earth observation satellites, and to address intrinsic limitations in some of these, such as the saturation of leaf-area-index (LAI) measurements.

The three Global Terrestrial Networks (hydrology, glaciers, permafrost) should be fully implemented, gaps in the measurement networks that they have highlighted should be filled and data should be provided to the designated international data centres.

III. Implementation Considerations

Achieving global coverage of climate-quality observations for the variables in Table 1 is essential to ensure that the needs of the UNFCCC and IPCC for systematic climate information are met. This requires an integrated approach incorporating a mixture of high-quality satellite and *in situ* observations as well as associated infrastructure. Implementation requires the allocation of resources to priority activities, the participation of all Parties, and mechanisms for the establishment of and promulgation of standards. In addition, as understanding of the climate system increases and deployment of the required observing techniques becomes both feasible and cost-effective, observations of additional climate variables will have to be incorporated.

Conclusion:

7) **Parties, both individually and through multilateral agreements and intergovernmental mechanisms, should commit to the full implementation of integrated global observing systems for climate, sustained on the basis of a mix of high-quality satellite and *in situ* measurements, dedicated infrastructure and targeted capacity-building.**

Integrated Approach

Global climate products are commonly generated by blending data from different sources, such as *in situ* and satellite observations. It is essential that analysis centres be identified to regularly generate these products.

Maximum benefit is extracted from all climate observations through real-time data-assimilation and re-analysis systems in which different data are integrated into comprehensive and internally-consistent descriptions of the state of the climate system, although simpler approaches are currently appropriate for some products.

There is also a need to provide on-going support for satellite observations of the Essential Climate Variables and for the generation of integrated climate products from these observations. Table 2 contains a list of variables largely dependent upon satellite observations and used in integrated climate products.

Re-analysis has been applied to atmospheric data covering the past five decades. Although the resulting products have proven very useful, considerable effort is needed to ensure that re-analysis products are suitable for climate monitoring applications. Re-analysis will be improved by the inclusion of historical climate data, which together with their associated metadata need to be available in international data centres. The least-developed countries, small-island states and many countries with economies in transition will benefit from assistance in the rescue of paper records, their transcription into digital form and permanent archiving for use in global re-analysis.

Conclusion:

8) **Internationally-coordinated re-analysis activities need to be enhanced and sustained by the involved Parties to meet the requirements for monitoring climate trends, to establish ocean re-analysis for the recent satellite era, and to include variables related to atmospheric composition and other aspects of climate forcing;**

9) **Parties with responsibility for space agencies should support the long-term operation of Earth observation satellites; ensure that homogeneous climate data and integrated products are produced; and strive to make them available to all Parties; and**

10) **Such Parties should support an internationally-coordinated approach to the development of an initial set of integrated global climate products, related to the variables**[9] **in Table 2, and make them accessible to all Parties. Developing a strategy for implementing these global products could be an important role for the Integrated Global Observing Strategy (IGOS) partners, of which GCOS is a member.**

[9] Or where appropriate, a surrogate, e.g., microwave radiance in a specified band for upper-air temperature.

Table 2. Variables largely dependent upon satellite observations.

Domain	Variables
Atmospheric (over land, sea and ice)	Precipitation, Earth radiation budget (including solar irradiance), Upper-air temperature (including MSU radiances), Wind speed and direction (especially over the oceans), Water vapour, Cloud properties, Carbon dioxide, Ozone, Aerosol properties.
Oceanic	Sea-surface temperature, Sea level, Sea ice, Ocean colour (for biological activity).
Terrestrial	Snow cover, Glaciers and ice caps, Albedo, Land cover (including vegetation type), Fraction of absorbed photosynthetically active radiation (FAPAR), Fire disturbance.

Participation by All Parties

Many of the Parties, especially those least-developed countries and small-island developing states, as well as some countries with economies in transition, are not in a position to participate fully in global observing systems for climate. Problems include a lack of trained personnel, expensive consumables, inadequate telecommunications, and an absence of equipment. There is also limited capacity for them to draw benefits from the observations currently being taken. The Parties have previously discussed these matters within the context of the COP where Parties have been encouraged, in cooperation with the GCOS Secretariat, to explore the full range of funding options that might address these problems as well as to participate in the development and implementation of action plans for specific regions. In addition, the SBSTA has decided to consider the need to support capacity-building for systematic observations (and research) at future meetings.

Conclusion:

11) **Annex 1 Parties, in conjunction with GCOS and its Sponsors, should explore the establishment of a voluntary funding mechanism for undertaking priority climate-observing-system improvements and related capacity-building with least-developed countries and small-island developing states as well as with some of those countries with economies in transition.**

Standards

Given that climate observations are made by many different organizations and in almost all nations, the production of homogeneous and high-quality global climate observations and associated products requires an international mechanism, to prepare regulatory and guidance material relating to climate observing systems, data management and products. The existing international mechanisms for the atmospheric and oceanic domains are encouraged to develop and promulgate standards, including those for satellite observations, for all of the Essential Climate Variables. It has been noted that many organizations make terrestrial observations, for a wide range of purposes. Various different measurement protocols are used, even for the same variable. The resulting lack of homogeneous observations limits capacity to monitor the terrestrial changes relevant to climate and to investigate the causes of observed land-surface changes. As a result, there is an urgent need for the establishment of an international mechanism for the terrestrial domain similar to those already in existence for the atmospheric and oceanic domains.

Conclusion:

12) **The GCOS Sponsors, in consultation with other international or intergovernmental agencies, as appropriate, should consider the establishment of an international mechanism that would prepare and issue regulatory and guidance material relating to terrestrial observing systems and management of their data and associated products.**

Planning and Reporting

The information provided by the Parties on systematic observation as part of their National Reports has proven to be useful to GCOS in the planning and implementation of global observing systems for climate. Unfortunately, detailed information was available only from a limited number of nations. Obtaining a global perspective requires regular and coherent information from all Parties. It was noted by some nations that the preparation of these reports for the UNFCCC had become a stimulus for enhanced coordination and planning. In a few cases, this planning had led to the allocation of resources and adjustments to the national observing systems to more fully meet climate needs. It is likely that many developing countries and some countries with economies in transition will need assistance to develop and implement such coordination and planning processes.

The GCOS Sponsors undertake a number of regional planning and implementation activities. In response to the request of the UNFCCC, the GCOS Regional Workshop Programme has been undertaken to supplement these activities by organizing workshops involving developing countries in a number of regions. Action plans to resolve specific deficiencies in climate observing systems are subsequently developed for each region. Five workshops have been held to date and three action plans have been developed that now require project funding for implementation. Further workshops are being held in other regions in the next two years. The development of regional action plans has the substantial benefit of sharing work across many partners with common interests who are able to learn from the experience of other regions and participants.

Conclusion:

13) **Nations are encouraged to adopt a systematic approach to implementing global observing systems for climate involving active national and regional coordination and planning processes and a commitment to systematic climate observation;**

14) **All Parties are strongly urged to submit information on their systematic observations as part of their national communications to the UNFCCC; and**

15) **The SBSTA, in consultation with the GCOS Secretariat, is urged to review the guidelines for National Communications by the Parties on research and systematic observation[10] to include, *inter alia*, a specific requirement to report on the exchange of observations of the Essential Climate Variables and on the submission of current and historical observations and metadata to the international data centres.**

[10] Decision 4/CP.5

Developing Future Capabilities

Improved observing techniques are needed, both to make more effective measurements of Essential Climate Variables and to expand the suite of key climate variables that can be observed globally. Improvement in both satellite and *in situ* observing technology is needed. The transfer of proven research observation activities to sustained operational status needs to be encouraged. Improved understanding of climate phenomena and their impacts, as well as greater understanding of the uncertainties associated with climate projections, is also needed. The integrated observing system will need to evolve as new observing capabilities, new understanding of climate variability and change, and better awareness of the needs of society are developed.

Conclusion:

16) Further research and development is required to improve the comprehensiveness, accuracy and efficiency with which the global climate system can be characterized.

Annex 6

NEEDS IN OBSERVING DATA FOR PREPAREDNESS AND REDUCTION OF DAMAGE FROM NATURAL DISASTERS AND DANGEROUS HYDROMETEOROLOGICAL PHENOMENA

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Natural disasters and extreme natural phenomena have a considerable negative impact on the economies and result in human losses. Global statistics show the increasing number of people affected by hydrometeorological disasters that account for over 90 per cent of human losses.

Close cooperation of national hydrometeorological services, government bodies, media and non-governmental organizations in the past years has allowed decreasing human losses and the damage done to the economy by natural disasters. A well functioning early warning system is one of the most effective ways to decrease damage in the process of undertaking measures to ensure preparedness for natural disasters. The early warning system includes three basic phases: forecast, warning and response. To successfully mitigate natural disaster consequences, improved forecasts followed by long-term warnings and early response are essential. The response phase success is determined by the forecast and warning reliability, as well as their credibility, and “the human factor in assessing the extent of danger, and in the decision making process.”

National hydrometeorological services provide for observing dangerous hydrometeorological phenomena, compiling weather forecasts, warning, and informing the government and population. Observing dangerous hydrometeorological phenomena includes observing air, sea, and internal water objects at stations and posts, aerological observations, satellite, radio-meteorological and other types of observations. Timely collection and processing of data ensure successful weather forecasts and more effective warning of dangerous meteorological and hydrological phenomena.

Sustainable operations of the meteorological, hydrological and aerological observing network both in terms of their frequency and area coverage provide for a successful early warning system. Due to the economic hardships a number of newly independent states cannot provide for the necessary level of their aerological stations’ and meteorological radio-locators’ operations. The presentation gives separate CIS countries’ observing network quantitative characteristics for the past years.

Climatic data stored at the national archives serve as a basis for identifying the local climate peculiarities, including frequency and intensity of dangerous hydrometeorological phenomena, as well as for vulnerability assessment. Such data obtained through observations over long periods of time, contain data extremely important for assessing the frequency and intensity of local weather and climatic phenomena which may be dangerous for human lives and destructive for people’s property. National hydrometeorological services in most countries include observing data into their national computerized archives that provides easy access to those data and an opportunity to quickly implement complicated risk analysis and update previous observing outcomes by using the later data.

This has allowed summarizing long-term observing outcomes in many countries and preparing reference materials on the dangerous meteorological and hydrological phenomena that took place. Such a reference-book has also been published in Belarus. The presentation gives examples of the data provided in the reference-book.

Timely collection and processing observing data and forecasts circulation is an important link to carry out effective early warning of dangerous meteorological and hydrological phenomena. The WMO special Global Telecommunication System (GTS) provides for data exchange between national hydrometeorological agencies and circulation of the data processed (analysis, forecasts, and warnings). The GTS provides access for all countries to regional and global data, products and other data required for their operations and research work and mitigating natural disaster consequences.

Warnings about dangerous hydrometeorological phenomena by national hydrometeorological services within the scope of their responsibilities are based on the data analysis obtained from the observing network stations and posts, meteorological satellites, radars, neighboring countries, and the WMO regional centers' forecast data. Warning identifies the time of emergence, duration, and intensity of a dangerous phenomenon. The presentation gives a list of dangerous phenomena, which have meteorological and hydrological origin in line with the Australian Meteorology Bureau, and dangerous hydrometeorological phenomena classification which is applied in Russia, Belarus, and other newly independent states.

Information containing a text warning about a natural disaster is transferred to users in line with the coordinated at the national (regional) level plans. (An example of such a plan for Belarus is given). The procedure for transferring warnings about disaster phenomena to the neighboring countries is set out in according to bilateral agreements between national hydrometeorological services or states.

During a dangerous phenomenon a national hydrometeorological service should actively promote coordination of all organizations participating in mitigating natural disaster consequences, ensure a continuous information flow to the population and government officials to enable them to make decisions on the response. It is particularly important to use all possible ways of data transmission through the media. It is important that national hydrometeorological service officials, extra-ordinary situation managers and local governments assess the situation correctly and provide true information to the population.

All weather data and situation development forecast should be brief, clearly formulated to avoid wrong interpretations. The message texts should presume that the listener has not heard the previous messages or warnings and be sufficiently full, contain the situation assessment and its development projections. It is very important to have reliable communication channels with the extra-ordinary situation managers and media.

When a natural disaster is over, a national hydrometeorological service carries out assessment of the phenomenon intensity and the damage done. The national hydrometeorological agency units' operations are also assessed in order to check the functioning of the warning system and seek possibilities to improve it.

Recommendation for National Hydrometeorological Services for Preparedness and Actions in Case of Natural Disasters

National hydrometeorological services should closely coordinate their actions with national and local governments and media to mitigate natural disaster consequences. On the basis of the climate data archive, scientific, historical reports and information on the damage done as a result of natural disasters in the previous years, their analysis should be implemented. Analysis summarizes a list of hydrometeorological phenomena, their frequency and intensity, areas of occurrence, and vulnerability assessment. This is significant for the government and extra-ordinary situation managers to manage community development, land use planning, vulnerability indices development, negative impacts decrease, and preparedness plans development.

National hydrometeorological services should play an important role in the national warning system operations and support the following key elements of the system:

- Standard observing network;
- International data transmission networks;
- Detection and forecasts of dangerous hydrometeorological phenomena;
- Warning and observing implementation;
- Data circulation;
- Community's response and feedback.

National hydrometeorological services provide information for the government and population during and after a natural disaster. Good functioning of the all warning system links, its effectiveness and proposals to improve it should serve as a basis for natural disaster consequences reviews.

