

**G** GLOBAL  
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**REPORT OF THE JOINT CCI/CBS EXPERT  
MEETING ON THE GCOS SURFACE NETWORK**

(Norwich, UK, 25-27 March, 1996)

August 1996

GCOS - 26

WMO/TD No. 766

UNITED NATIONS  
ENVIRONMENT PROGRAMME

INTERNATIONAL COUNCIL  
OF SCIENTIFIC UNIONS

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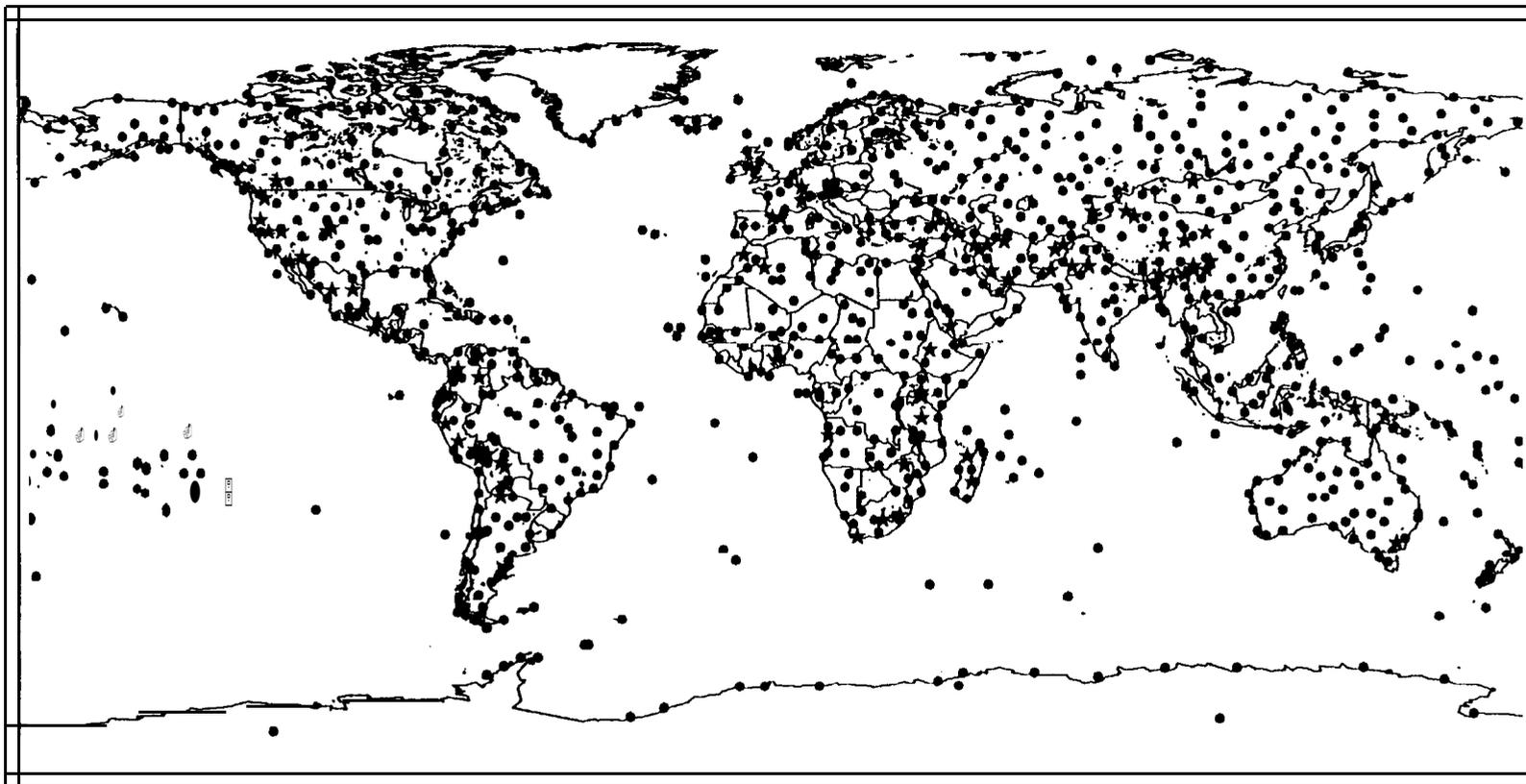
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## GCOS Surface Network



- best land-based stations selected by the algorithm in 986  $5^{\circ} \times 5^{\circ}$  grid boxes
- ★ extra elevation stations in those 85 grid boxes where there was an elevation difference of **1000m** or more between the selected prime station and other stations in the grid box.

