J7.11A An Update on the Status of the U.S. Global Climate Observing System (US-GCOS) Program

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1. INTRODUCTION

The international 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 cosponsored by the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC) of United Nations Educational Scientific and Cultural Organization (UNESCO), the U.N. Environment Program (UNEP) and the International Council of Scientific Unions (ICSU). GCOS is intended as 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, modeling 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. More Information on the international program can be found at http://www.wmo.ch/web/gcos/gcoshome.html

2. BACKGROUND OF THE U.S. GCOS PROGRAM

The United States (U.S.) has been involved with GCOS since its inception. Since 1992, a considerable amount of work has been done by various federal agencies. In particular, federal agencies have supported the international GCOS Steering Committee, and the work of the GCOS data, space, and science panels, as they have engaged in planning GCOS, defining its requirements, and contributing parts of the initial system. NOAA's National Climatic Data Center (NCDC) in Asheville, North Carolina, supports a number of GCOS data management activities. A national GCOS program has begun to emerge over the past two years. In November 1999, a full-time national GCOS program manager position was established and filled by NOAA/NESDIS to manage the national program. The primary focus of this position is to coordinate the development of a national GCOS program that involves all U.S. federal agencies with a role in climate observing and monitoring. Those agencies include all of NOAA's line offices, the National Aeronautics and Space Administration (NASA), the National Science Foundation (NSF), the U.S. Departments of Energy and Agriculture, the Environmental Protection Agency, and the U.S. Geological Survey. As part of this effort, a national GCOS Coordination Group was formed in January 2000 to aid in the various aspects of the national GCOS program. The initial focus of the group was the production of a national report detailing the current state of the various components of GCOS in the U.S.

3. U.S. NATIONAL GCOS REPORT

In November 1999, the United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP-5) directed all Annex I industrialized nations (reference the following link for a list of Annex I nations http://www.unfccc.int/resource/natcom/nctable.html) to prepare detailed reports on systematic observations in time for the October 2001 meeting of the UNFCCC Conference of the Parties. The UNFCCC directed the GCOS Secretariat at the WMO in Geneva, Switzerland, to be involved in the preparation and eventual adequacy assessment of the global climate observing system. As such, the U.S. State Department assigned the task for preparing the U.S. national report to the GCOS program coordinator at NOAA.

The U.S. report on systematic observations (also known as the U.S. GCOS Report) delineates climate monitoring in the U.S. in five distinct yet integrated areas: (1) *in-situ* atmospheric observations; (2) *in-situ* oceanographic observations; (3) *in-situ* terrestrial observations; (4) satellite based observations, which by their nature cut across the atmospheric, oceanographic, and terrestrial domains; and (5) data and information management related to systematic observations.

Actual work on the national report was begun in November 2000 with the establishment of four writing groups as follows: (1) atmospheric observations headed up by Russell Vose of NCDC; (2) oceanographic observations headed up by Steve Piotrowicz of NOAA's Ocean and Atmospheric Research line office; (3) terrestrial observations headed up by David Clark of NOAA's National Geophysical Data Center; and (4) satellite observations headed up by Robert Schiffer of NASA. The data and information section of the report, as well as the overall coordination of the format and content of the report were handled by

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the author of this paper in his role as U.S. national GCOS Coordinator.

The report was finalized and made available to the U.S. State Department in August 2001 for transmission to the UNFCCC Secretariat. The full report as well as a summary of the report are available in Adobe PDF format at the U.S. national GCOS home page at http://www.eis.noaa.gov/gcos.

4. INTERNATIONAL COORDINATION

In addition to the requirement for national reports on systematic observations, the UNFCCC at its 1999 meeting invited the GCOS Secretariat to continue to assist with and facilitate the establishment of an appropriate intergovernmental process that would identify potential improvements in the global observing system for climate and set priorities for acting on those improvements. As such, the U.S. GCOS program has been one of the leaders in this effort.

The Australian Bureau of Meteorology (BOM) took the lead in the international coordination of GCOS by hosting an informal meeting of national GCOS coordinators primarily to discuss a common format for national GCOS reports but also to recommend an intergovernmental process for GCOS. As a result, the first national GCOS coordinator's meeting was held in Melbourne, Australia, at the BOM from August 9-11, 2000 with representatives from Australia, Finland, Germany, the Netherlands, New Zealand, Sweden, and the U.S. participating. Other national GCOS focal points were invited but, while they expressed interest, were not able to attend. The main topic of discussion and work centered on developing a supplemental format for the national GCOS reports that will be due at COP-7. The outcome of that meeting was very successful. Not only did the national coordinators come up with a standardized supplementary format for the national reports that will be a tremendous aid to the GCOS Secretariat in assessing the adequacy of the global climate observing system, but it also began an extremely positive dialog among GCOS programs in various countries that has been beneficial to all.

While the U.S. had offered to host the next such meeting in the May/June 2001 time frame at the NCDC in Asheville, NC, the finalization of the national GCOS reports as well as other activities made that meeting difficult to arrange. The U.S. is still interested in hosting such a meeting in the future, but the next informal meeting of national coordinators will take place at the venue of the next UNFCCC COP meeting in Marrakech, Morocco, in October 2001.

The U.S. has also been supportive of regional workshops for developing countries called for at COP-5. The first such workshop was held in Apia, Samoa, from August 14-15, 2000. A subsequent meeting has been planned for the writing of an action plan, involving the nations of the South Pacific, for a plan for improving sustained climate observations in that region under the auspices of GCOS. In addition, the U.S. national coordinator is a member of the GCOS Regional Workshop Advisory Committee (RWAC). The purpose of the RWAC is to advise the GCOS Secretariat on the program of regional workshops they are developing over the next few years. The next GCOS regional workshop will take place in Kenya from October 3-5, 2001, and a third regional workshop for the Carribean Basin is being planned for the Spring 2002 timeframe.