Annex 7

OBSERVING NEEDS FOR AGRICULTURE AND DROUGHT

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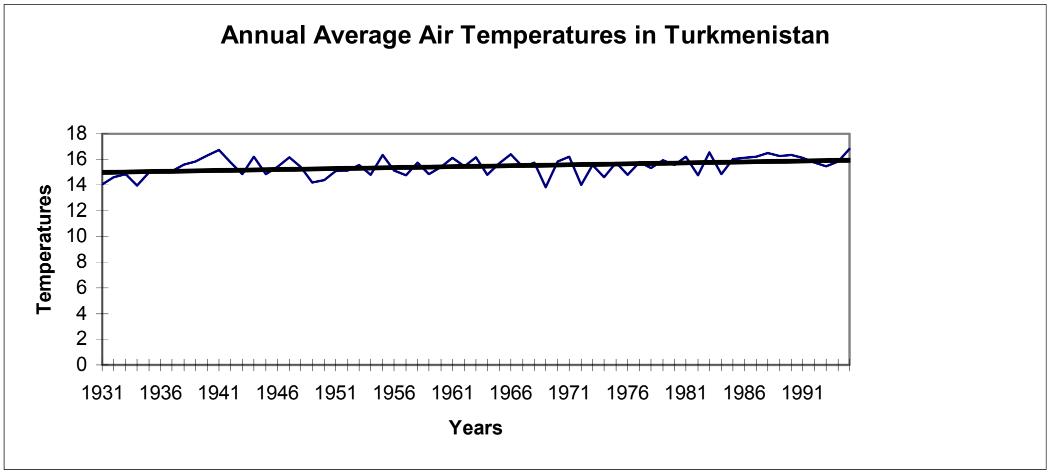
Sharply continental climate is a characteristic feature of Turkmenistan, with the exception of its coastal and mountainous areas. The average air temperature data overall analysis in Turkmenistan for 1931-2001 has shown a trend for insignificant rise of average seasonal and annual air temperatures. Comparison of the average annual air temperatures for 1991-2001 and long-term normal average annual air temperatures for 1960-1991 shows the following:

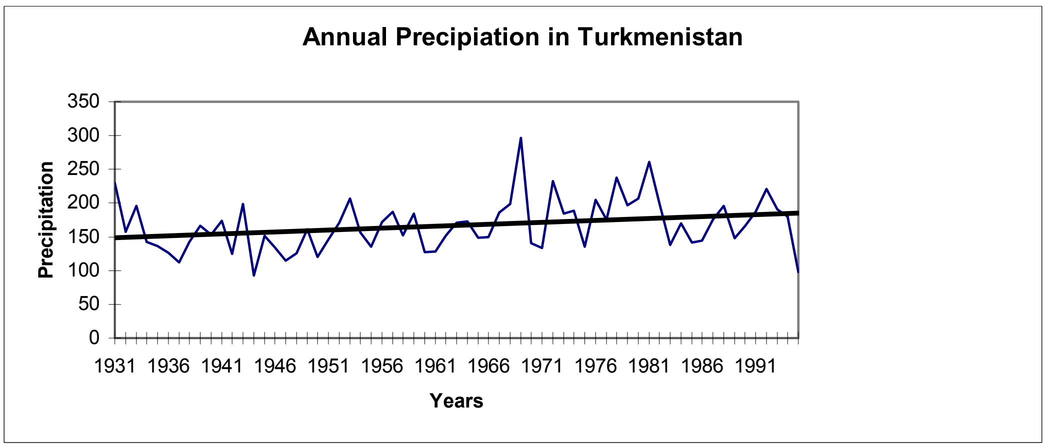
At Erbent MS: 1997-2001 – 17.4-17.8°C, with the normal temperature 16.3°C the deviation is 1.6-2.3°C;
At Chemshe MS: 2000-2001 - 7.6-17.8°C with the normal temperature 16.3°C the deviation is 1.3-1.5°C;
At Darvaza MS: 1995-1998 - 17.2-17.9°C, with the normal temperature 15.6°C the deviation is 1.6-1.5°C;
At Uchadzhi MS: 1995-2001 - 17.7-21.3°C, with the normal temperature 17.0°C the deviation is 1.0-4.3°C;
At Akmolla MS: 1997-2000 - 17.3-17.5°C, with the normal temperature 16.2°C the deviation is 1.1-1.3°C;
At Yekedzhi MS: 1997-2001 – 15.0-15.4°C, with the normal temperature 14.0°C the deviation is 1.0-1.4°C;
At Chagyl MS: 1997-2000 – 15.0-15.3°C, with the normal temperature 14.3°C the deviation is 0.7-1.0°C;
At Repetek MS: 1997-1999 – 17.3-17.6°C, with the normal temperature 16.5°C the deviation is 0.8-1.1°C.

The precipitation amount has increased in summer, mainly in the North, the East of the country and at Kopetdag foot-hills. In the West of Turkmenistan precipitation has been uneven. In spring there has been observed overall precipitation decrease in Turkmenistan. In summer there was very little precipitation, and it was mainly in the East of the country and Kopetdag foot-hills. In the North and the West of the country at a number of stations the precipitation amount has increased, and at a number of other stations it has decreased. The overall autumn precipitation amount has decreased in Turkmenistan but the average annual precipitation amount has insignificantly increased, especially in winter.

Linear Trend of Average Air Temperatures and Precipitation Amounts for 1931-1995 in Turkmenistan

Period	**Air Temperature, C / 65 years**	**Precipitation Amount, mm / 65 years**
Winter	0.1	1.6
Spring	0.2	1.3
Summer	0.2	0.1
Autumn	0.2	1.1
Year	0.1	12.3





Cotton is the main agricultural crop in Turkmenistan. In the southern areas the most valuable growths of thin fiber cotton are grown which are used for manufacturing the first and second grade fibers used for manufacturing high-grade cloths. Silkworm breeding, vegetable-growing, melon-growing, wine-growing, fruit growing are developed in the country.

In stock-breeding sheep-breeding prevails. Camel-breeding is significantly developed. In the irrigated areas there is cattle-breeding. Sheep and goats are kept all the year round at Karakum desert pastures. The forage consists of grass with coarse fodder and concentrates in autumn and winter.

With the development of industries and agriculture in Turkmenistan a need to use climatic characteristics and weather forecasts in various sectors of the economy has arisen. In the first half of the 20th century a hydro-meteorological network of stations and posts was established. In the 30-s and 40-s 28 meteorological stations were established. Further with the oil and gas complex development, the Karakum river construction and cultivation of new areas under crops in the 50-s – 70-s a great number of hydrological and specialized stations were established. In 1986 the hydro-meteorological network covered mostly all physical geographical conditions of Turkmenistan. At that time in the Turkmenhydromet system 65 stations and 95 posts were operating, which implemented meteorological, hydrological, agro-meteorological, aerological, air-meteorological, water balance, and mood flow observing. After the hydro-meteorological observatory was established in Ashkhabad in 1956, close cooperation with the Turkmenistan Academy of Sciences started, and as a result of it climatic description of Turkmenistan was implemented and the weather impact on distant pasture stock-breeding and status of pastures was studied. The weather impact on the main agricultural sectors was studied: cotton-growing, grain farming, and silkworm breeding. An evaporation measuring network was established. All this improved provision of hydro-meteorological regime data for the economy in a more efficient manner. 26 reference-books on climatic, agro-climatic, and hydrological resources were published for developing the economy of Turkmenistan. Hydrological, meteorological and agro-meteorological studies have played an important role in developing Karakum desert, which occupies 80% of the whole area of Turkmenistan.

Agriculture is the major user of the climate information. In 1980-1988 agro-meteorological observing was implemented at 37 meteorological stations and 30 posts. Stationary agro-meteorological observing was implemented and route studies of sown areas, pastures and objects that had been subjected to perilous and natural calamity hydro-meteorological phenomena were implemented. Projections of cotton, cereals and grass crops at pastures were made. The pasture grass crops were determined by using air- instruments. Presently the hydro-meteorological network consists of 48 meteorological station, 40 meteorological posts, and 33 hydrological posts. Out of them 26 stations and 20 posts have been used for implementing agro-meteorological observing and 6 – sea observing.

In Turkmenistan there were six aerological stations in: Ashkhabad, Turkmenbashi, Tagtabazar, Esenguly, Turkmenabat, and Dashoguz. Presently none of the stations is operating. At two stations in Turkmenbashi and Dashoguz equipment is in the working condition but due to the lack of radio-sondes and balloons observing is not implemented. In addition, there is an urgent issue to establish an aerological station in Akhal velayat, and for that equipment is required.

Taking into account the current network, one can say that it is insufficient to study the meteorological regime of Turkmenistan, and the agro-meteorological network of stations and posts is insufficient to study the agro-meteorological regime and service the agriculture. It is particularly true for the desert plain area and the mountainous part of the country. There are extremely few stations and posts observing pasture vegetation, and in the South of Balkan and Mary velayats such type of observing is not implemented at all.

Special attention should be paid to the fact that the hydro-meteorological network equipment and instruments are completely outdated. Many types of observing are not implemented due to the lack of instruments. Oil production and the Caspian Sea shelf development require full re-equipment of the sea meteorological stations.

As a summary, it is necessary to note that the hydro-meteorological network of Turkmenistan requires full re-equipment using the new technologies in the sphere of observing and data processing and exchange. The observing network should be also expanded to reach the 1986 level, which means that 17 new meteorological stations and 20 agro-meteorological posts should be established.

Annex 8

IPCC – MAIN ACTIVITIES AND PRODUCTS

A. Zaitsev

In 1988, under the auspices of the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), nations established the Intergovernmental Panel on Climate (IPCC). The IPCC is not a research body, but was set up to assess the available scientific, technical and socio-economic information impacts of changes in climate; and options for adaptation and mitigation of climate change.

The IPCC is an intergovernmental body that is open to all members of the United Nations and of WMO. The Panel meets in plenary sessions about once a year. It decides of the IPCC structure, its principles and procedures, the work programme and budget, and it elects the IPCC Chair and the Bureau. It also agrees on the mandates of the Working Groups, the scope and outline of reports, and accepts/approves/adopts IPCC Reports.

The IPCC has three Working Groups and a Task Force on national greenhouse gas inventories.

- Working Group I – assesses the scientific aspects of the climate system and climate change;
- Working Group II – assesses the vulnerability of human and natural systems to climate change, consequences of climate change and options for adaptation to them;
- Working Group III – assesses options for limiting greenhouse gas emissions and otherwise mitigating climate change and economic issues.

The main IPCC products are periodic comprehensive Assessment Reports on climate change, its causes, possible impacts and response measures. The IPCC also prepares Special Reports, Methodology Reports and Technical Papers. IPCC Reports consist of detailed assessments and Summaries for Policymakers. IPCC Reports are written by teams of authors, which selected specifically for that task, based on their respective expertise. The preparation of all reports follows procedures agreed by the Panel.

The IPCC’s 1990 First Assessment Report confirmed the scientific basis for concern about climate change and lead to the decision of the UN General Assembly to establish the Intergovernmental Negotiating Committee, which prepared the UN Framework Convention on Climate Change (UNFCCC), which was opened for signature at the Earth Summit in Rio de Janeiro in 1992.

The Second Assessment Report “Climate Change 1995” provided valuable input to the negotiations of the Kyoto Protocol to the UNFCCC.

The Third Assessment Report “Climate Change 2001” (TAR) consist of three working group reports – The Scientific Basis; Impacts, Adaptation and Vulnerability; Mitigation and the Synthesis Report of the Third Assessment Report. The Synthesis Report addresses a range of policy – relevant scientific and technical questions and synthesizes and integrates information contained in the TAR.

One of the key conclusions of the TAR Synthesis Report is that the Earth’s climate system has changed on global and regional scales; human activities have increased the atmospheric concentration of greenhouse gases and aerosols, since the pre-industrial era. The global average surface temperature has increased from 1860s to 2000, the period of instrumental record. Over the 20th century this increase was 0.6° $\pm$ 0.2°C. It is very likely (90-99% chance) that the 1990s was the warmest decade and 1998 the warmest year of the instrumental record.

The SPM of “Climate Change 2001: The Scientific Basis” specifically indicated that there is a need for additional systematic and sustained observations. A serious concern is the decline of observational networks. The following are high priority areas of action in systematic observations and reconstructions:

- reverse the decline of observational networks in many parts of the world;
- sustain and expand the observational foundation for climate studies by providing accurate, long-term, consistent data including implementation of a strategy for integrated global observations;
- enhance the development of reconstructions of past climate periods;
- improve the observations of the spatial distribution of greenhouse gases and aerosols.

The IPCC also publishes Special Reports, often in response a request from the UNFCCC. Presently, two Special Reports are under preparation: on Safeguarding the Ozone layer and the Global Climate System: issues related to hydro-fluorocarbons and perfluorocarbons, and on Carbon Dioxide Capture and Storage.

The IPCC prepares methodology reports on greenhouse gas inventory-related methodologies and practice. The last publication was in April 2004 “Good Practice Guidelines for Land Use, Land-use Change and Forestry.” Presently a major revision of the guidelines is carried out and new IPCC Guidelines for National Greenhouse Gas Inventories will be available in 2006.

The “Task Group on Data and Scenario support for Impact and Climate Analysis (TGICA)” was set up to facilitate the wide availability of climate change related data and scenarios to enable research in sharing of information across the three IPCC working groups. It coordinates the Data Distribution Centre (DDC), which provides data sets, climate and other scenarios, and other materials e.g. technical guidelines on use of scenarios.

The 19th session (April 2002) of the IPCC decided that the Fourth Assessment Report (AR4) should be completed in 2007 and it will be comprehensive, but more focused and shorter. The extremely rigorous preparations have been undertaken for the AR4. Two intensive scoping meetings were held in 2003 – April in Marrakesh and September in Potsdam respectively, to prepare the intellectual underpinnings of various components of the AR4 and to develop of the structure of the three Working Group Reports.

Some of the new and unique features will be included in the AR4 cover the explicit treatment of a set of crosscutting themes include: Uncertainty and Risk, Integration of Mitigation and Adaptation, Article 2 of the UNFCCC and Key Vulnerabilities, Sustainable Development, Regional Integration, Water, Technology.

The outlines of the three Working Group assessment reports have been revised in response to comments received from governments and approved by the Working Groups Sessions (November 2003). The IPCC accepted the outlines at its 21st session (November 2003). The nominations and selection of lead authors and expert reviewers has been organized during December 2003 – February 2004 and the final selection was completed at 31 Session of the IPCC Bureau in April 2004. The first lead-authors meetings of the IPCC working groups are planned in September 2004.

The IPCC publication programme is an integral part of the Panel work programme and outreach activities. It should be noted that:

- IPCC Reports (full volumes in English including TAR Vol. 4) are published commercially and after an initial free distribution free copies are provided upon request to developing countries;
- SPM and TS of Assessment Reports and Special Reports, Stand-alone Synthesis Report and any translations of IPCC Reports (including TAR Vol. 4) are distributed free of charge upon request;
- CD-ROMs of any IPCC products are normally distributed free of charge.