MAP SHOWING LOCATIONS OF 1012 STATIONS INITIALLY SPECIFIED BY ALGORITHM

(i)

## JOINT CCL/CBS EXPERT MEETING ON THE GCOS SURFACE NETWORK

### 1. ORGANIZATION OF THE MEETING

#### 1.1 Opening remarks

Dr P. Jones welcomed the participants (Annex A) to the University and provided practical information on the conduct of the meeting.

Mr P. Scholefield described the historical evolution of the current initial list of 800 stations, referring to a background document (Annex 8) on this subject. He explained that one of the principal reasons why, at its second session in March 1994, the CCI Working Group on Climate Change Detection originally proposed collaboration with the Global Climate Observing System in establishing a surface reference network. It was to provide new impetus in the establishment of national Reference Climatological Station (RCS) networks. The Working Group re-emphasized at its third session in February 1996 that the development of this GCOS network should be an integral and inseparable part of the strategy of the Climate Change Detection project of the World Climate Data and Monitoring Programme to encourage WMO Members to build and maintain national RCS networks.

The task for this CCI/CBS expert group was to assess and recommend future actions concerning the list of 800 stations based on their working knowledge, using information from the recent (26 February - 1 March) meeting of the CCI Working Group on Climate Change Detection in Geneva and referring to a number of lists of stations including the: WMO Reference Climatological Station networks; GCOS Upper Air Network; WMO Global Atmosphere Watch; WMO CLIMAT; NCDC Global Historical Climate Network; WMO Regional Basic Synoptic Network; synoptic stations for which data are held at the International Data Rescue Coordination Centre; and stations submitted by WMO Members for compilation of the the 1961-90 Climatological Normals.

Mr Ed Sarukhanian, explained the process followed to establish the GCOS Baseline Upper Air Network and outlined the future steps that would be needed following this meeting to implement the surface network.

#### 1.2 Election of chairman

Dr Tom Karl was elected to chair the meeting.

#### 1.3 Adoption of the Agenda

The provisional agenda (Annex C) was adopted.

### 2. BACKGROUND AND RATIONALE FOR THE NETWORK

Dr Jones led the discussion on the scientific rationale for the network in the following concise form which had been developed by the recent meeting of the CCI Working Group on Climate Change Detection:

“The proposed GCOS network of stations has been selected to provide a homogeneous array of high quality stations of sufficient density and coverage over land to allow, with the inclusion of ocean surface observations, the detection of the spatial patterns and scales of global temperature change at the surface. This network will also provide a basis for detection of global atmospheric circulation changes. Additionally, the network will provide a framework for the denser set of stations that will be used in many climate change detection, climate change mechanisms, and climate change impact studies.

The network could also be used as one basis for the quality control of denser temperature networks and for other variables (e.g., precipitation). An additional consideration is the potential value of the network in providing observations for the monitoring of extremes and variability of weather phenomena. While the network is intended to provide long-term data continuity, replacing

or adding stations may be necessary from time to time to minimize gaps, especially in data sparse regions.

The rationale used by Jones (Climatic Research Unit) in deciding which stations to include is outlined in a document entitled "Selection of a GCOS Network of 800 Stations"..... The criteria used were that the station record was long, homogeneous (according to published papers by Jones and others), that the temperature data are available to the Climatic Research Unit and that the station be currently observing and reporting. Also, where possible, urban centres were avoided. It was not always possible to meet all these criteria in some regions of the world. To achieve reasonable spatial representation, approximately one station per  $5^{\circ}\times 5^{\circ}$  square of the world was chosen. The greater variability of air temperature and sea level pressure in mid-to-high latitudes implies more stations per unit area should be selected in these regions as opposed to tropical latitudes. In this respect, the network will not give suitable coverage for the analysis of other climate variables such as precipitation."

Dr Jones further elaborated on another reason for the number of stations being 800 was that there were found to be 779 grid cells around the globe which contained at least one station. Also, he stated that while one of his studies concluded that a global network as small as 172 stations was adequate to monitor globally averaged monthly mean surface temperature over the land, it was not adequate for the analysis of spatial temperature anomaly patterns.

