CONSOLIDATED REPORT

OF

C.G.M.S. ACTIVITIES

CGMS

8TH EDITION

APRIL 1989

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ANNEXES

EDITOR'S NOTE

The present edition of the Consolidated Report of the Co-ordination on Geostationary Meteorological Satellites (CGMS) has been compiled by EUMETSAT, acting as the CGMS Secretariat.

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ANNEXES

1 INTRODUCTION

1.1 Foreword

A global network of geostationary satellites evolved during the 1970's following the successful demonstration of the large benefits shown by the USA's Applications Technology Satellites (ATS-1 and ATS-3) for meteorological applications. The launch of the first GOES satellite in 1974 by the USA was followed in 1977 with the launches of GMS by Japan and METEOSAT by the European Space Agency (responsibility for this satellite now rests with the European Meteorological Satellite Organisation, EUMETSAT). The network was augmented in 1983 with the launch of the first INSAT and will develop further with the launch of the Russian GOMS, provisionally planned for 1990.

Since 1972 CGMS has provided a forum in which the satellite operators have studied jointly with the WMO the technical and operational aspects of the global network, so as to ensure maximum efficiency and usefulness through proper coordination in the design of the satellites and in the procedures for data acquisition and dissemination. The specific design of each of the satellites is based of course on national and regional requirements for data and services and therefore some differences in design and mission are inevitable. However the regular meetings of the group have permitted a gathering and exchange of results during the course of development of each system and a considerable measure of coordination has been achieved.

The purpose of the Consolidated Report is to present a summary of matters discussed by CGMS in recent years.

1.2 Purpose and Layout of the Document

This document is intended to serve two purposes:

(a) as a reference for CGMS members,

(b) as a source of information for non-CGMS individuals who wish to participate in the exploitation of the international space meteorology system.

To this end, a layout has been adopted where CGMS discussions and recommendations are summarised in a narrative part consisting of 9 chapters, while more detailed information on key subjects is found in a set of 12 annexes.

Throughout the document, an effort has been made to keep the text concise by eliminating background or purely historical information. Nevertheless, an index to CGMS items in the original CGMS reports, as well as a list of working papers, are provided in the annexes for those who wish to penetrate deeper into the deliberations of CGMS.

The first seven CGMS meetings dealt mainly with the coordination among satellite systems under development. The deployment of meteorological satellites during the global weather experiment in 1979 demonstrated the operational value of this global network. This value was also reflected in the CGMS sessions of that period and subsequent years being more orientated towards the operational aspects of coordination. More recent sessions continue to give importance to operational matters but also include the coordination of the next generation of satellites now under construction.

At CGMS XVII members agreed that it was important to be aware of the development of future polar orbiting meteorological satellites since they, like the geostationary satellites, played a key role within the total global observing system. A new item was introduced into the Agenda - Polar orbiting satellites of interest to members. This item would in future be supported by a document, produced by the Secretariat, containing brief descriptions of all present and planned geosationary and polar orbiting meteorological satellites.

1.3 The Global Role of Geostationary Satellites

The global network of geostationary meteorological satellites, whose technical and operational co-ordination is the objective of CGMS, constitutes a major portion of the space-based subsystem in the Global Observing System (GOS) of the World Weather Watch (WWW). This network design evolved during the period from 1965 to 1978 as a portion of the Global Atmosphere Research Programme (GARP). The GARP and WWW are responses of the WMO and International Council of Scientific Unions (ICSU) to three resolutions of the General Assembly of the United Nations, calling for international programmes in Meteorology for the benefit of mankind. WWW is a continuing programme of WMO to assist meteorological services in all parts of the world in operational and research functions by making available basic meteorological and other relevant data. The GOS provides the input data for numerical weather prediction models. GARP was a research effort, sponsored jointly by WMO and ICSU, to gain a better understanding of the laws and the behaviour of the earth's atmosphere. This is important both for improving operational forecasting and for a better determination of the influence of human activities on the atmosphere. The World Climate Programme is a follow-on to the GARP activities.

CGMS members contributed to the implementation of the first GARP Global Experiment (FGGE) by developing the network of the 5 geostationary satellites. FGGE was started in September 1978 with a build-up phase, followed by a 12 months operational phase starting 1 December 1978. The latter included two special observing periods of one month's duration (15 January to 15 February 1979 for the first and 15 May to 15 June 1979 for the second), where all components of the GARP Global Observing System were simultaneously in operation.