The IPCC Secretariat is responsible for publicising and disseminating IPCC Reports to the wider scientific and policy-makers community, including translation of SPMs into UN official languages.

Annex 9

SIX CONCEPTS THAT
I WANT TO BRING TO THE ATTENTION OF GCOS

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The idea for this presentation was to identify the relevance and possible use of certain ideas about ecological changes taking place as a result of human activities such as land use practices and as a result of climate variations on all time and space scales. The various changes on the land's surfaces have been induced directly or indirectly either by human factors or by natural factors but, most likely, by some mix of the two. People are concerned about climate in their regions because variations and changes in climate can generate benefits or hazards with which they must learn to cope. Therefore, climate information is needed by societies so that they can improve the various ways they cope with climate variability, change and extremes.

In Central Asia there are several climate zones. Among them the drylands have been acknowledged as particularly fragile environments. Adverse impacts in the drylands can have long-term consequences for the land and for society. The drylands include hyperarid, arid, semiarid, and sub-humid regions. About one fifth of the world's population inhabits these areas and, relatively speaking, they are among the most vulnerable people to climate variations. While some observers see great socio-economic value in the drylands as they are (e.g., part of the natural environment that supports the lifestyles of various cultures), others see these lands as targets of development, sort of the last frontier for human development and exploitation. As populations increase and the pressures mount to produce food and have access to water supplies, people are forced to move into areas that are known to be increasingly marginal for sustained agricultural or rangeland use. Yet another group views much of the drylands as being relatively unproductive harsh environments for human activity, except for mining raw materials or as dumping grounds for nuclear and other types of waste produced elsewhere such as from urban areas.

The ideas of interest presented are as follows: (1) problem climates or problem societies; (2) creeping environmental problems; (3) drought follows the plow; (4) forecasting by analogy; (5) early warning systems (6) the precautionary principle. Each of these ideas has a similar goal: to provide decision makers with an early warning of impending adverse changes in environmental conditions. The idea of early warning is to provide decision makers, from individuals to national policy makers, with enough lead time to take pro-active measures to mitigate if not avoid permanent harm to people, property or the environment.

These ideas are not only relevant to drylands ecosystems but to other ecosystems as well: marine, coastal, inland water, forests, mountain, polar, cultivated, and urban. These ecosystems are influenced by atmospheric processes that are, in fact, changing on all time scales.

1. Problem Climates or Problem Societies

- 40 years ago Trewartha (The Earth's Problem Climates, 1961, University of Wisconsin Press) introduced the notion of problem climates. Since then, our knowledge of what is known and not known about the climate system has greatly improved.

- We now realize that all climate regimes, local to global, are problem climates in some respect.

- People are increasingly living in areas at risk to climate anomalies and climate-related hazards.

- Some of the existing natural hazard risks have been increased as a result of government policies.

- Some risks have increased because population growth numbers have far outstripped the natural resources needed to support them. Then, the present as well as future populations are at increasingly greater risk to adverse impacts from existing climate conditions, and more so in the face of deep climate change.

- There are numerous examples to support the contention that there are problem societies as well as problem climates.

2. Creeping Environmental Problems (CEPs)

- CEPs are low grade, incremental, long term but accumulative environmental changes: Each day the quality of the environment is not much different than that of the previous day. And the environmental quality of tomorrow will likely not be much different than that of today. Nevertheless, an environmental and, therefore, societal crisis is building imperceptibly over time. ***For CEPs it is apparently difficult to identify adverse thresholds of change in an objective (scientifically determined) way before many of those thresholds have been crossed.***

3. Drought Follows the Plow

- MARGINS refer to high (altitudinal), dry, cold, soil fertility, climate variability and extremes, and the slope of the terrain.
- Governments are under pressure to make their marginal lands more productive and increasingly inhabited by human settlements.
- People are in search of a better life for their families and the margins appear to provide opportunities that do not exist under their present living conditions.
- Extended wet periods on the order of several years or decades make it seem that normally marginal lands will be more productive in the future. However, as a result of decadal scale fluctuations in precipitation, there is an inevitable return to drier conditions for which the new inhabitants to the region remain unprepared.
- As a result, people become confused and disappointed, when the rains disappear and the regional climate returns to multiyear or multi-decadal below average rainfall conditions.

4. Forecasting by Analogy (FBA)

- Forecasting the future by analogy can be a fruitful approach to improve our understanding of how well society is prepared to cope with the presently known regional characteristics of a potential climate change some decades in the future.

- Analogues can help us to identify societal strengths and weaknesses in coping with extreme meteorological events so that they can reinforce those strengths and reduce the weaknesses.

- The purpose of looking back is to determine how flexible (or rigid) societies are or have been in dealing with climate-related environmental changes. Societies everywhere have already shown the propensity to prepare for the last climate anomaly by which they were affected. We must be aware of past events, but we must not get drawn into preparing for them.

5. Early Warning Systems

- All governments, corporations, groups and individuals are interested in early warning about climate-related problems they may have to face. The earlier the warning the more time they have to prepare. They have ample time to prepare for and hopefully cope with the natural or human-induced threat or to prepare for its potential impacts.

- An early warning system (EWS) is made up of several components and is not well represented only by issuing a warning. Components are the formulation of the warning, the issuance of the warning, and the reception of and response to the warning -- each of which has to be considered in evaluating an EWS. A weakness in any part of this process of events from warning preparation to responses can render the early warning system ineffective, and an early warning system that does not warn will not be taken seriously.

- In fact, there are numerous EWSs in any given society, in addition to those in hydrometeorology. They are designed for famine, flash floods, infectious disease epidemics, heat, drought, etc. The meteorological community has been using EWSs for a long time to deal with all kinds of extreme hydro-meteorological events.

- The truth of the matter is that EWSs are constantly being created for newly identified threats (terrorism, West Nile virus, SARS), being revised for existing threats (food insecurity, invasive species), and critiqued for shortcomings. Existing systems are constantly being challenged by Nature. Making the difficult task of early warnings even more difficult is the fact that societies are changing as well as are ambient environmental conditions.

6. Precautionary Principle (PP)

- PP attempts to foster risk-averse decisions about environmental issues that still contain a lot of scientific uncertainty about outcomes. PP is based on the view that scientific uncertainty should not be an excuse for inaction.

- The PP is “when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof.”

Annex 10

GCOS SURFACE AND UPPER-AIR NETWORKS AND REGIONAL BASIC CLIMATOLOGICAL NETWORKS

Eduard I. Sarukhanian and Richard K. Thigpen
GCOS Secretariat

The GCOS Surface and Upper-Air Networks (GSN and GUAN) were established in 1999 and 1996 respectively to form a critical baseline calibration network for use in a variety of climate activities. The identification process that was followed was similar for the two networks. A group of CCl/CBS experts used lists of existing synoptic and climatological stations around the world and then developed a ranking process (based on certain criteria) that rated each station on its geographic location, historical record, quality of observations, and sustainability for the future. The objective was to identify stations that provided a good geographic coverage of the globe and also had long histories of operation so that there would be a good long-term historical database. The identification process for GSN stations was described by T.Peterson, H.Daan, and P.Jones (Bulletin of the American Meteorological Society, Vol. 78, No. 10, October 1997).

The identified stations are by definition an integral part of the WMO World Weather Watch / Global Observing System. They are listed in WMO Volume A, many of them identified in the Regional Basic Synoptic Networks (RBSN) and all of them in the Regional Basic Climatological Networks (RBCN) established by Resolutions of Regional Associations during the period from year 2000 (RA II) to 2003 (RA VI). As of 1 January 2004, the GSN consists of a total of 981 stations. The current total for the GUAN network is 152 stations. The current list of GSN and GUAN stations is available through the GCOS Web site (http://www.wmo.ch/web/gcos). RBCN consist of 2586 stations over the globe, including GSN, GUAN, and additional CLIMAT and CLIMAT TEMP reporting stations.

Network performance requirements, both minimum and target are found in the "Guide to GCOS Surface and Upper-Air Networks: GSN and GUAN (GCOS-73)." This guide also contains the GCOS Climate Monitoring Principles as well as the format for the submission of historical data and explanations of the performance indicators used by the monitoring centres. This Guide may be found on the GCOS Secretariat home page. (http://www.wmo.ch/web/gcos/gcoshome.html).

The CBS Lead Centres for GCOS have been formally established and have begun their activities in Climate Centre Tokyo (JMA) for GSN and in the National Climate Data Centre Asheville (NOAA) for both GSN and GUAN. According to information provided NCDC, as 1 March 2004 117 (68%) of 173 GSN stations located in this region were transmitting CLIMATE reports, 48 (28%) stations were not transmitting CLIMAT reports, and 8 (4%) stations were silent (not producing synoptic data). Regarding the upper-air network, 16 (90%) of 18 GUAN stations located in the region were transmitting CLIMAT TEMP reports, while two stations were closed.

As regards RBCN, according to the results of monitoring of WWW implementation (October 2003) 294 (72%) of 408 RBCN stations located in this region were transmitting CLIMAT reports, while 114 (28%) RBCN stations were not sending them.

These data show that the performance of GSN, GUAN and RBCN in this particular region as well as in others has not yet achieved the level that is needed. There are a variety of reasons for this. First, observing stations in synoptic networks in some cases do not forever remain in operation. The NMSs may make changes in the operation or locations of their stations. Errors have existed in the identification of stations and their altitudes. Equipment has become obsolete and supplies have become prohibitively expensive for some operators. Synoptic stations may not prepare and send the monthly summary bulletins (CLIMAT and CLIMAT TEMP) upon which the primary monitoring activities are based. Thus some stations are identified as "silent" for GCOS purposes when in fact they are operating on a fairly regular schedule as synoptic stations. It has been reported for some time that roughly 40% of the stations in GSN and GUAN are "silent", although more recent analysis indicates that the networks are actually working somewhat better. In addition network stations are generally not achieving the target performance requirements, especially for the GUAN that specifies soundings twice a day and levels of 5 hPa.

The biggest contribution to GSN and GUAN in this part of the world was provided by the Russian Federation. Unfortunately, serious difficulties in Russian observational networks in the second half of 1990s affected both GUAN and GSN stations. Since 1999, Roshydromet has done its best to help both networks recover. At present it has proposed a revised contribution to GSN and GUAN that would provide better availability of CLIMAT reports from Russian territory.

An important point is to establish a network of focal points for validation of GSN and GUAN stations in individual countries. Each host country should identify a national focal point to work with a regional focal point and the World Weather Watch (WWW) to validate that the information in the GSN and GUAN stations lists is correct. At the WMO, the WWW maintains and publishes the RBSN and RBCN lists, which include the GSN and GUAN stations. After this validation process, the same focal points would become the points of contact for the operation of these stations in their host country.

Another serious deficiency in the implementation of these networks so far is the lack of historical data from many of the stations. The National Climatic Data Centre (NCDC) in Asheville is responsible for building a permanent data base of GSN daily and monthly data, along with the appropriate station metadata history, and for providing free and open user access to this information via their web site at http://lwf.ncdc.noaa.gov/servlets/gsn. This site contains all of the historical daily and monthly CLIMAT-formatted GSN data received (as of September 2003) at NCDC from 387 of these surface stations in 36 countries. Unfortunately, no historical data are available from CIS countries. It may be a technical issue, as the historical data are either lost or not in a suitable form. In any case, of the 981 stations in the GSN, historical data for only 30% of stations is in the NCDC archive today, making the GSN substantially less useful for long-term climate analyses. Current initiatives in France and the US are intended to address the rescue of historical data. These historical data are important to any country, to countries within the region, and to the global climate community.

Progress, though slow, in improving both networks is being made recently through a variety of means, such as through regional workshops (like this one) conducted by GCOS, efforts of the World Weather Watch and GCOS to correctly identify network stations, analysis of operational problems, and improvements in monitoring functions. Regional Action Plans have been developed for some regions and should be prepared for this region as an outcome of the Workshop. Our knowledge of the problems and operational issues would be improved. Working together, we can insure that these globally important networks operate well.

Recommendations for inclusion in the Regional Action Plan

1. Establish Regional and National Focal Points for the RBSN and RBCN, especially the GSN and GUAN Stations.
2. Develop a Regional Network Improvement Plan/Proposal.
3. Develop a Regional Plan for Rescuing and Sharing RBSN and RBCN Historical data with Emphasis on GSN and GUAN Stations.

Annex 11

CLIMATE OBSERVATIONS IN MOUNTAINS

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Our ancestors lived in the close relations with the nature, being dependent permanently on the weather conditions. In the course of centuries they observed and kept in mind the changing weather conditions.

Our knowledge about climate are based on the day-round observations on the weather elements: solar radiation, air and soil temperature, wind, precipitation, cloudiness, atmospheric phenomena, conditions of rivers, seas and other natural and atmospheric phenomena. For the first time the information about climate in the Central Asia appeared in II c. and was presented in the book “Geography” written by Ptolemei.

Regular observations on the weather conditions on the territory of Central Asia were started in the second half of X1X century. The meteorological network of the Central Asian hydrometeorological services (NHMS) has reached the highest accuracy of the quantity of meteorological observation points in 80s of XX century (see the Table). In the beginning of XX1 c. NHMS of Uzbekistan carries out the main types of observations at 77 meteorological stations (16 of which are situated in mountains).

The relief has a significant effect on climate. Big mountain relief effects especially strongly on climate conditions. That is why, a specific climate type is formed in mountains which is called “mountain climate”.

Three following causes hamper the study of climate and weather conditions in mountains:

- Many mountain areas are far from the main centres of the human activities (populated areas), they are difficult to access which also makes the installation and maintenance of observing meteorological stations problematic;
- The nature of mountain terrain stipulates different types of conditions, which explains that any station will be the representative one only for the limited parts of the area;
- In case of severe weather phenomena the fulfillment of the standard weather observations at mountain stations is very complicated.

The last two points should be considered more comprehensively. Concerning the representativeness of mountain stations of the National Hydrometeorological Service of Uzbekistan it can be noted that they comprise 21% of all stations included into the network of weather observations. By the data of O.Poslavskaya (1981), mountain occupy 21,3% of the territory of Uzbekistan. It can be accepted that meteorological stations located in mountains, are representative for the description of mountain climate of the republic.