### 3. REVIEW THE LIST OF STATIONS

During the process of discussing a strategy for reviewing and assessing the list, the following additional relevant information and station lists were added to those listed at the end of the third paragraph of section 1.1 in this document:

- Mr Plummer advised that the 101 identified reference climatological stations for Australia had been reviewed and reduced for the purposes of this exercise to a list of 52 mainland stations and 7 offshore stations;
- A list of suggested stations from Finland and Nordic countries was provided by the Finnish Meteorological Institute;
- The Hadley Centre provided an analysis of the coding and reception of global surface CLIMAT and upper air CLIMAT TEMP bulletins during the months December 1995 through February 1996 and an analysis of the SYNOP message reception over the period February 1995 to February 1996;
- An analysis of the reception of CLIMAT bulletins by the Seewetteramt in Hamburg, Germany; and
- Mr Harald Daan brought a global computerized analysis of the proposed network of 800 stations, with particular attention given to the spacing of the stations and some proposed additional stations were given that could be added to fill in gaps.

It was suggested during the discussions that a number of back-up or alternative stations could be designated in addition to 800 stations. The experts agreed to proceed on the basis of finding the best possible station within each  $5^{\circ}\times 5^{\circ}$  latitude/longitude grid cell, although there could be two in a grid cell if there was a good enough reason.

Criteria were formulated to assess the list which included spatial coverage, availability, homogeneity and quality of data. It was also felt that priority should be given to those stations that were listed on the WMO RCS lists and where monthly data were distributed as CLIMAT. It was also considered desirable to include stations that are part of the GUAN, RBSN and GAW networks.

The experts divided themselves into four groups to review the stations on a WMO regional basis. Working maps were provided that showed the location of stations in each of the six WMO regions. Difficulties were experienced almost immediately in trying to subjectively determine the best stations based on the general criteria developed and making use of the numerous other lists and analyses that had been provided. This was particularly noticeable when trying to determine the best station when there were more than one or two stations clustered into one grid cell.

At this point it was decided that the best way to proceed would be to develop a computer algorithm which could objectively synthesize the criteria and information provided. As the first step in this process, the experts developed a list of input sources for developing the algorithm along with related properties (Annex D). Based on this list, specific criteria were developed and a weighting factor and process assigned to each criteria (Annex E).

The steps to be followed in the procedure were specified as follows:

- a. A topographic analysis of each 5 degree square grid cell (total 779 bounded by the equator and the Greenwich meridian) to determine the potential number of stations desired per grid cell:
  - calculate % land/water and if less than or equal to 1 then include only 1 station; and
  - calculate variance of orography with 5 minute resolution over land • those in the upper 10% in each continent could have 2 stations (then try 2 Standard Deviations between the two stations to be selected).
- b. Select the stations for each grid cell using the weighted computer algorithm approach.
- c. Optimum selection of stations should be checked by first running the distance separation algorithm and then the stability of the selection should be checked by offsetting the grid by 2.5 degrees of longitude.

The experts agreed on specific actions and a schedule (see Annex F) to develop and apply the algorithm in order to produce a refined list of 800-odd stations in time for the session of CBS in November 1996.

#### 4. **LETTER REQUESTING COMMENTS AND INPUT FROM WMO MEMBER COUNTRIES**

The experts felt that the letter that will eventually be sent to WMO Member countries asking for their comments and inputs to the proposed list of stations was an extremely important step in the process of establishing the GCOS surface network and that this would provide an unique opportunity to not only refine and improve the list of stations but also to encourage the establishment of more dense national RCS networks and to improve upon the distribution of data being transmitted over the GTS in CLIMAT message bulletins. During the process of developing the specifications of the algorithm, a number of points and issues arose that the group felt should be considered for inclusion in this letter. The WMO Secretariat representatives noted these and agreed to prepare a draft letter and circulate it to the participants for comments.

#### 5. **GSN REPORTING AND MONITORING**

The experts noted that a large proportion of the stations to be selected and proposed for the GSN currently does not provide any climatic data through the operational channels of the WMO. There are well established procedures for the monthly exchange of climate observations from existing WMO networks which should be used. It was recommended that WMO Members be requested to provide additional data in CLIMAT code from all selected GSN stations. The exchange of these messages over the GTS will ensure the timely availability of the data. Mr Plummer advised that Australia is prepared to distribute data for all of its designated GSN sites on the GTS.