At CGMS-XII, WMO reminded members of the value of geostationary meteorological satellites for the WWW Global Observing System and reviewed the questions involved in achieving and sustaining an operational network. Some possible roles for international co-operation were discussed with the aim of providing a continuous availability of, and access to, satellite meteorological data.

The importance of operational continuity and reliability for the global coverage from satellites was further discussed at the CGMS-XIII and XIV sessions. In particular, all satellite operators were asked at CGMS-XIV to re-examine the opportunities and constraints for redeployment of satellites in the event of failures of one or more geostationary meteorological satellites in the network. WMO at CGMS-XV presented a comparison of several different strategies for achieving reliability and coverage on a global scale. This comparison strongly indicated that a strategy based on the redeployment of <u>operating</u> satellites has limited utility due to the inability to rationalise the needs for geographical coverage by different users and due to the presence of different types of spacecraft.

EUMETSAT, also at CGMS-XV, proposed that a strategy based on deployment of spare satellites, with satellite control maintained by the satellite owner, could be useful in alleviating the affects due to satellite failures in the neighbouring positions of the spare satellite owner. It was agreed that this proposal had merit, especially for the near-term and should be developed further as a potential basis for system to be developed and operated during the rest of the century.

CGMS-XV also considered the strategy of overlapping satellite coverage with a resultant "fail-soft" global network which was one of the alternative strategies analysed by WMO. CGMS members endorsed the idea of increased direct participation in geostationary meteorological satellite operations and agreed that countries such as the People's Republic of China, who are actively considering the operation of a geostationary meteorological satellite, should be strongly encouraged. It was recognised that such additional satellites would provide some overlapping coverage and thus provide the basis for a "fail-soft" system over several regions.

At CGMS XVI the Group recognised that the discussion of common back-up satellites had been too general and represented a goal which might seem too difficult and too distant. It was decided that at future meetings this matter would be discussed under more precise and limited agenda headings. The concept of regional "help your neighbour" schemes, proposed by EUMETSAT at CGMS XV seemed a more realistic approach to the problem.

The problem of interference on IDCS channels I16 and to a lesser extent on I17 and some regional DCP channels received considerable attention. The problem was most severe in the European sector (via the GOES-4 satellite). The Group agreed that IDCS channel I12 should be opened up in support of ASAP operations. Since the Data Collection System was classified under ITU regulations as a "secondary" user of the 401 to 403 MHz frequency band and could therefore be increasingly in conflict with other non aeronautical or mobile users CGMS XVI agreed to ask responsible bodies (i.e. CBS) if the DCS could be upgraded to "primary" status in co-existence with Meteorological Aids.

The USA announced at CGMS XVI that it had issued a request for proposals for a new digital WEFAX dissemination scheme. Preliminary studies were also underway in Europe. The Group, realizing the impact of a change to digital WEFAX on the already very large user community, agreed that a clear strategy for change-over should be agreed before deciding upon any new system and decided to set up a special working group to study the overall impact of the change.

1.4 The Geostationary Satellite Systems and Missions

The five geostationary meteorological satellite systems currently in operation are provided by:

EUMETSAT	(one METEOSAT spacecraft)
India	(one INSAT spacecraft)
Japan	(one GMS spacecraft)
USA	(two GOES spacecraft)

The satellites are more or less evenly positioned around the earth in geostationary orbit (see paragraph 2.1).

The meteorological instrumentation on board INSAT satellites is only part of the satellite payload. INSAT satellites are also used for domestic communications services.

The launch of GOMS is planned to take place within the next one or two years.

All these satellite systems have been designed to fulfill the following mission objectives:

a) **High-resolution imaging** of the Earth's surface and of its cloud coverage, in the visible and thermal infrared spectra, and extraction of meteorological information such as cloud motion wind vectors, sea surface temperatures, cloudiness and cloud top heights from the image data.

b) **Dissemination of cloud cover images** and other meteorological information to User Stations.

c) **Collection and relay of environmental data** from fixed or mobile Data Collection Platforms, located either on the Earth's surface or in the atmosphere.