In traditional approach to the description of climate the long-term data of observations covering 30-year period are being used. The observation series of the high-elevation remote stations located in the mountain part of Uzbekistan are sufficiently long for the generalization of climate data.

Climate data collected by these stations are presented in Climate Reference Books issued in 1965-1967 and 1989 in Gidrometeoizdat Publishing House (Leningrad) of the former USSR.

Taking into account the difficult access to the mountain stations, it can be concluded that the mountain climatology in NHMS of Uzbekistan is based on the representative long-term data which provide for the more or less reliable forecasting of the possible changes of the main climatic factors of the air temperature and precipitation amount.

Development of the hydrometeorological network of Central Asia referring to the main types of observations

Years	Total	Number of stations/post measuring the parameters						
		Precip itation	Temperature					air hu-midity
			air	soil surface	soil in ground, cm			
					20	160		
Uzbekistan								
1975	84/93	84/93	84/-	84/-	28/-	20/-	84/-	
1980	92/109	92/10 9	92/-	92/-	37/-	19/-	92/-	
1985	93/90	93/90	93/-	93/-	42/-	18/-	93/-	
1990	85/91	85/91	85/-	85/-	34/-	16/-	85/-	
1995	76/90	76/90	76/-	76/-	31/-	15/-	76/-	
1996	76/90	76/90	76/-	76/-	31/-	15/-	76/-	
2001	77/90	77/90	77/-	77/-	31/-	15/-	77/-	
Central Asian region								
1975	355/373	355/37 3	333/-	302/-	153/-	133/-	303/-	
1980	365/431	365/42 3	341/-	312/-	161/-	131/-	313/-	
1985	361/371	361/37 1	335/-	306/-	165/-	129/-	307/-	
1990	331/314	331/31 4	312/-	283/-	147/-	118/-	284/-	
1995	282/-	282/-	273/-	248/-	135/-	108/-	248/-	
1996	282/-	282/-	269/-	248/-	133/-	106/-	249/-	

Note: N of stations is given in numerator; N of posts – in denominator; «-» – data of the N of posts are absent.

Taking into account that both weather and climate conditions determine to a large extent the life and economical activities of population, it is very important to detect the severe weather phenomena and to evaluate their climatic variability during different seasons of the year and from year to year.

Almost all atmospheric phenomena can be attributed to the category of "severe weather" in definite conditions. All meteorological situations are referred to as "severe weather" when certain weather elements deviate significantly from the mean values, to which people adapt during the long period of economical activities. It is clear that the criteria of the weather phenomena danger are different for the different kinds of activities and even for their stages.

The extreme **floods** are formed due to the fall of considerable solid precipitation in winter, to their intensive spring melt and heavy rains. The floods pass through all rivers of the Central Asian region. During the last years the problem of the high flood water passing through the river channels arose, as their flood lands were intensively used for construction of buildings, houses, etc. during the long period of low water period in the end of XX c.

Showers and continuous heavy rains transformed to showers are the main factors causing the **mudflows**. The high frequency of the mudflows cases is typical for mountain area.

Avalanches are presented by the snow masses sliding down the slopes or rushing down from the steep, the movement of which was caused by special conditions. The avalanche prone areas occupy 12 % of the territory of Uzbekistan. The avalanches are very destructive and cause a considerable damage every year.

For the monitoring of the mudflows and avalanches processes the service of monitoring of severe weather phenomena (SMSWP) was established at the NHMS of Uzbekistan. The main tasks of this service are the warning of population and objects of the national economy about possibility of the mudflows and snow avalanches. On the base of this service (SMSWP) NHMS of Uzbekistan fulfils one of its main functions – warning of population and objects of the national economy about the severe weather phenomena.

Regarding the climate observations in mountains, it should be noted that the meteorological stations in mountain areas are the objects of the background monitoring of the environment pollution.

The role of these points of hydrometeorological observations becomes more important in the present conditions because of the environment pollution and increase of CO_2 concentration.

Coming back to the first of the above-mentioned difficulties, related to the installation and maintenance of the mountain meteorological stations, it should be mentioned that the majority of stations was installed and equipped in 70-80 of XX c. Only limited number of stations is provided by the modern computers, but the modern communication facilities are absent at these stations. The remote sensing devices which were used at several stations for the snow cover measurements are obsolete and not changed by new ones.

The state of the snow-measuring observations in mountains which are needed for the accurate estimation of the water resources of the region both for the present time, and for the future is also worsened.

Without such information the quality of hydrological forecasting as well as the quality of the user servicing drop considerably.

Several years ago snow-route surveys were made in 24 basins at 250 snow-measuring points. At present the snow-cover measurements are carried out only in three basins. Almost at all NHMSs of CA region the observations of the snow cover depth were ceased. Since 1992 at NHMS Uzbekistan in points, where the observations by the airborne remote stakes still are continued, they are carried out once a year instead of four times.

The airborne gamma-surveys of the snow-water equivalent were ceased, and the number of the airborne snow surveys of the snow-reserves in mountains as well as of the surface snow-surveys was reduced.

The economical causes had a negative effect on the providing the hydrometeorological network of the CA NHMS with the equipment, instruments, devices, spare parts and materials. The equipment and devices in use are already obsolete. During the last ten years the new hydrometeorological instruments and equipment are not practically being purchased.

The financing of NHMSs of CA region is insufficient for the construction, repair and maintenance of operation of the points of hydrometeorological observations, not to mention the restoration of the closed hydrometeorological stations in mountains.

Such situation can cause an absence of information, i.e. the users will not be able to have the access to the forecasts about weather conditions, about severe weather phenomena, river regime, environment pollution and possible climate changes.

Without the reliable information, many models and techniques of the hydrometeorological regime forecasting, developed and tested during the last decades, cannot be used in future and besides, the further development of this research field is rather doubtful.

At present the evaluation and reorganization of the existing network is necessary. For the preservation and reconstruction of NHMSs of the region the investments that are aimed at the network updating, training of specialists of the high and medium class as well as conduction of scientific studies are necessary.

Annex 12

DATA SAVING ISSUES IN CENTRAL ASIA

Olga N. Bulygina

The Global Climate Observing System (GCOS) addresses the climate data preparation issue for assessing the climate, monitoring the natural and anthropogenic factors' impact on the climate system, and characterizing extreme phenomena, which is important for their assessment and adaptation to their impact.

The presentation highlights the issues arising while preparing the climate data historical rows collected by the GCOS in Central Asia.

The ways to save historical data depending on specific conditions in the region countries are proposed. Resolving the gaps in historical data, their heterogeneity and climate data quality control are addressed. In addition, the issue of the Central Asia current data processing and their entry into the Climate Data Base Management System (CDBMS) is discussed.

The data saving issues are closely related to the data management issues in the region. In line with the Voluntary Cooperation Program, Roshydromet is ready to provide the Central Asian hydrometeorological services with PERSONA-MIS, CliWare and CLICOM software package the requirement for which has been voiced by the region hydrometeorological service representatives at the Regional Meeting on the climate data management and saving which was held in Kyrgyzstan on 14-19 April 2003. The proposed software installation may be considered as one of the measures to save the data.

Annex 13

THE GLOBAL ATMOSPHERE WATCH

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Overview

In order to predict climate change, it is critical to monitor the changing composition of the earth's atmosphere as affected by the release of gases and aerosols through natural and man-made processes. Almost a half a century ago during the International Geophysical Year (IGY), scientists began a long-term atmospheric chemistry measurement programme at key stations around the world. To coordinate and harmonize this effort, the WMO's Global Atmosphere Watch (GAW) was created in 1989, combining earlier WMO programmes dating back to the early sixties. The GAW mission is threefold:

1. Systematic monitoring of the atmosphere's chemical composition and related physical parameters on a global and regional basis.

2. Analysis and Assessment in support of environmental conventions and future policy development.

3. Development of a predictive capacity for future atmospheric states.

In 1992, GAW was incorporated into the Global Climate Observing System (GCOS) as its atmospheric chemistry component.

Two points should be made about GAW's role within GCOS. (1.) It should be noted that GAW differs from the other components of GCOS in that the trends and global distribution of atmospheric chemistry parameters are primarily used in predictive climate models and are not a direct measurement of climate change per se. (2) GAW has an additional objective of coordinating regional air quality measurements worldwide. Associated with the air quality objective is the GAW Urban Meteorology and Environment Programme (GURME), which has been established to assist meteorological services in developing countries with urban air quality forecasting.

It has long been recognized that climate change and air quality are closely linked.
The results of deteriorating air quality particularly in urban areas are commonly known to cause a range of environmental issues. For example, respiratory illnesses are intensified during haze and smoke events. As urbanization increases in the coming decades, the release of aerosols and gases from cities into the atmosphere will continue to be one common point of interest between climate change and air quality researchers.

To build and maintain GAW's worldwide monitoring system, a network of stations has been set up which consists of Regional (over 300) and Global (22) stations, with additional observations made at contributing and associate stations. Though the programmes at GAW stations vary depending on the monitoring goals of the station, a list of the parameters measured includes carbon dioxide, methane, nitrous oxide, chloroflurocarbons, total ozone, vertical ozone, surface ozone, precipitation chemistry, carbon monoxide, the physical and chemical properties of aerosols, and solar/ UV radiation.

To ensure consistency in the GAW worldwide monitoring network, a strong infrastructure had to be developed. This structure includes Quality Assurance/ Science Activity Centres (QA/SACs), World Calibration Centres (WCCs), World Data Centres (WDCs) and the GAW

Training and Education Centre (GAWTEC). The QA/SACs and WCC provide a system for common calibration and quality assurance standards throughout the GAW system. The WDCs provide a depository for GAW data and conduct initial analysis and assessment of the data. Training in the GAW measurements system is provided in a number of ways: directly at the stations, visits to participating laboratories, technical workshops, or through GAWTEC.

In recent years, the GAW programme has broadened its scope by not only improving its infrastructure but also enlisting the help of the scientific community through the establishment of Scientific Advisory Groups (SAGs) for different parameters such as ozone, aerosols, greenhouse gases and precipitation chemistry. These groups have been very active in advising GAW on the appropriate scientific approach. Also, the recent advances in satellite technology have made it imperative that ground-based GAW measurement programmes be closely coordinated with satellite measurements. This coordination has been actively pursued through the International Global Observing Strategy. In support of GCOS, the GAW system must continue to promote quality ground-based measurements, but it must also broaden its agenda and incorporate efforts to integrate ground- and satellite-based measurements to lead to a better understanding of climate change.

The above is a very brief overview of the Global Atmosphere Watch system. For those countries active or considering participation in GAW, it is imperative that the following four GAW Technical Reports be available as references:

GAW No. 140 WMO/CEOS Report on a Strategy for Integrating Satellite and Ground-based Observations of Ozone.
GAW No. 142 Strategy for the Implementation of the Global Atmosphere Watch Programme (2001-2007), A Contribution to the Implementation of the Long-Term Plan.
GAW No. 143 Global Atmosphere Watch Measurements Guide.
GAW No. 144 Report of the Seventh Session of the EC Panel of Experts/CAS Working Group on Environmental Pollution and Atmospheric Chemistry and The GAW 2001 Workshop.
GAW Information Sheet No. 23 (May 2002 – December 2003).

All can be obtained in hard copy from the WMO Secretariat (Contact Ms. Chantal Renaudot, Tel: 41 22 7308587, Fax: 41 22 7308049, e-mail: CRenaudot@wmo.int).

Two other important sources of information on GAW is the WMO web site, from which the latest information is available (http://www.wmo.ch/web/arep/gaw), and the GAW Station Information System (GAWSIS), which gives all the available information on the GAW network (http://www.empa.ch/gaw/gawsis).

The Global Atmosphere Watch in Central Asia

The experts attending this workshop come from countries that over the last decades have been growing at an ever-increasing rate in both population and agricultural/industrial development. The effect of such changes has had a direct impact on the air quality in the region and hence on the global climate. On the basis of information listed in the GAW Station Information System (GAWSIS), Armenia, Georgia, Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan have identified GAW Regional stations in their respective countries. Other countries participating in the workshop (China, Japan, Mongolia, the Russian Federation and the Republic of Korea) also have active GAW programmes.

It is requested that participants of the workshop bring with them the latest information on the GAW network in their country that would include information on station location, measurement programmes and central laboratories to be submitted to GAWSIS.

To coordinate the GAW system in Central Asia, a number of organizations play important roles. The WMO Secretariat in Geneva has the main task of oversight but must depend on the GAW infrastructure to do most of the day-to-day work. This includes the QA/SACs, WCCs and the WDCs. In this respect, the Quality Assurance/ Science Activity Centre for Asia and the South-West Pacific located in the Japan Meteorological Agency is the focal point for the region and provides coordination specifically for Asia. Other centres in North America and Europe also assist in the GAW network in the region.

As with the other GCOS networks, the GAW programme in the region can undoubtedly begin to make an important contribution to our understanding of the changing composition of the atmosphere and thus the climate. This is outlined in the following recommendations.

Main Recommendations

-Name a GAW Contact Person within the given country to interact with the WMO Secretariat and other parts of the GAW infrastructure.

-Review the present GAW programme and update the status in the GAWSIS.

-Review what further measurements can be made to contribute to the GAW programme. Measurements that should be considered include aerosol optical depth, precipitation chemistry and selected trace gases.

Annex 14

THE ARCTIC OCEAN AND ITS ROLE IN CLIMATE

N. P. Smirnov

Polar oceans are an important component of the global climate system, as polar and sub-polar seas of both hemispheres are areas of deep water formation in the World Ocean and, consequently, play a key role in the World ocean thermohaline circulation. The latter, in its turn, determines the heat transport by currents and the center locations of heat emissions from the ocean to the atmosphere, which is one of the most important Earth climate formation factors.