The experts further considered it to be important that the operation of the GSN be monitored routinely. The CBS initiative for the monitoring of the WWW observations was seen as a suitable approach which could be adapted for the purposes of the GSN. A task force should meet later in 1997 to discuss the detailed monitoring requirements and propose suitable procedures which should be applied to the aspects of data quality and availability.

**6. RECOMMENDATIONS TO FURTHER ADVANCE THE IMPLEMENTATION OF THE NETWORK**

The experts recommended the following:

- (a) Monthly climate data reports at all stations identified for the the GSN should, if it is not already the case, be routinely available as CLIMAT messages.**
- (b) All stations identified for the the GSN should, if it is not already the case, be included in national Reference Climatological Station (RCS) networks and WMO Members are urged to use the designated GSN stations in their country as the basis for building and maintaining more dense national RCS networks.**
- (c) The existing WMO regional system for monitoring the quality of synoptic observations is one of the possible candidates for the operational monitoring of the network that should be examined by a task group later in 1997 after the network has been established.**
- (d) The procedures developed for the design and implementation of the network should be implemented according to the schedule proposed in Annex F.**
- (e) The draft letter at annex F should be used to accompany the list of network stations that is sent to WMO Member countries for review and comment.**
- (f) A electronic mailist which includes all of the e-mail addresses of the participants of this meeting should be established on the WMO Internet server to facilitate commuunication on matters pertaining to the design and implementatiom of the network.**
- (g) A technical report describing the algorithm and related procedures used to select GSN stations should be prepared and distributed as a GCOS document.**

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**ANNEX A, pg. 2**

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**Joint CCI/CBS Expert Meeting on the Baseline  
Surface Network for GCOS  
{University of East Anglia, Norwich, UK, 25 - 27 March 1996}**

## Background

At the meeting of its second session in March 1994, in Washington, the CCI Working Group on Climate Change Detection recognized the difficulties being experienced by WMO in encouraging Member countries to establish Reference Climatological Station (RCS) networks. It proposed collaboration with the Global Climate Observing System GCOS to provide new impetus in the establishment of national RCS networks.

The Atmospheric Observation Panel (AOP) of GCOS met the following month in Hamburg and considered this proposal from the CCI Working Group on Climate Change Detection. The AOP recommended that a Task Group be established, having representatives from the CCI Working Groups on Climate Data and Climate Change Detection and the AOP, with the purpose of specifying a baseline network of approximately 200 stations, selected from those which would qualify as WMO Reference Climatological Stations. A complementary initiative to establish a GCOS Baseline Upper Air Network was already well under way at that time.

The meeting of the Task Group took place in Geneva, 30 January - 2 February 1995. It recognized that there is no comprehensive global network of surface observing stations that has been scientifically recognized or endorsed for use in the routine monitoring and analysis of the variability and trends in global temperature. There is a critical need for such a network. It proposed a network of approximately 800 stations which would accommodate observed data from most land areas, including many mid-oceanic islands, at an approximate density of one station per 250 000 square kilometres. This number of stations was considered adequate to monitor global and large hemispheric temperature variability and would permit some multi-element analysis. A document giving the rationale for the network was produced, based on the discussions at the meeting of the Task Group.

The AOP of GCOS met the following month in Tokyo and agreed with the proposal for approximately 800 stations to be included in the network which would be initially specified by the Climatic Research Unit at the University of East Anglia. The AOP further proposed that it collaborate with the CCI Working Group on Climate Change Detection to establish a task team of experts to prepare an initial design of the network, starting with the initial list specified by the Climatic Research Unit at the University of East Anglia.

The third session of the CCI Working Group on Climate Change Detection will meet in Geneva from 26 February to 1 March. It will consider the recommendations and work of the Task Group and examine the progress made in the initial specification of the list of stations. It is expected that the Working Group will emphasize that the development of this network is an integral and inseparable part of the strategy of the Climate Change Detection project to encourage WMO Members to build and maintain national RCS networks. These considerably more dense networks are critically important for the analysis and monitoring of a variety of climatic parameters on regional and national scales. The GCOS network should be developed as global subset of the totality of the national RCS networks.

## Purpose of the Norwich meeting

The purpose of this meeting is to review the initially specified list of 800 stations and compare it with other lists of observing stations, that have been compiled for a variety of purposes, to ensure the stations specified are optimum in terms of spatial distribution, length and homogeneity of record, parameters observed, quality and the accessibility of the ongoing observations.