5. GCOS MONITORING AT NCDC

In September 1999, the Secretary General of the WMO issued a request to all member states with GCOS Surface Network (GSN) stations to submit historical daily and monthly CLIMAT-formatted data from their GSN stations to the NCDC. The GSN is a global network of 989 surface weather observation stations that were selected based on a number of parameters (Peterson et al 1997). To date, NCDC has received historical GSN data and metadata on 250 stations from 28 nations. A number of countries, certain to send in their data, have not done so yet. The expectation is that the number of nations submitting data will soon rise. Unfortunately the data is being received on a variety of media and in a variety of formats not in accordance with the original WMO request. In addition, not all requested data parameters are being consistently provided. This has precipitated the need for NCDC to formulate new procedures for processing and archiving the data. The U.S. GCOS Program Manager has forwarded specific GSN data formatting problems to the GCOS Secretariat at the WMO. NCDC is creating an inventory of the historical data received; collecting current daily and monthly data; entering that into a data base; and developing a web access to produce both flat files as well as graphs of Yearly Mean Temperatures and Yearly Precipitation Total. This data is publicly available on the Internet at http://lwf.ncdc.noaa.gov/servlets/gsn.

NCDC's monitoring is done in conjunction with the two GSN Monitoring Centres located at the Deutscher Wetterdienst (DWD) in Offenbach, Germany, and the Japan Meteorological Agency (JMA) in Tokyo, Japan. DWD and JMA began operational monitoring and quality control (QC) of CLIMAT-formatted GSN data beginning with the data for January 2000. Currently, DWD provides the monitoring information and JMA provides the QC information (precipitation QC is provided by the DWD's Global Precipitation Climatology Centre), along with the complete exchange format for transmittal to NCDC. Upon approval, the two GSN Monitoring Centres plan on sending monthly data to NCDC for archival and dissemination via World Data Center-A on a routine basis, approximately 6 weeks after the end of a data month. The GSN Monitoring Center can be accessed on the Internet at http://www.dwd.de/research/klis/gsn_mc/

The GCOS Upper Air Network (GUAN) is a global network of 150 upper air stations. While no official GCOS-sponsored GUAN has been received at NCDC to date, a considerable amount of GUAN data already exists at NCDC from previous efforts such as the Comprehensive Aerological Reference Data Set (CARDS) project. The various organizations' activities are still in their formative stages, with formal endorsement of the respective roles of NCDC, the Hadley Centre, and the European Centre for Mid-Range Weather Forecasting still to be determined.

Finally, NCDC is continuing work on the development of a system of performance indicators to which a user can pose relatively complex questions about observing systems. These include not only in-situ systems such as the GSN and GUAN, but also remote sensing systems. Seven basic types of performance indicators have been identified: (1) number of observing platforms; (2) spatial coverage; (3) length of record; (4) data completeness; (5) data quality; (6) timeliness of receipt; and (7) homogeneity. The project has started with the GSN and GUAN stations. The system will be web-based and will be powered by Geographic Information System (GIS) software. The goal of this project is to provide observing managers with the ability to monitor the health of their networks, to remedy deficiencies in a timely manner, and to answer a variety of complex queries that present the information in a variety of formats (i.e., graphs, tables, and maps). This system will aid in the monitoring of GCOS information to ensure that high quality controlled data necessary for climate studies are available to the end-users.

6. NATIONAL ISSUES

Since the report made on GCOS at the AMS Meeting in January 2001, considerable progress has been made in developing a coordinated U.S. national GCOS program. Many of the issues raised last year are in much better shape For the atmospheric program, in addition to the GSN and GUAN, other national networks such as the NWS's Cooperative Observer Network; NCDC's new Climate Reference Network; NOAA's atmosphere flask sampling network; as well as the Department of Energy's radiation monitoring have been better addressed. The diverse set of terrestrial observing is much better coordinated with GCOS. Since last year a national GCOS web page has been developed, and a more stable and permanent U.S. budget has been established to better administer the program.

One issue that the U.S. GCOS program is addressing is the continued operation of the Global Observing System Information Center (GOSIC) located at http://oceanic.cms.udel.edu/gos/. The GOSIC is under a second-phase 3-year development effort under the auspices of Dr. Ferris Webster at the University of Delaware. The U.S. GCOS Coordinator sits on a newly formed GOSIC Advisory Group that had its first meeting in April 2001. The group reviewed the operation and relevance of the GOSIC and provided some good direction and ideas for the GOSIC to pursue. NOAA is providing on-going financial support to the GOSIC for this new 3-year development phase. At the end of that developmental period, the GOSIC plans a 2-year transition period in which to transition its operation to a permanent operational agency. NOAA may be one of the candidate organizations to host the GOSIC system.

7. CONCLUSION

Considerable effort has been expended over the past several years by the various elements of the U.S. National GCOS program. The task of the national program manager and steering group is to ensure that these elements are well coordinated in order to assure that the national GCOS program is effective in providing support to the various communities involved with studying climate variability. The goal of the program is to provide these communities with a well-coordinated system of supported and sustained high quality climate observations.

The national GCOS report is the first step in this process. Until now no comprehensive catalogue of observing systems in the U.S has existed. In his testimony to the U.S. Congress on May 9, 2001, Dr. Eric Barron of Pennsylvania State University stated that "We need a real inventory of current observing systems including their purpose, connection to users, management, and decision making rules." It is hoped that the national GCOS report can begin to provide such a baseline of information to be used as a tool for beginning to assess the adequacy of the nation's climate observing capabilities.

8. REFERENCES

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9. ACKNOWLEDGMENTS

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