Since the Polar Regions, as the long-term observing and model calculations have shown, are the most sensitive to the climate change, climate change studies in the Arctic Ocean area are extremely actual to understand the nature of climate change, in particular that has been observed in the recent years. The Arctic basin is not only the heat inflow area but also the area where cold air masses are coming from to the middle latitudes and effecting the weather and climate conditions in Central Asia, as well as the area where the cold fresh water and ice are coming form to the western areas of the Northern-European Basin and of the North Atlantic. The latter circumstance makes the Arctic Basin particularly important in the formation of the atmospheric circulation long-term variability in the middle latitudes Northern hemisphere.

The Arctic Ocean sea level is an evident indicator of the atmospheric and ocean circulation dynamics, and as a result, of the climate variability. Interannual variability of the Arctic Ocean sea level appears to be closely linked with the climate dynamics in the North Atlantic. The Arctic Ocean ice coverage (sea-ice distribution and thickness,) is another important global climate change indicator.

This shows that for comprehensive analysis of the most important climate system components, a long-term climate observing system in the Arctic should be established. Unfortunately, in the past 10 years a sharp reduction of the hydrometeorological observing stations at the Arctic Ocean coast and islands took place. Up to two thirds of sea level measurement stations were closed, together with the simultaneous deterioration of the quality of observations at the remaining points. Standard hydrological sections in arctic seas in summer and ice survey from aircraft along North Sea Route were stopped. The total number of the hydrometeorological stations has been reduced. In the light of the above it is a very difficult task to carry out climate monitoring in the Arctic Ocean area.

The need and urgency of such monitoring can be vividly illustrated by the following example. It is well-known that the so called global warming issue related to anthropogenic green-house emissions, first of all, carbonic acid, to the atmosphere is one of the disputable issues. How much has the “global warming” been noticeable in the Arctic Ocean area? The air temperature change analysis carried out by us at 16 stations located at the coast and on the Arctic Ocean islands over the past 70 years (1931-2000) has shown that at 11 of them not the 90-s but the 30-s and 40-s were the warmest decades. Only in the Canadian sector of the Arctic basin (the Chucotskoye Sea and Bofort Sea area) the last decade of the 20th century was the warmest one. Thus, in the most part of the Arctic Ocean warming in the 30-s – 40-s was the most remarkable. The air temperature linear trends calculated for 50 years, from 1951 to 2000 confirm it as well. In the most part of the Arctic basin there have been no temperature change trends. In the Chukotskoye Sea and Bofort Sea area a positive trend has been observed, but a more negative trend has been observed in the Baffin Sea area and Davis Strait (Vorobyev, Smirnov, 2003). Finally, it is interesting to compare the extreme temperature recurrence frequencies during the warming periods in the 30-s – 40-s and the

90-s. The recurrence analysis of such anomalies for 1921 to 1998 has shown (Alekseev, Ivanov, 2003) that during the warming period in the 30-s – 40-s the temperature anomalies recurrence both in winter and particularly, in summer was higher.

The arctic seas ice coverage data do not confirm the "global warming" either. The ice coverage of the Barents Sea directly affected by the North Atlantic has reduced the most evidently over the past 50 years (by 25%). But the ice coverage in the Canadian sector of the Arctic basin has even more visibly increased (Vorobyev, Smirnov, 2003). Hydrological cycle acceleration, and consequently, increase of precipitation amount in the Arctic basin and river discharge should be the "global warming" impact. The data analysis shows that there has been observed neither any noticeable precipitation increase in the Arctic basin nor river discharge increase. The overall rivers inflow into the Arctic Ocean over the past 50 years has not increased, and even decreased, and in the overall increase of salinity in the upper layer of the Arctic basin has been observed, particularly marked in the Canadian sub-basin (Timokhov and others, 2003). Only an insignificant sea level increase (≈1.5 mm/year) at the Arctic basin coast could testify in favor of the "global warming". However, this increase is completely explained by the change in the ocean circulation intensity over the past two decades of the 20th century, namely the increase of the cyclonic circulation and weakening of the anti-cyclonic circulation.

In this regard it is very important to establish an observing system in the Arctic Ocean area to meet the climate change monitoring requirements, which is one of the objectives of the Global Climate Observing System (GCOS). In our opinion, it should be the Arctic Ocean Observing System that would include the reactivation of existing and the establishment new sea level measurements stations, extending of the ice drifter network, deployment of ocean moorings, conducting marine expeditions on board ships, icebreakers, submarines, national airborne visual and radar patrols, supplemented by satellites with active and passive microwave sensors, optical scanners and sounding instruments. As we know, this task was included in the Outline Science Plan for the International Polar Year 2007-2008.

Annex 15

STATUS, DRAWBACKS AND NEEDS IN HYDROLOGICAL OBSERVATIONS FOR CLIMATE

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In many regions of the world over several decades there has been observed a sustainable rise of the air temperatures and change of weather conditions. Many researchers explain those changes by the climate change impact, which may result in unpredictable consequences for the whole mankind. That is why the need to study the climate change observed and its forecast for the future decades is put forward as one of the most important world issues. In this regard the task to study the water hydrological regime as a component and indicator of the climate change is becoming urgent.

The climate change will result in the global hydrological cycle intensification and have a considerable impact on the regional water resource. The precipitation quantity, frequency and intensity change will have a direct impact on the amount and distribution of water flows in time, catastrophic floods frequency, spring floods, and water shortages. Even a relatively small temperature and precipitation change alongside with the non-linear impact on the evaporation transpiration and soil humidity may result in a relatively considerable water flow change in arid and semi-arid areas. This determines a particular vulnerability of the Central Asian region countries and additional reduction of local water resource because the amount and quality of water are serious issues for Central Asia.

To study the climate change, a special “climatic” hydrological network is required to study the regime of specially selected “hydro-climatic” objects and dependence of that regime on the determining factors, and to use the study outcomes for the identification and study of the climate dynamics and its change impact on the rivers’ hydrological regime.

As “hydro-climatic” objects, rivers and lakes (preferably – closed lakes) with one prevailing source can be used. Those objects should be minimum subjected to economic activities, or a methodology for accounting for economic activities’ factors should be developed to exclude through calculation their impact on the river and lake water regime.

Long-term complex hydrometeorological observations the selected objects’ regime should be implemented at “hydro-climatic” posts, which have quality equipment, with simultaneous observing the water flow formation factors in their basins.

For “hydro-climatic” objects both the available hydrological network posts can be used which have an advantage of long-term observations in the past, and newly established posts.

Presently special hydrological observations earmarked for the climate change studies is not implemented in Central Asian countries. National hydrometeorological services have been engaged in implementing complicated tasks to preserve, restore and develop the hydrometeorological observing network under contemporary conditions.

The Table 1 data show that hydrometeorological observations were mostly developed in the mid 80-s of the XX century. Later steadfast reduction of the stations and posts network and the scope of their observations started. However, even during the period of the utmost hydrometeorological network development in Central Asian Republics, that network was less dense that in the European countries. At that time only in the Aral Sea basin 400 meteorological stations, 475 hydrological posts, 16 aerological, and 20 actinometrical and agro-meteorological stations were operating simultaneously.

Table 1. Number of hydrological posts as of 2004 against the mid 1980s

Country	Number of Posts		2004, in % of the mid 80-s
	80-s	2004	
Kazakhstan	506	206	41
Kyrgyzstan	147	81	55
Tajikistan	139	89	64
Turkmenistan	38	31	82
Uzbekistan	155	131	85
TOTAL	985	538	55

Observing the snow cover and snow reserves in the mountains was implemented at 239 ground snow points, 988 air snow points, 268 summary precipitation measurement posts, and 13 gamma picture helicopter routes. In this region 6 water balance stations were operating at that time, and 4 out of them were operating in the irrigated areas. At 4 points observing evaporation from the water surface with an area of 20 sq. m. was implemented. About 50 points were equipped with GGI-3000 evaporators to monitor evaporation from water and with GGI-5000 evaporators – from the land. On the Aral Sea there were 11 points to monitor its regime.

In the 1980s, during the hydrological observing network highest development, it consisted of 506 posts on the rivers, water reservoirs, lakes, and seas.

The last decade of the 20^{th} century in Kazakhstan and other Central Asian republics was characterized by economic difficulties. Reduction of the observing network has resulted in the hydrological forecast quality deterioration. Stations for observing mudflows, agro-meteorology, hydrology and water cadastre units were liquidated; water balance studies and observing hard flows were stopped. By 1999 the hydrological network had been reduced to 159 posts, coming back to the 1940 level.

After Kazhydromet's restructuring in 1999, funding the hydrological observing network started improving, and its activities were resumed. Since 2000 the work on preparation and issue of hydrological annual books has been renewed. In 2002 the Government funded the hydrological network development program, and as a result of it, 4 hydro sites transboundary with China were restored and equipped with new equipment, and 44 new hydrological sites were constructed.

Presently the state hydrological network of Kazakhstan comprises 206 hydro-posts on rivers, lakes and water reservoirs and 4 sea hydrometeorological stations. This number of observing points is insufficient for implementing full-scale hydrological observing the country's vast area.

In 2004 construction and establishment of 20 informational hydrological posts, 4 meteorological stations, 1 aerological station, repairs of 34 hydrological posts, 20 meteorological stations and 2 aerological stations are planned. In addition, in Kazakhstan, the Program for Developing the National Hydrometeorological Service for 2005-2007 has been developed.

The Republic of Kazakhstan is a region with the most scarce water resource, which restricts the economy development. The most part of the RK consists of deserts, semi-deserts and dry steppes (the aridity indicator is close to 75%). Fertile land and relatively favorable climatic conditions determining the ecological capacity are located in the country's outlying districts. The ecological capacity is significantly determined by the water reserve. By this indicator the Republic of Kazakhstan with its 46 mm average perennial water resource cover is at the lowest place among the CIS countries (Table 2) and at one the lowest places in the world.

Table 2. Natural water resource and water supply in Central Asian countries

Country	Area, thous. km^2	Water resource, km^3/year		Water resource, mm/year		The local and the overall flow proportion
		local	overall	local	overall	
Kazakhstan	2717.3	69.4	125	25	46	1.8
Turkmenistan	488.1	1.13	70.9	2	145	62.7
Uzbekistan	447.3	9.5	108	21	241	11.4
Kyrgyzstan	198.5	48.7	48.7	245	245	1.0
Tajikistan	143.1	47.4	95.3	331	666	2.0

Insufficient, old and outdated instruments and equipment is the major hydrological network problem in Kazakhstan. Kazakhstan traditionally had Russian made equipment. Due to the cessation of manufacturing hydrometric current meters by the CIS factories, the national hydrometeorological service has purchased water flow meters manufactured in Russia, which are not widely used due to their unreliability. Repairs of hydrometric current meters are complicated by the lack of spare parts. In 2004 replacement of the calibration flume for testing hydrometric current meters is planned.

The national hydrometeorological services in Tajikistan, Kyrgyzstan, Uzbekistan and Turkmenistan experience the most difficulties in providing the hydrometeorological network with equipment and instruments, repairs and calibration of instruments.

The national hydrometeorological services in the region, particularly in Kyrgyzstan and Tajikistan experience certain difficulties with professional staff. To implement their functions, the national hydrometeorological services need a reliable telecommunication system. The National Hydrometeorological Service of Kazakhstan has direct telephone communication channels with the World Data Center in Moscow and the Regional Center in Tashkent. The annual volume of data processed by the Republican communication service reaches 8.6 ml messages. The external communication system provides for receiving international data, numerical weather predictions and satellite data. This communication system is a part of the World Meteorological Organization Global Telecommunication System.

The communication system provides for the data collection from the monitoring network every 3 hours for their further processing and transfer to the Hydrometcenter, regional hydrometeorology centers and the World and Regional Centers.

The computerized hydrometeorological observing database, which had been created since the 70-s at the World Data Center (All-Russian Research Hydrometeorological Institute - World Data Center, Moscow) on tape has become practically inaccessible due to the dismantling of the outdated electronic equipment. In 1997 the CIS Interstate Hydrometeorology Council adopted a program for creating the CIS hydrological database with the transfer of the appropriate data from the Roshydromet archive to each country, but that program has not been implemented yet.

The following recommendations are proposed. For the Central Asian national hydrometeorological services to overcome the current hard situation, new State programs should be worked up for developing hydrometeorological activities envisaging the following objectives:

- Developing and enacting laws on the hydrometeorological services to provide for the legal-regulatory framework regulating the national hydrometeorological services' relations with the government.
- Developing the hydrometeorological network and restoring the hydrometeorological posts' operations on major rivers, including transboundary ones, in the countries of the region.
- Establishing a hydrological observing network for the climate studies.
- Renewal of observing the hard flows at stations and posts, and acquiring the required instruments, equipment and consumables.
- Renewal of observing evaporation from the water surface at stations and posts through equipping them with GGI-3000 evaporation meters.
- Providing the current posts with modern hydrological instruments and equipment (hydrometric current meters, water level recorders, floating facilities etc.).
- Renewal of the water-balance stations' operations.
- Opening the earlier closed sea coast and lake hydrometeorological stations and posts necessary to monitor the Caspian and Aral Sea, the Balkhash and Issyk-Kul Lakes, equipping them with floating facilities (sea vessels and river boats), modern automatic radar stations and other necessary equipment.
- Renewal of the mud flow stations' operations.
- Renewal of the snow avalanche stations' operations, implementation of surface and air visual observing the snow cover formation and its water content. Providing the observing stations and posts with both standard and distance observing instruments to identify the water reserves in the snow.
- Modernization of the telecommunication and computer processing the observing materials.
- Implementation of the calibration flume and other laboratory testing equipment modernization.

In the framework of the WMO Technical Cooperation Program, the CA countries' hydrometeorological services need assistance aimed at:

- Improvement of the equipment to implement observing, communication, and data processing with the use of the most modern technologies;
- Improvement of the software to process meteorological and hydrological data;
- Transfer of hydrological data and software in order to access, use and add the data, from the Roshydromet centralized archive to the national hydrometeorological services;
- Expanding the opportunities to prepare and train staff in regions at regional hydrometeorological training centers and universities;
- International exchange of operational data, hydrological data and cadastre publications, first of all on transboundary water bodies.