The following are the lists of stations that will be available to participants before (\*) and at the meeting to compare with the initially specified list of 800 stations:

**ANNEX B, pg. 2**

- 1. \*Station lists submitted to WMO from 73 countries that responded to a 1990 RCS questionnaire;**
- 2. ● GCOS Baseline Upper Air Network;**
- 3. \*WMO Global Atmospheric Watch Network;**
- 4. \*Regional Basic Synoptic Network of the World Weather Watch Programme;**
- 5. CLIMAT station network;**
- 6. Selection from the Global Historical Climate Network of the National Climatic Data Center in USA;**
- 7. Complete list used by the Climatic Research Unit of the University of East Anglia;**
- 8. List of DARE I stations from the International Data Rescue Coordination Centre; and,**
- 9. List of stations that were submitted for preparation of the 1961 - 1990 WMO Climatological Normals.**

WORLD METEOROLOGICAL ORGANIZATION

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...../Doc. 1  
(18.III.1996)

JOINT CCI/CBS EXPERT MEETING ON DESIGN AND  
IMPLEMENTATION OF A GCOS PERMANENT  
LAND-BASED SURFACE CLIMATE OBSERVATION NETWORK

ITEM 1

ENGLISH

UNIVERSITY OF EAST ANGLIA, NORWICH, UK  
25-27 MARCH 1996

### AGENDA

1. ORGANIZATION OF THE MEETING
    - 1.1 Opening Remarks
    - 1.2 Election of the chairman
    - 1.3 Adoption of the Agenda
    - 1.4 Working Arrangements
  2. BACKGROUND AND RATIONALE FOR THE NETWORK
  3. REVIEW OF THE STATIONS SELECTED
  4. FORMULATE RECOMMENDATIONS TO FURTHER ADVANCE THE IMPLEMENTATION
  5. CLOSURE OF THE MEETING
-

## INPUT SOURCES FOR THE ALGORITHM AND RELATED PROPERTIES

1. **Station lists submitted to WMO from 73 countries that responded to a 1990 RCS questionnaire (including updates for Botswana, Australia, Finland, USA, Canada stations):**
  - beginning date of record
  - country preference
  - be permanent
2. **GCOS Baseline Upper Air Network:**
  - GCOS upper air reference site
3. **WMO Global Atmospheric Watch Network:**
  - GAW site
4. **Regional Basic Synoptic Network of the World Weather Watch Programme:**
  - WWW station RBSN
5. **CLIMAT station network:**
  - regular monthly climate messages
6. **Global Historical Climate Network of the National Climatic Data Center in USA:**
  - urban/rural, beginning/end dates of record, % data (known to be digital and exchanged) available, homogeneity (correctable), station elevation
7. **Complete list used by the Climatic Research Unit of the University of East Anglia:**
  - urban/rural, beginning/end dates of record, % data (known to be digital and exchanged) available, homogeneity (correctable), GCOS version 0 (800 stations, subjective, most still operating, mostly non-urban), station elevation
8. **List of DARE I stations from the International Data Rescue Coordination Centre:**
  - non-digital data from over 30 African countries available on microfiche
9. **List of stations that were submitted for preparation of the 1961 - 1990 Normals:**
  - station normals computed from 1961-90 period, station elevations
10. **Digital topography file:**
  - 5 minute resolution, terrain base
11. **Dave Cullum's list of WWW synoptic stations:**
  - % transmitted (March 95 - February 1996)
12. **Harold Daan's list:**
  - % transmitted (1995)

13. WMO list of WWW suspect stations (from RBSN stations only)

Generic Inputs (mostly from WMO Publication No. 9, Vol. A):

- station name
- latitude, longitude
- altitude
- WMO station number
- name of country