The design characteristics of all the geostationary meteorological satellite systems differ from one to another, but they bear a general similarity in their mission performance:

i) They all carry scan imagers to provide high-resolution full disc images in the visible and in the infrared. The useful coverage of these images, in particular for acceptable wind vector extraction, extends up to 50 or 55 degrees around the sub-satellite points. They employ comparable imaging techniques,i.e. a maximum of 48 full earth images per day can be generated by each satellite system.

ii) They all include data relay capabilities for the dissemination of images and data collection. Furthermore, since these two missions affect a wide community of users operating APT stations, Data User Stations and Data Collection Platforms, the transmission characteristics and the operational procedures have been standardised. The coverage of the data relay capability extends up to about 75 degrees around each sub-satellite point.

1.5 History and Purpose of CGMS

CGMS came into being on 19 September 1972, when representatives of the European Space Research Organisation (since 1975 called the European Space Agency), Japan, the United States of America and observers from the World Meteorological Organisation (WMO) and the Joint Planning Staff for the Global Atmospheric Research Programme met in Washington to discuss questions of compatibility among geostationary meteorological satellites. The meeting identified several areas, in particular for the collection of data from moving platforms and for WEFAX image dissemination, where both technical and operational coordination would be needed.

It was decided at the original CGMS meeting in Washington to establish two working groups:

a) one under the designation "System Engineering Working Group" to study the engineering aspects, and

b) the other entitled "User Considerations Working Group" to look after the interests of future users.

CGMS I, furthermore, concluded that a meeting of Senior Officials of the participating agencies should be held each time immediately following the meetings of the technical working groups to finalise the report of the meeting and to approve decisions, recommendations and actions.

In the course of CGMS activities, it appeared that some items were related simultaneously to both of the above mentioned working groups. In the beginning of CGMS such items were resolved by exchanging temporarily individual experts between the two working groups. CGMS V however, introduced the idea of "joint sessions". In subsequent meetings this resulted in the establishment of an autonomous "Joint Working Group", acting on its own agenda and generating, by CGMS VII, a separate report to the Senior Officials.

The Union of Soviet Socialist Republics, having expressed its intention to develop and operate a geostationary meteorological satellite, GOMS, joined the small group of satellite operators in January 1973. At that time WMO became a full member of CGMS and the USSR cooperated in developing the technical elements and operational principles for the system of geostationary satellites.

India, operator since 1983 of a series of geostationary telecommunications satellites (INSAT) with an imaging radiometer on board, joined the group in 1979.

The Peoples Republic of China, also considering the development of both polar orbiting and geostationary satellites, has attended recent meetings of CGMS with observer status.

CGMS-meetings have been held as follows:

CGMS I	19-20 September 1972	Washington	
CGMS II	18-24 January 1973	Zurich	
CGMS III	11-18 October 1973	Tokyo	
CGMS IV	13-17 May 1974	Geneva	
CGMS V	18-25 April 1975	Geneva	
CGMS VI	5-9 April 1976	Washington	
CGMS VII	24-31 January 1977	Geneva	
CGMS VIII	13-17 March 1978	Paris	
CGMS IX	5-9 March 1979	Tokyo	
CGMS X	17-21 March 1980	Geneva	
CGMS XI	8-12 February 1982	Washington	May 82
CGMS XII	25-28 April 1983	Paris	COSPAR stereo
CGMS XIII	10-13 April 1984	Geneva	
CGMS XIV	20-24 May 1985	Tokyo	
CGMS XV	3-7 November 1986	New Delhi	
CGMS XVI	28 Sept-2 Oct 1987	Washington	
CGMS XVII	3-7 October 1988	Darmstadt	

(The next meeting of CGMS is tentatively scheduled for 13-17 November 1989, to be hosted by the WMO in Geneva).

1.6 Role of WMO

The WMO, a specialised agency of the United Nations, has a membership of 160 states and territories. Three of the purposes of the organisation are particularly pertinent to the activities of CGMS:

a) To facilitate world-wide cooperation in the establishment of networks for making meteorological, as well as hydrological and other geophysical observations and centres to provide meteorological services,

b) To promote the establishment and maintenance of systems for the rapid exchange of meteorological and related information,

c) To promote the standardisation of meteorological observations and ensure the uniform publication of observations and statistics.