MONITORING OF GLACIERS: STATUS, DEFICIENCIES AND NEEDS

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Two major causes determine the need of glaciological monitoring in Central Asia. The first cause is that mountain glaciation is one of the most vivid indicators of climate change. All earth surface heat balance changes and mountainous area summary humidity are directly reflected in the regime characteristics and the glacier mass balance. The fact that the increase of the average annual air temperature by less than 1°C over the past century has been sufficient to cause a decrease of the Central Asian mountains' glaciation by more than one third is important.

The second cause is that glaciers are one of the major water resource formation sources in the region countries. The share of melted glacier water in the region annual river flows is around 30% and more, and their share in the summary river flows during the vegetation period often exceeds 50%.

Regular glaciological observations at the region glaciers started in the late 50-s of the past century under the International Geophysical Year (IGY) work program. It was at that period that complex all-the-year-round glaciological observing was organized at the Fedchenko (the Pamirs), Tuyuksu (The Northern Tyan-Shan), Abramov (Gissaro-Alai), Jankuat (the Caucasus) Glaciers, and annual observations - at Shumsky (Jungar Alatau), Golubin and Karabatkak (the Northern Tyan-Shan) and other Glaciers. At the same period regular field studies of the Pamirs, Gissaro-Alay, Tyan-Shan, Jungar Alatau, Altai and Caucasus glaciations started. The study materials served as a basis for compiling the mountainous countries' Glacier Catalogue, and were summarized in numerous scientific publications and the World Snow and Ice Resource Atlas (1997).

In the early 90-s of the past century field studies practically stopped, observing at the Fedchenko Glacier was broken off, the Abramov Glacier station was burned by Mojaheds in 1998, and regular observing at the Golubin and Shumsky Glaciers stopped. Actually, continuous all-the-year-round glaciological-climatic observations remained only at the Kazakhstan Institute of Geography Tuyuksu Glacier on the Zailiisk Alatau northern slope. It has been the longest (since 1957) all-the-year-round specialized observational series in the whole former USSR area. Just as the Jankaut Glacier, the Tuyuksu Glacier has been included into the Global Glaciological Monitoring, which data are published on a regular basis in a respective bulletin.

With regard to the continuing climate global warming and intensive glaciation reduction in the past years, apprehension of considerable -by 20-40%- water resource reduction in the major water collection basins of Central Asia and Kazakhstan and the related great material losses, has been voiced. Under the region arid climate conditions, such development would inevitably cause the need of the radical water consumption restructuring and provoke the social economic situation aggravation in the region countries, which might threaten the regional security. With this regard knowledge of the contemporary region glaciation dynamics and its forecasts are becoming particularly important.

The most reliable glaciation change assessment over the past decades can be implemented only for South-Eastern Kazakhstan as only for this area glaciers unified catalogue data which have been compiled on the basis of the air-photo materials for 1955, 1972 and 1990 (Dzhunghar Glacier system) and 1955, 1975, 1979 and 1990 (Zailiiskiy-Kungey Glacier system) are available. Comparative analysis of those catalogue data allows making the following conclusions:

1. In the past decades South-Eastern Kazakhstan mountains' glaciation has been in the continuous degradation state. The glaciation area reduction rate has not been constant but its increase has been an overall trend.

2. The glaciation area average reduction rate for 1955 to 1990 for the mostly studied Zailiisk Alatau northern slope area has been 0.92% a year. If this calculation is made on the basis of the glaciers' area indicated in the first catalogue (based on maps 1:100000), the South-Eastern Kazakhstan mountains' glaciation area reduction will be 0.8% a year. This coincides with the similar assessment results for the Pamirs, Western, Central and Internal Tyan-Shan and shows similar glaciation degradation intensity for the whole region – from the Pamirs in the south to Jungar Alatau in the north which makes it possible to use the regularities and quantitative correlations discovered in South-Eastern Kazakhstan for the other mountainous areas of the region.

3. The glacier area reduction rate is mainly determined by glaciers' size. As for glacier exposition and morphological type, their role is insignificant. Dependence of the glacier reduction speed on its surface area has exponential nature, and the threshold is the F= 13-14 km^2 glacier area: when it is exceeded a glacier regime is mainly determined by the area macro-climatic conditions with very limited local factors influence. It is evident, that those are glaciers with an area above the threshold that are mostly interesting for detecting the glaciation - climate correlation system regularities. Unfortunately no observing is implemented at such glaciers presently.

4. Every glacier regime is particularly individual, and it is risky to use a specific glacier glaciological regime for characterizing a regime of other even closely located glaciers. The varieties may be not only significant but have a different sign.

5. The glaciation degradation rate territorial varieties are determined on the one hand by the air temperature background differences, and on the other hand – the orography changes. The southern mountain ridge macro-slopes are characterized by the maximum glaciation degradation speed, and the eastern orographically closed basins and the mostly humid basins at the western outlying districts of mountainous countries which are favorably oriented to relatively domineering direction of the air humidity transfers are characterized by the minimum glaciation degradation rate.

6. The lack of strongly pronounced dependence of the glacier area reduction on their exposition shows the determining role of the advective component in the glacier surface heat balance.

7. The data available provide a basis to believe that small glaciation forms are mostly resistant to the climate change. This makes it possible to believe that even with the contemporary climate change trends, the Central Asian and Kazakhstan mountains' glaciation would last for at least 200 year. Given the cyclic climate fluctuations one can hope that during the current century the region climatic conditions will change for more favorable ones for glaciers' existence.

8. Despite the intensive ice resource reduction, the flow norms during the above-mentioned period have remained sustainable. The annual river flow distribution has not changed either. The average maximum snow water equivalent in the zone of run-off formation snow cover has also remained stable during the past decades.

The cause of the flow characteristics sustainability under the ice resource considerable reduction conditions could be explained by the fact that the compensation mechanism is more and more manifested in the river flow regime: due to the climate global warming, ground ice melted water concentrated first of all in perennial permafrost layer makes most part of the river flow. As the area of the perennial frozen rocks in the Central Asia mountains is much larger than the glacier area, even insignificant melting of perennial permafrost layer in combination with the subterranean ice melted water flow could compensate for the melted water flow losses due to the glacier surface area reduction. So far scientists have not paid attention to this circumstance but given the water resource possible change forecasts, it is worth serious consideration.

According to the study outcomes, more than 50% of the region major river basin snow resource is formed in the alpine zone – above isogypsa 3100-3200 m, which area in various basins makes only 15-35% of the basins total area.

This emphasizes once again the exceptional importance of monitoring the alpine zone glacial sphere as it is here that the overwhelming part of the region snow and ice resource is formed which is the fresh water major renewable source.

Speaking about the glaciological-climatic observing network development in the Central Asia mountains, the need of organizing the alpine zone glacial sphere monitoring should be emphasized which apart from glaciers would include all other ice forms – snow cover, wind and avalanche snow, river ice, ice crust and subterranean ice. It is here – in the alpine zone (300 to 3,200 m above the sea level) - that all the ice and more than 50% of the snow resource is located which is the major source of the region river flows formation.

As for the monitoring organization measures, one has to start practically from nothing: even at the Tuyuksu Glacier full replacement of instruments and equipment is required to say nothing of the need to provide more or less decent conditions for life and work under alpine conditions.

Annex 17

THE PERMAFROST MONITORING NETWORK IN CENTRAL ASIA AS A PART OF THE GLOBAL CLIMATE OBSERVING SYSTEM

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Since 1998, the International Permafrost Association (IPA) has been working with Terrestrial Observation Panel for Climate (TOPC) to develop a global network for permafrost observations. The World Meteorological Organization's Global Climate Observing System (GCOS) and Global Terrestrial Observing System (GTOS) invited the IPA to join them to form a global network of active layer and permafrost sites for detecting, monitoring and predicting changes in climate. The GCOS has identified permafrost as one of the key indicators of climate change (*WMO, 1997*) and initiated permafrost monitoring through the Global Terrestrial Network for Permafrost (GTN-P). The GTN-P is organized and managed by the International Permafrost Association (*Burgess et al., 2001, 2002;* http://www.gtnp.org). The program is officially part of the World Meteorological Organization (WMO) and its Global Climate Observing System (GCOS).

The Council of the International Permafrost Association at its June 1998 Yellowknife, Canada, meetings passed two resolutions to facilitate development of a permafrost monitoring network and service. The GTN-P was established in 1999 to provide long-term field observations of active layer and permafrost thermal state that are required to determine the present permafrost conditions and to detect changes in permafrost stability. Both the EU Permafrost and Climate in Europe (PACE) program and the Circumpolar Active Layer Monitoring (CALM) network are part of GTN-P (http://k2.gissa.uc.edu/~kenhinke/CALM/).

Permafrost measurements are particularly important for determining the long-term terrestrial response to surface climate change. Permafrost monitoring for climate change includes measurements of temperature profiles in perennially frozen ground and the thickness and temperature of the overlying active layer (seasonally thawing and freezing soil). For these purposes a sufficient number of permafrost sites are required to monitor variations in active layer conditions and ground temperatures in near-surface and deep boreholes in major permafrost regions of the world.

Many components of the cryosphere, particularly glaciers and permafrost, are sensitive to climate changes. Modeling results from 21st Century climate-change scenarios predict increased seasonal thawing and movement northward of contemporary ground temperature zones and to higher elevations in mountains (*IPCC II, 2001*). Therefore, we expect a further degradation of glaciers and alpine permafrost with a corresponding shift in landscape processes (*Romanovsky and Osterkamp, 2001; Nelson et al. 2001; Romanovsky et al., 2002*).

While the increase in permafrost temperature may change many of its physical properties, the major threshold occurs when permafrost starts to thaw from its top down. The most significant impacts on permafrost thermal state will be observed near the lower boundary of alpine permafrost distribution, the region where the frozen ground is very sensitive to changes in surface energy balance (*Harris and Haeberli 2003*). In the high-mountains regions near-surface permafrost degradation will probably accompany a transformation in environmental conditions and may lead to slope instability and permafrost-related hazards (landslides, thermokarst, mudflows).

The Central Asian region is the largest area of alpine permafrost in the world. The Central Asian mountains are one of the major sources of fresh water for surface runoff, groundwater recharge, hydropower plants, community water supply, agriculture, urban industry, and wildlife habitat in the region. Central Asia is included in the water-stressed areas where projected climate change could further decrease stream flow and groundwater recharge (*IPCC II, 2001*). The ice-rich permafrost is wide spread within the Tien Shan and Altai Mountains of Central Asia. Permafrost and associated periglacial formations contain large quantities of stored water in the form of ice (up to 50-70%). An approximate evaluation indicates that the quantity of water stored in ground ice in the Tien Shan is comparable with the volume of modern surface glaciation in the same region. Under continuing warming, the melting of ground ice could increase future water supply, and the melt waters from permafrost could become an increasingly important fresh water source in the near future.

The IPA Working Group on Mapping and Distribution Modeling of Mountain Permafrost identified sites and responsible organizations and programs in Russia, China, Mongolia, Kazakhstan and other countries with mountain permafrost (see *Frozen Ground, Number 27, December 2003*; http://www.geo.uio.no/IPA/). Mapping, modeling, and monitoring strategies in mountain regions should be designed for the testing and verification of climate change scenarios. Several areas in Mongolia and Kazakhstan have adequate borehole data for use in calibrating or validating the models at differing spatial resolutions. At present, there are some 30 GTN-P monitoring sites in the high elevations of Kazakhstan, Mongolia and China that are observing active layer thickness/temperature and permafrost temperature (Fig. 1). An additional 20 boreholes within Inner Tien Shan permafrost area could be considered as potential contribution to the GTN-P project.

The systematic investigation of mountain permafrost thermal regime in the northern Tien Shan began in 1973 (*Gorbunov and Nemov, 1978*). A few boreholes within the discontinuous permafrost zone were instrumented with temperature sensors. The permafrost investigations in the Inner Tien Shan during the period 1985-92 were carried out by the staff of the Kazakhstan Alpine Permafrost Laboratory of the Yakutsk Permafrost Institute Russian Academy of Sciences. Data obtained included permafrost temperature records, active-layer thickness, descriptions of cryogenic frozen ground structures, distribution of permafrost, ground ice and periglacial landforms (*Gorbunov et al., 1986*). Ground temperature measurements were carried out in more than 40 boreholes. There are a large number of boreholes within the Inner Tien Shan permafrost area that have historical temperature records. Re-measurements of temperatures in boreholes that were drilled up to 20 years ago using modern techniques are required to assess recent thermal changes and predict the potential future geothermal impacts of climate warming in high elevations of the Central Asian mountains.

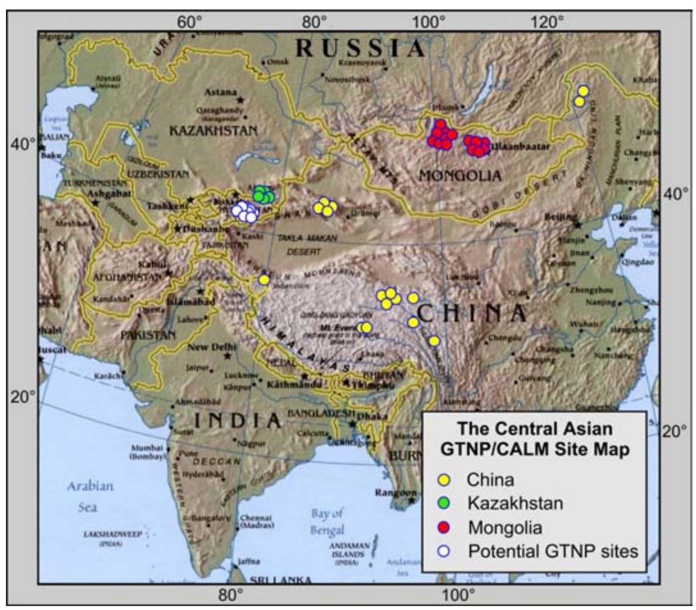

***Figure 1**. The GTN-P/PGTN-P boreholes location within Central Asian Mountain Permafrost Area.*

The climatic regimes during the 20th century and especially during the last two decades had a considerable influence on the contemporary thermal state of permafrost. During the last 30 years geothermal observations in the Tien Shan Mountains, western Mongolian sector of the Altai Mountains, and Qinghai-Tibet Plateau indicate permafrost warming by 0.3°C for undisturbed systems, and up to 0.6°C for those areas affected by human activities. In the northern Tien Shan and Mongolian Altai mountains the average active-layer thickness increased by 25% in comparison with the early 1970s (*Marchenko, 1999, 2002; Jin et al., 2000; Sharkhuu, 2003*).