## CRITERIA AND WEIGHTING FACTORS FOR THE ALGORITHM

## Criteria:

Weights

- .15 length of record (scale by 100 years) X % data available during the last 100 years
- .20 currently operating • if not sure and we have data up to at least 1990 then .1 (Y/N/U i.e. .2/0/.1) • % transmitted over the past year (max of any of: .2 for RCS or .2 x % transmission as CLIMAT or .2 x % transmission as SYNOPS • N.B. not less than 0.1), i.e. MAX (0.2 x R; 0.2 x fraction of CLIMAT reports; 0.2 x fraction of SYNOP reports; 0.1 x S where R= 1 for RCS, otherwise R=0 and S = 1 if there are data in 1990 or later, otherwise S = 0
- .20 length (scale by 50 years) of homogeneity (years) (.2, .1, 0) x % data available during the last 50 years, i.e., .20 x MIN (1, homogeneity length in years/50)
- .20 urban/rural (urban, small urban (1 0,0000-50,000) rural, unknown: 0, .75, 1 ., .5 scaling factors)
- .10 RCS station (1,0)(Y/N) use earliest beginning date (scale by 50 years)
- .05 RBSN (1,0) (Y/N)
- .02 GAW (1,0) (Y/N)
- .03 GCOS Upper Air (1,0) (Y/N)
- .05 Normals available (1,0) (Y/N)

## PROPOSED SCHEDULE FOR IMPLEMENTATION OF THE NETWORK

### Schedule and Related Commitments

#### 1. Input needed to prepare Algorithm:

generic data from Vol A of WMO Pub 9 (<http://www.wmo.ch>)

draft report of meeting

revised RCS network stations from Australia, Canada and US

GAW stations

RBSN stations

- WMO RCS network stations

suggestions from Botswana, Finland, Germany

CLIMAT network stations (already at NCDC)

GHCN stations (already at NCDC)

Complete Jones list of stations

- WMO Normals stations (already at NCDC)

Topographic file (already at NCDC)

SYNOP message transmission statistics

CLIMAT " " " "

urban rural statistics (already at NCDC)

flow chart

#### 2. Overall Implementation milestones:

- 30 Jun 96 • refined list resulting from the algorithm completed
- 10 Jul 96 • refined list sent to the rapporteurs of the CBS WG on GOS and to the chairman of the CCI WG on Climate Change Detection
- 15 Sep 96 • reply from rapporteurs
- 1 Oct 96 • report from F. Baede GCOS rapporteur for CBS WG on GOS
- 1 Nov 96 • submit to session of CBS as info and to relevant Departments in the WMO Secretariat such as WWW, WCP, WCRP, GCOS, IPCC
- 1 Nov 96 • technical document completed by Tom Peterson
- 1 Dec 96 • letter to relevant WMO Members along with technical document
- 31 Jan 97 • replies from WMO Members
- 1 Mar 97 • consolidated report based on WMO Member responses and rapporteurs responses to be prepared by F. Baede

**ANNEX F, pg. 2**

- 15 Mar 97** • **list with consolidated report of all comments to be sent to a small group of experts (T. Peterson, H. Daan and P. Jones)**
- 15 Apr 97** • **review by of consolidated report and appropriate revisions made to the list by the small group of experts**
- Apr 97** • **submit progress report to session of CCI as info**
- 1 May 97** • **letter from the chairman of CBS WG on Observations to the Atmospheric Observation Panel of GCOS**
- ? 97** • **submission of the list to the JSTC of GCOS**
- ? 97** • **letter to all WMO Members announcing the establishment of the network**
- ? 97** • **approval by the Presidents of WMO Regional Associations**
- ? 97** • **possible meeting of experts to discuss the ongoing routine maintenance and monitoring of the network**