Analyzes of long-term international permafrost observations in the Northern Hemisphere (*Brown et al., 2000*) showed that climate warming had a profound effect on active-layer thickness in middle latitude sites where high-altitudinal permafrost exist. The long-term permafrost thawing process is accompanied by raise in summer, winter and mean annual air temperatures, and also by changes in hydrology due to deeper penetration of subsurface runoff and summer precipitation.

Geothermal investigation of high mountain permafrost is the research field of great relevance, because of its linkage to climate change and hazard assessment. A standard mapping and classification program across the national boundaries is required to significantly improve knowledge of the occurrence and changes in mountain permafrost due to natural and human-induced. For the permafrost borehole network, the long-term observations of temperatures in boreholes within mountain regions of Central Asia are required. The locations for these observations should be selected according to the known or predicted occurrence of permafrost. The selection should be based on existing maps or models that predict distribution of permafrost. Currently, a regional permafrost map of Central Asia is in preparation by an international team of experts (*Gravis et al., 2003*). These and other new initiatives must continue, but to be successful they require additional or new national and international financial support.

Recommendations for further actions that could be proposed:

- Continue and expand the Central Asian permafrost network and equip existing boreholes with modern sensors and loggers and establishing new sites (without borehole drilling process) for monitoring near-surface ground temperature regime at different altitudes and landscapes. Re-measure temperatures in boreholes that were drilled up to 30 years ago and comparing results with the historical temperature records.
- Develop a database and continue its improvement by combining the collection and analysis of long-term instrumental observational data with the data on spatial distribution of permafrost, ground ice and glaciation.
- Combine the efforts of climatologists, glaciologists and geocryologists in the joint investigation of climate, glaciers and permafrost changes in the Central Asian region. Develop a joint regional program for the investigation of relationships among climate change, recent glacier retreat, and permafrost warming and degradation.
- Assess the ground-ice volume and the role of melt waters from thawing permafrost in the future water supply to the Central Asian region.
- Initiate compilation of alpine permafrost and ground-ice conditions map over the Tien Shan, Pamir and Altai mountains of Central Asia, using existing geomorphic, hydro-meteorological, geocryological, and borehole data and aerial and satellite images.

Expected results:

- Recent changes in permafrost thermal regime in the Central Asian Mountains will be assessed in a quantitative manner. The Central Asian permafrost-monitoring network will be incorporated into a GIS and established as a part of the WMO/GCOS GTN-P database.

- Basic regularities in the interaction between surface glaciation, permafrost dynamics and runoff in the Central Asian mountain area will be revealed. This knowledge will allow development of reliable glacier-permafrost related hazard assessment and vulnerability of high mountain landscapes to climate change within the Central Asian region.
- Assessments of ground-ice volume and its role in the future water supply provides an opportunity to elaborate on a reliable plan for the adaptation to future water-stressed problems of Central Asia.
- Produce a permafrost and ground-ice distribution map over the Central Asian mountains as an updated supplement to the IPA circum-Arctic permafrost and ground-ice map (*Brown et al., 1997*).

During the Eighth International Conference on Permafrost, Zurich, July 2004, the IPA Council passed two resolutions (*Frozen Ground, Number 27, December 2003*) related to permafrost responses to climate changes. These includes: 1) continuation and expansion of the IPA-coordinated, GCOS/GTOS Global Terrestrial Network-Permafrost (GTN-P) monitoring programme including CALM, PACE, and other networks; 2) examination of the development of a unified approach to the definition of permafrost and delineation of permafrost boundaries at various spatial resolutions and scales (for past, present, and future climate scenarios); 3) mapping of existing permafrost and ground-ice conditions and monitoring of changes at regional and continental scales (including mountains). Several of the IPA activities over the next four years will contribute to activities of the International Polar Year (IPY), the IUGS International Year of Planet Earth, and the WMO/WCRP Climate and Cryosphere (CliC) programs. By employing the GTN-P, the IPA is proposing a coordinated borehole thermal measurement campaign during the IPY (2007-2008).

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Annex 18

GENERATING DETAILED SCENARIOS OF CLIMATE CHANGE

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Introduction

In order to investigate the impacts of climate change, and plan adaptation to it, all countries need to have estimates of how their climate will change in the future, in the form of scenarios. The only tool we have for predicting change, representing all components of the climate systems, atmosphere, ocean, cryosphere, land surface etc., and the relevant interactions and feedbacks between them, is the global climate model (GCM). In order to run global models even on the largest of supercomputers, the models generally have a resolution of some 300km square, and the predictions from them are not detailed enough to use directly to study impacts and adaptation. Over a distance of 300km there can be great changes in the terrain, such as mountains and coastlines, the effect of which is not adequately captured by global models. Hence we need to be able to downscale the global predictions to give a greater detail over individual countries in order for them to be useable.

Regional Climate Models

The most robust form of downscaling GCM predictions is the use of a regional climate model (RCM). This is a full physical climate model very similar to a GCM, containing the same representations of the climate system, but at a much higher resolution – typically 50km or 25km. Because of computer limitations it can only be run over a limited area ("domain"), typically 5000km x 5000km (about the size of Australia). It is "nested in" (or "driven by") predictions from a global model, and therefore carries any uncertainty in the GCM predictions. Predictions from RCMs have substantial advantages for impacts studies, viz:

- they show greater geographic detail
- they take account of smaller-scale terrain features such as mountains and coasts
- they resolve smaller-scale weather features such as cyclones
- their representation of current climate is much better than in GCMs
- climate extremes simulated in RCMs are much closer to those observed than simulations in GCMs, and hence changes in extremes will be better predicted.

The Hadley Centre PRECIS regional climate model

In the past, RCMs have required supercomputers or large workstations to run on, and this has generally limited their availability to developed countries. Over the last few years the Hadley Centre RCM group has ported its current regional climate model to work efficiently on a PC, and made it possible for the user to set up the RCM area over anywhere in the world. A straightforward User Interface has been provided, together with analyses and graphical software. The whole system is known as PRECIS; Providing REgional Climate for Impacts Studies. With funding from UK ministries (Defra, Dfid and FCO) and from UNDP, the model is being made freely available to government and related institutes in developing countries.

To run PRECIS, users require a fast PC (the faster the better) with adequate memory and hard disk capacities, a digital tape drive with which to input global data and to store RCM output data. On a 3GHz PC, with a typical setup (50km resolution; 5000km x 5000km domain), PRECIS will run for 10 model years in about 1 month. PRECIS can also incorporate a full sulphur cycle, allowing prediction of aerosol cooling from sulphur dioxide emissions, with an increase of about 50% in run times.

Using PRECIS

To generate climate change scenarios using PRECIS involves ideally running the regional climate model to make a simulation of climate over the period 1961-1990 (the current WMO reference period) and then running to make a climate prediction over a future period (generally 2071-2100) under a particular scenario of future emissions (most commonly the IPCC SRES A2); the basic climate change scenario is the difference between these two. Running the model for as long as 30 years in each case is not essential; 10 years may be sufficient to make an initial estimate of changes in average climate although uncertainty in these estimates due to the effect of natural variability will be larger and little information on changes in climate extremes will be available.

Climate change scenarios for other emissions (for example, SRES A1F1 or SRES B1) or other time periods (for example 2041-2070) can be generated from a single climate change scenario (typically the 2071-2100 SRES A2) by scaling changes by the global temperature predicted by the GCM for the other time periods and emissions. It is normal practice for the climate change scenario to be added to a baseline observational data set (for example, 1961-90) to give the scenario of future climate, rather than using the model predictions directly.

The need for observational data

It is important to validate the model over the area of interest, which can be done in two ways:
(a) by comparing the 1961-90 model climatology with observational data for the same period (both seasonal means and distributions/extremes) and
(b) by carrying out a run of the model driven by a re-analysis of global observations, such as that compiled by the European Centre for Medium Range Weather Forecasting (ECMWF) and known as ERA15 (and recently updated and extended to ERA40), and comparing the RCM output with day-to-day or month-to-month observations.

Validation allows users to assess the reliability of the model, for specific outputs (eg precipitation) and in different regions; it is therefore important in estimating confidence in the predictions. In order to be able to carry out the validation, it is critical that countries maintain and extend national climatological observations, to GCOS standards. A good observational data base is also required to provide the baseline climate of the country (for example, over 1961-90), to which the PRECIS prediction of climate change can be added to form a climate scenario for a future period.

Uncertainties in climate scenarios

The PRECIS system will provide users with a detailed climate change scenario which can be used to investigate impacts. However, it is important the uncertainties in the scenarios are fully understood, so that adaptation can be properly designed to reflect these. The first uncertainty arises from our lack of knowledge of future emissions; this can be taken into account by developing scenarios for a wide range of SRES emissions profiles (for example, A1FI to B1). The second uncertainty is associated with our incomplete understanding of the climate system and our inability to model it perfectly – so called "science" or "modelling" uncertainty. This can be quite large in some regions of the world, as shown in the IPCC Third Assessment report. We can scope the modelling uncertainty by using global fields from a number of GCMs to drive the PRECIS RCM; currently PRECIS can accept the Hadley Centre GCM and soon will be able to accept fields from the German ECHAM4 model. In a few years we aim to have probabilistic GCM predictions to use with PRECIS.

The remaining uncertainty in scenarios is that due to natural variability of the climate system; we do not know if natural variability will act in the same direction as human-made climate change in a particular future period and location and hence accentuate it, or act in the opposite direction and hence reduce its effects. This uncertainty can be quantified by running the global model a number of times with different initial conditions, and driving the PRECIS RCM with each of these global predictions. It is clear from the above that, several experiments with PRECIS will be required in order to take account of these uncertainties, and it is more efficient for the work to be done in a collaboration between several countries, and the model domain chosen to include these countries.

Training for PRECIS users

In order to ensure that PRECIS is used in the most efficient way, but also to ensure that all the uncertainties in scenario generation are properly understood and appreciated, the model will be made available together with a week-long training course, ideally involving users from several neighbouring countries. This has already been done for users in India, China, West Africa (through ACMAD) and Southern Africa, Central America and the Caribbean. In 2004, courses will be run in Bhutan (for several countries on the Indian sub-continent) and Sao Paulo (for several South American countries). We would like to plan further courses in 2005 with groups of countries in other parts of the world.

Using PRECIS predictions

We believe that regional climate models such as PRECIS can provide useful information on future climate change, with clear advantages of corresponding GCM predictions, whilst always bearing in mind the uncertainties inherent in GCMs. The use of PRECIS by local centres of expertise will give national ownership of the scenarios. The scenarios can then be used:

(a) in publications, to effectively raise national awareness of climate change as an issue
(b) in National Communications to the UNFCCC
(c) to feed into models which estimate the impacts of change on agriculture, water resources, infrastructure, etc.

Hence PRECIS, used in conjunction with impacts models, will aid choice of efficient adaptation, through the process of mainstreaming climate change in planning by governments and businesses.

Annex 19

THE WMO SPACE PROGRAMME

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Recent activities within the World Meteorological Organization culminated at the Fourteenth WMO Congress held in Geneva in May 2003 in the establishment of a new major WMO Programme, the WMO Space Programme. Several key factors led the WMO Congress to establish the WMO Space Programme including the convening of Consultative Meetings on High-level Policy on Satellite Matters. The purpose of the Consultative Meetings was to enhance the dialogue between WMO and the heads of all environmental space agencies with the potential to contribute to the World Weather Watch's (WWW) Global Observing System (GOS). After only three sessions of the Consultative Meetings, the WMO Executive Council agreed to expand the space-based component of the GOS to include appropriate Research and Development (R&D) space missions to complement the existing mainstay operational meteorological satellites.

The WMO Space Programme is a major crosscutting Programme that will increase the effectiveness and contributions from satellite systems to the development of the WWW's GOS, as well as to other WMO-supported Programmes and associated observing systems (GAW, GCOS, WCRP, WHYCOS and GOOS) through the provision of continuously improved data, products and services, from both operational and R&D satellites, in order to facilitate and promote their wider availability and meaningful utilization. In addition, the Space Programme will coordinate the WMO requirements for environmental satellite data and products, facilitate cooperation between WMO and the satellite operators, and strengthen Members' capabilities to receive and effectively use satellite data. The WMO Space Programme Strategy, nominally covering the period 2004-2011, is intended in particular to identify the role the satellite operators could play in better implementing the WMO Space Programme. Because of the long lead-time required for initiating new operational satellite services, the Strategy also covers an extended period - up to 2015.

Status of the space-based sub-system of the WWW's Global Observing System

The space-based sub-system of the WWW's GOS is now comprised of three types of satellites: operational meteorological polar-orbiting and geostationary, and environmental Research and Development (R&D) satellites. With regard to meteorological satellites, both polar-orbiting and geostationary, they continue to prove invaluable to WMO NMHSs through the provision of a multitude of services including imagery, soundings, data collection and data distribution.

In particular, the present operational meteorological satellites included the following geostationary and polar-orbiting satellites: GOES-9, GOES-10, GOES-12, NOAA-16 and NOAA-17 operated by the United States; GMS-5 operated by Japan; METEOR-3M N1 and METEOR-3 N5 operated by the Russian Federation; Meteosat-5, Meteosat-7 and Meteosat-8 (former MSG-1) operated by EUMETSAT; FY-2B and FY-1D operated by China. Additional satellites in orbit or in commissioning included GOES-8, GOES-11, NOAA-11, NOAA-12, NOAA-14 and NOAA-15 operated by the United States, GOMS N-1 operated by the Russian Federation, Meteosat-6 operated by EUMETSAT, FY-2A and FY-1C operated by China.

It should be noted that most space agencies contributing operational polar-orbiting and geostationary satellites have in place contingency plans for satellite systems that guarantee the continued daily flow of satellite data, products and services WMO Members have come to depend on. In this regard, Japan and the United States of America initiated a back-up operation of GMS-5 with GOES-9 on 22 May 2003.

With regard to R&D satellites, NASA's Aqua, Terra, NPP, TRMM, QuikSCAT and GPM missions, ESA's ENVISAT, ERS-1 and ERS-2 missions, JAXA's ADEOS II and GCOM series, Rosaviakosmos's research instruments on board ROSHYDROMET's operational METEOR 3M N1 satellite, as well as on its future Ocean series and CNES's JASON-1 and SPOT-5, are all now part of the R&D constellation.

The WMO Space Programme establishment

In response to the momentous expansion and in recognition of the increased responsibilities for WMO, the fifty-fourth session of the WMO Executive Council in June 2002 agreed to establish a WMO Space Programme as a matter of priority. The Council requested that the scope, goals, objectives and long-term strategy of the new WMO Space Programme respond to the tremendous growth in the utilization of environmental satellite data, products and services within the expanded space-based component of the WWW's GOS that now include appropriate R&D environmental satellite missions. In May 2003, the Fourteenth WMO Congress supported the WMO Space Programme Long-term Strategy and agreed that the main thrust of the WMO Space Programme Long-term Strategy should be:

> *"To make an increasing contribution to the development of the WWW GOS, as well as to other WMO-supported Programmes and associated observing systems (such as AREP's GAW, GCOS, WCRP, HWR's WHYCOS and JCOMM's implementation of GOOS) through the provision of continuously improved data, products and services, from both operational and R&D satellites, and to facilitate and promote their wider availability and meaningful utilization around the globe."*

In recognition of the critical importance for data, product and services provided by the WWW's expanded space-based component of the GOS to WMO Programmes and supported Programmes, and that such importance would continue to expand rapidly, the Fourteenth WMO Congress decided to initiate the WMO Space Programme as a major crosscutting Programme to increase the effectiveness and contributions from satellite systems to WMO Programmes.

The WMO Space Programme long-term strategy

The main purpose of the WMO Space Programme is to coordinate environmental satellite matters and activities throughout all WMO Programmes and to give guidance to these and other multi-sponsored programmes on the potential of remote sensing techniques in meteorology, hydrology and related disciplines, as well as in their applications. The overall objectives of the WMO Space Programme are:

(a) To contribute to the development of the WWW's GOS, through the full participation of WMO Members, as a composite system comprised of surface and space-based components, with a primary focus on matters related to both operational and R&D environmental satellites;

(b) To encourage and facilitate the evolution of the WWW's GOS by taking advantage of advances and improvements made possible by WMO Members;

(c) To promote high-quality satellite-related continuing education to keep the knowledge and skill of Members' operational and scientific staff up-to-date with the latest technological innovations, and to provide the competence and skills needed in related fields, such as communications with users.

(d) To review the space-based components of the various observing systems throughout WMO Programmes and WMO supported Programmes, e.g., WWW's GOS, AREP's GAW, GCOS, HWR's WHyCOS, JCOMM's implementation of GOOS, etc., with a view towards the development of an integrated WMO global observing system that would encompass all present observing systems.

The lead responsibility for the WMO Space Programme has been assigned to the Commission for Basic Systems (CBS), with the WMO Consultative Meetings on High-level Policy on Satellite Matters providing expert advice and guidance and maintaining a high-level policy overview of the Programme.

Education and training

In conformity with the recommendation of the Executive Council, additional emphasis will be placed on education and training in satellite matters, especially for data and products from R&D satellites. The aim will be to assist capacity building such as to become an important element in achieving sustainable development. Building on the WMO Strategy for Education and Training in Satellite Matters, and the success of the more recent Strategy to Improve Satellite System Utilization, it is intended to intensify efforts in this field. Increasing the ability of members to exploit the new data streams, products and services is a keystone of the WMOSP Strategy. To this end, and initially focusing on the six specialized "centres of excellence", close links will be maintained with the various national and international education and training initiatives.

Implementation activities 2004-2007

Implementation of the WMO Space Programme relies upon Members' efforts to improve the utilization of satellite systems through the provision of information, advice and guidance on technological developments, as well as on changes in existing meteorological and hydrological observing systems. Members also will play the major role in the transition of low-resolution imagery satellite services from analogue to digital. The Secretariat will assist Members in these activities. Specifically, in the transition of low-resolution imagery satellite services from analogue to digital the Secretariat will:

(a) Coordinate with space agencies to articulate the requirements of Members and to keep apprised of space agencies' plans;
(b) Ensure distribution of appropriate information to Members through various communication media (e.g., mail, Internet, constituent body meetings);
(c) Coordinate the establishment of Members' satellite service requirements and workstation standards.

Satellite Observations for Climate

Space based observations are essential and have impacts for climate monitoring and climate research activities. For climate research, the value of space missions comes mostly from the capability to produce globally integrated, high quality, reliable data products requiring merged analysis of measurements from the whole constellation of operational and research/demonstration earth observation satellites, complemented and validated by data from in situ observing networks. The WMO Space Programme, together with CEOS, maintains the database, which contains information on such things as user observational requirements, space agency missions, instruments on a mission, and parameters observed by space/surface based instruments. WMO publishes handbooks as well as makes information available on its website.

Annex 20

MOBILIZATION OF RESOURCES FROM DONORS FOR FINANCING GCOS REQUIREMENTS IN CENTRAL ASIA

Jim Williams, Independent Consultant

Summary

The objective of this workshop in Almaty is to address the need for improvements in observing systems for climate in Central Asia. One output is likely to be an Action Plan for sustaining the regional Climate Observing System in Central Asia. Within this context, the purpose of this document is to help inform efforts towards mobilizing resources to meet identified priority needs in Central Asia. It seeks to identify propitious opportunities and provide context so that partners in countries of Central Asia might best ‘position themselves’ to take advantage of these possibilities.

In essence this presentation seeks answers to three basic questions.

Q 1. Are flows of international development assistance sufficiently large in Central Asian countries, to be worth seeking for GCOS objectives?

Q 2. Which financing organisations and development partners would be most likely to provide support to address climate observing system needs in Central Asia?

Q 3. What strategies might be most successful in approaching these organisations towards obtaining support for GCOS purposes and allied institutions?

Outline Response to Questions

Q 1. Aid Flows: Quantities in perspective: Are flows of international development assistance sufficiently large in Central Asian countries, to be worth seeking for GCOS objectives?

The world’s total aid to Central Asia is significant, particularly for the poorer countries of the region. However, there is considerable variability in the distribution of development finance between countries, as shown in the rows 11 and 12 of Table A???? Much of the assistance is still directed towards structural reform. Thus the answer to Question 1 is: **Yes, probably, particularly for the least rich countries**.

Q 2. Which financing organisations and development partners would be most likely to provide support to address climate observing system needs in Central Asia?

Examination of the rest of Table A, that shows the top 10 funding sources for each country, suggests a first list of donors active in many countries in the region, that might be worth approaching for GCOS.

Answer to Q2: From this rather crude analysis, the most promising sources of donor finance for GCOS Central Asia purposes would appear to be Japan, USA, IDA, Germany, and EC, in that order.

Q 3. What strategies might be most successful in approaching financing agencies towards obtaining support for GCOS purposes?

This is a much more difficult question and one which demands clear definition of needs and better understanding of the position and priorities of each donor (detail in Table B) and the environment in which donors function.

Japan: The Japanese International Cooperation Agency JICA, is currently undergoing a major reorganisation. Previously it worked with the five nations of Central Asia viz Uzbekistan, Kazakhstan, Kyrgyzstan, Turkmenistan, and Tajikistan, and the three nations of Azerbaijan, Armenia, and Georgia in Caucasia. At the moment the JICA web site is not sufficiently up to date to be useful. Japan is however a partner country in this region of GCOS, and could be a most useful development partner to assist the weaker countries in an area of common concern.

USA: USAID is well aware of the critical importance of the water sector and is already working there on in improving measurements in the Kyrgyz Republic. The rest of their programs have strong economic, democratic and social aims.

World Bank are fully aware of the importance of the water resources sector in this region but work through loans.

Germany: With several regional programs in Central Asia and a developing climate protection program, Germany is an interesting possibility for discussions with GCOS.

European Commission: the EC with its liking for regional scale activities and developing interests in helping partners with adaptation to climate change would also appear worth exploring.

The above options will be elaborated in the presentation, in the context of:

- The changing donor scene: the Organisation for Economic Cooperation and Development (OECD) and the Donor Assistance Committee (DAC).
- Significance of the Millennium Development Goals and Development Assistance Targets (towards which 40 % of ODA is already committed)
- The tendency towards fewer larger projects with more inter-collaboration
- More emphasis on aid effectiveness
- The merits of several national projects or one regional project linked to Regional networks and institutions,
- How to make partner institutions more pertinent to national development priorities and more attractive to donor funding.

It is expected that the information in Table B will be supplemented at the workshop with local knowledge from people in the region, to prioritise donor suitability even further.

Table 1: Flow of Official Development Assistance in $ millions, along with the top 10 funding sources for the 12 countries in Central Asia. (Data for year 2002 from OECD)

Country	Armenia	Azerbaijan	China	Georgia	Kazakhstan	Republic of Korea	Kyrgyz Republic	Mongolia	Russian Federation	Tajikistan	Turkmenistan	Uzbekistan
GNI <	**1000**	**1000**	**(1000)**	**1000**			**500**	**500**		**500**		**500**
1	US 96	Japan 121	Japan 1202	US 114	US 65	Japan 63	AsDF 43	Japan 83	US 813	US 59	Arab C 18	US 63
2	IDA 61	USA 46	Germ 281	IDA 61	Japan 38	Germ 14	US 40	AsDF 29	EC 106	IDA 22	Japan 14	Japan 36
3	EC 20	IDA 42	IDA 259	IMF 32	Spain 12	Franc. 11	IDA 30	Germ 24	Germ 59	EC 21	US 13	Germ. 18
4	Germ.18	EC 18	France 79	Germ 21	Germ. 11		Japan 16	IDA 19	Israel 42	Japan 16	EC	Korea 10
5	IMF 13	IMF 10	UK 58	EC 17	Korea		IMF 15	US 17	UK 40	IMF 13	Turkey	Israel
6	Japan	Germany	Spain 46	Japan 17	EC		EC 12	Korea 10	Swed. 32	AsDF	UNICEF	EC
7	Nether.	Arab Ags	Arab c 39	Netherl	Israel		Switzer	Norway	Norway	Germany	Germany	AsDF
8	France	Arab Cs	Montreal Proto. 36	UK	Arab C		Germany	Arab C	France	Switzer	UNHCR	Arab C
9	IFAD	Turkey	Netherlands	UNHCR	EBRD		Arab A	EC	Canada	Arab A	EBRD	Spain
10	Norway	UNHCR	EC 27	Arab C	Arab A		UK	UNTA	GEF 15	UNDP	UNDP	France
11 ODA $m	293++	349++	1476 =	313=+	188=	neg	186=-	208=	1 301=	168=	41-	189=
12 Aid/GNI	12%	6%	0.1%	9%	0.8%	0%	12%	17%	0.4%	14%	0.5%	2%
13 GNI	790	710	940	650	1510	9 930	290	440	2 140	180	1 200	450
14 Pop millions	3	8	1281	5	15	48	5	2.4	144	6	5.5	25
15 Sector						90% edu						

Notes: Source: OECD data from year 2002: Afghanistan and North Korea not on participant list.

Top 5 donors (covering all sectors) appear to be: Japan, USA, IDA, Germany, EC

Asia Development Bank: remarkably little: World Bank =IDA, IMF =**SWAF & ISAP ????,** Arab A = Arab Agencies, Arab C = Arab Countries.

TABLE 2: Donor Interests and Activities

Development Partner	JICA	USA	WB/IDA	Germany	EC	Comments
Strategic 1	In Central Asia and Caucasus 1) support for the market economy; 2) infrastructural development 3) cooperation with social sectors 4) conservation of the environment.	WATER SECTOR: to improve the capacity for water management by:(1) upgrading data monitoring systems for water allocation decisions and (2) new knowledge training courses in water management.	Water Resources Management: Integrated multi-disciplinary approach	Several regional programmes Wheat growing Legal Reform Vocational Training Desertification: UNCCD	Tacis (technical assistance), ECHO (humanitarian assistance), macro-economic assistance and the Food Security Programme. Plus the benefits of greater regional co-operation	
Strategic 2		market economy and true democracy	market economy and true democracy	Also well Developed Climate Protection Program	Developing Climate Change Adaptation Program	
Armenia	Japan (private sector development and technical assistance),	Multiple mostly social	Irrigation	private sector, small enterprise dev. Infrastructure, public admin. and education.		Aid is very high aid compared with other investments and as proportion of GDP
Azerbaijan		restructure private sector especially in the agricultural sector	Irrigation			Donor programs tend to be small and active in refugee relief.
Georgia		energy security, agricultural business development, and micro-finance	Irrigation, and energy municipal infrastructure, and institution building			
Kyrgyz Republic		upgrading weather and water resources data-collection systems; and training in water management decisions, both national and trans-	Irrigation	high-level policy advisory services establishment of an - organized financial system, promotion of SMEs, and vocational training		No oil: dependant on local hydropower

		boundary level and for hydropower				
Mongolia	Japanese Programs cover a wide range of areas , including infrastructure and education	Judicial reform is the single largest program	Sustainable livelihoods	protection and conservation of natural resources, including control of desertification and forest fires		Desertification
Tajikistan		USAID focuses on improving the capability of Tajik water authorities to better collect, analyze, and transmit critical water data that will lead to more accurate and appropriate water allocations and improved efficiencies in water use.	Irrigation	Mainly regional inputs		
Uzbekistan		WATER SECTOR: Uzbekistan consumes up to 65% of Central Asia's water resources, mostly irrigation…a key link to improve water management on all levels in Central Asia, including trans-boundary rivers	Irrigation	to promote small-scale enterprises to promote exports to establish an Uzbek development bank to train auditors and to support the Uzbek supreme commercial court		
		Big AID water initiative in Kazakhstan also	*The Aral Sea Basin-Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan have some of the largest irrigation schemes in*			

			the world, involving some 22 million people. Without irrigation, much of the land would gradually revert to desert scrub			
		Is a program but 'Regional cooperation is largely rhetorical'	Risk management? Contingency decisions?			
Development Partner	**JICA**	**USA**	**WB/IDA**	**Germany**	**EC**	**Comments**