## LIST OF GCOS PUBLICATIONS

- GCOS-1**  
(WMO/TD-No. 493) Report of the **first** session of the Joint Scientific and Technical Committee for GCOS (Geneva, Switzerland, April 13-15, 1992)
- GCOS-2**  
(WMO/TD-No. 55 1) Report of the second session of the Joint Scientific and Technical Committee for GCOS (Washington DC, USA, January 11-14, 1993)
- GCOS3**  
(WMO/TD-No. 590) Report of the third session of the Joint Scientific and Technical Committee for GCOS (Abingdon, UK, November 1-3,1993)  
[ftp://www.wmo.ch/Documents/gcos/jstc-3.txt]
- GCOS-4**  
(WMO/TD-No. 637) Report of the fourth session of the Joint Scientific and Technical Committee for GCOS (Hamburg, Germany, September 19-22, 1994)  
[ftp://www.wmo.ch/Documents/gcos/jstc-4.txt or /jstc-4.wp5]
- GCOS-5**  
(WMO/TD-No. 639) Report of the GCOS Data System Task Group (Offenbach, Germany, March 22-25, 1994)  
[ftp://www.wmo.ch/Documents/gcos/dstg.txt or /dstg.wp5]
- GCOS-6**  
(WMO/TD-No. 640) Report of the GCOS Atmospheric Observation Panel, first session (Hamburg, Germany, April 25-28, 1994)  
[fip://www.wmo.ch/Documents/gcos/aop-1 .txt or /aop-1 .wp5]
- GCOS-7**  
(WMO/TD No. 641) Report of the GCOS Space-based Observation Task Group (**Darmstadt**, Germany, May 3-6, 1994)  
[ftp://www.wmo.ch/Documents/gcos/sotg.txt or /sotg.wp5]
- GCOS-8**  
(WMO/TD No. 642)  
(UNEP/EAP.MR/94-9) Report of the GCOS/GTOS Terrestrial Observation Panel, first session (Arlington, VA, USA, June 28-30, 1994)  
[ftp://www.wmo.ch/Documents/gcos/top-1.txt or /top-1.wp5]
- Gcos-9**  
(WMO/TD-No. 643) Report of the GCOS Working Group on Socioeconomic Benefits, first session (Washington DC, USA, August 1-3, 1994)  
[ftp://www.wmo.ch/Documents/gcos/wgsb-1.txt or /wgsb-1.wp5]
- GCOS-10**  
(WMO/TD-No. 666) Summary of the GCOS Plan, Version 1.0, April 1995  
[ftp://www.wmo.ch/Documents/gcos/gps-ver1.txt or /gps-ver1.wp5]
- GCOS-11**  
(WMO/TD-No. 673) Report of the GCOS Data and Information Management Panel, first session (Washington DC, USA, February 7-10, 1995)  
[ftp://www.wmo.ch/Documents/gcos/dimp-1.txt or /dimp-1.wp5]
- GCOS-12**  
(WMO/TD-No. 674) The Socioeconomic Benefits of Climate Forecasts: Literature Review and Recommendations (Report prepared by the GCOS Working Group on Socioeconomic Benefits), April 1995  
[ftp://www.wmo.ch/Documents/gcos/wgsb-1rr.txt or /wgsb-1rr.wp5]

- GCOS-13**  
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- GCOS-14**  
(WMO/TD-No. 681) Plan for the Global Climate Observing System (GCOS), Version 1.0, May 1995  
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- GCOS-15**  
(WMO/TD-No. 684) GCOS Plan for Space-based Observations, Version 1.0, June 1995  
[ftp://www.wmo.ch/Documents/gcos/sp-ver1.wp5]  
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- GCOS-16**  
(WMO/TD-No. 685) GCOS Guide to Satellite Instruments for Climate, June 1995  
(will not be on **FTP** Server)
- GCOS-17**  
(WMO/TD-No. 696) Report of the GCOS Atmospheric Observation Panel, second session (Tokyo, Japan, March 20-23, 1995)  
[ftp://www.wmo.ch/Documents/gcos/aop-2.txt or /aop-2.wp5]
- GCOS-18**  
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(UNEP/EAP.MR/95-10) Report of the **GCOS/GTOS** Terrestrial Observation Panel, second session (London, UK, April 19-21, 1995)  
[ftp://www.wmo.ch/Documents/gcos/top-2.txt or /top-2.wp5]
- GCOS-19**  
(WMO/TD-No. 709) Report of the GCOS Data Centre Implementation/Co-ordination Meeting (Offenbach, Germany, June 27-29, 1995)  
[ftp://www.wmo.ch/Documents/gcos/dcc-1.txt or /dcc-1.wp5]
- GCOS-20**  
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- GCOS-21**  
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- GCOS-22**  
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[ftp://www.wmo.ch/Documents/gcos/jstc-5.wp5]
- GCOS-23**  
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(UNEP/DEIA/MR.96-6) (FAO GTOS- 1) Report of the **GCOS/GTOS** Terrestrial Observation Panel for Climate, third session (Cape Town, South Africa, March 19-22, 1996)  
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- GCOS-24**  
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- GCOS-25**  
**(WMO/TD-No. 765)**  
**(UNEP/DEIA/MR.96-5)** Report of the GCOS Data and Information Management Panel, second session (Ottawa, Ontario, Canada, May 14-17, 1996)  
**[ftp://www.wmo.ch/Documents/gcos/dimp-2.wp5]**
- GCOS-26**  
**(WMO/TD-No. 766)** Report of the Joint CCI/CBS Expert Meeting on the GCOS Surface Network (Norwich, UK, March 25-27, 1996)  
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