Satellites have become a fundamental tool for the WMO to carry out its basic goals. The WMO needs to play a role in coordination of the global network of meteorological satellites because of the data and services provided to the large number of countries who are neither satellite operators nor members of a consortium operating such satellites. It is also very pertinent for the large parts of the globe outside national jurisdiction, especially the large open ocean areas.

The WMO, in its endeavours to promote the development of a global meteorological observing system, participated in the activities of CGMS from the first meeting. There are several areas where joint consultations between the satellite operators and WMO are needed. The provision of data to meteorological centres in different parts of the globe is achieved by means of the Global Telecommunication System (GTS) in near real time. This automatically involves assistance by WMO in developing appropriate code forms and provision of a certain amount of administrative communications between the satellite operators.

The active involvement of WMO has allowed the development and implementation of the operational ASDAR system as a continuing part of the Global Observation System. It is furthermore hoped that the implementation of the IDCS system will continue to be promoted by the willingness of WMO to act jointly with the satellite operators as admitting authority in the admission procedure for IDCPs.

WMO's interest in CGMS activities was demonstrated by the proposal of the Secretary General (Tokyo, 1973) that simultaneous meetings of CGMS and the WMO EC Panel on Meteorological Satellites be held and also by his offer to provide the necessary working facilities in WMO Headquarters in Geneva where five meetings have so far been held.

In addition, WMO arranged, in conjunction with CGMS XIII, a special session on calibration and intercomparison of satellite measurements and agreed to prepare a draft outline of a possible "Geostationary Satellite Data and Major Products Guide" to fill the information gap between the satellite operators and the users of satellite data and products.

The WMO is incorporating the information on geostationary satellite data and major products into the revision of the WMO publication which provides information on meteorological satellite programmes operated by Members and Organisations. This revision is scheduled for publication early in 1989.

2 OVERALL SYSTEM COORDINATION

2.1 Orbital Positions of Satellites

An important ambition of CGMS has been to achieve some overlap in the fields of view of the five geostationary satellites. This principle has sometimes been contradictory to national or regional interests, and the geographical location of data reception and ranging stations has also had an influence.

The resulting compromise is:

METEOSAT	0 degrees East	
GOMS	76 degrees East	(planned)
INSAT	74 degrees East	
GMS	140 degrees East	
GOES East	75 degrees West	
GOES West	135 degrees West	

2.2 Contingency Plans

Distinction is made between:

a) regional contingency plans: what is planned by the satellite operator to maintain operational continuity,

b) inter-regional contingency plans: what is foreseen by neighbouring operators to remedy the failure of one of their satellites,

c) global contingency plans: what is agreed by all operators to remedy the failure of any one of the existing operational satellites.

CGMSXVII was pleased to note that several satellite operators were already developing contingency plans.

2.2.1 Regional Contingency Plans

2.2.1.1 EUMETSAT

METEOSAT-3 (formerly called P2), an upgraded prototype model, similar in performance to METEOSATs 1 and 2, was launched using the first ARIANE-4 test flight on 15 June 1988.

After successful launch and commissioning, **METEOSAT-4** will replace METEOSAT-3 as the primary satellite. METEOSAT-3 will then become the stand-by satellite and may at times be moved west over the Atlantic (near 27 degrees West) to operate with the LASSO (Laser Synchronisation from Stationary Orbit) experiment.

Under the METEOSAT Operational Programme (MOP), three satellites are being built. The planned launch dates are:

METEOSAT-4 (MOP-1)	28 February 1989
METEOSAT-5 (MOP-2)	1990/1991
METEOSAT-6 (MOP-3)	1992/1993, or as required

To cover the possibility of failure during launch or early in satellite life, a set of spares (**METEOSAT-7**) have been manufactured, to be integrated and launched as quickly as possible. The basic philosophy remains of having one operational satellite, located at 0 degrees longitude, with a stand-by spare satellite close-by. Operation of the MOP satellites will continue until at least the end of 1995.

2.2.1.2 INDIA

India has plans for continuing the INSAT-I meteorological programme up to the middle of the 1990s.

INSAT-1B was launched in August 1983 and is located at 74 degrees East. The satellite has been operating successfully up to the present time, generating eleven full disk images daily as a routine, with up to 27 on special occasions.

INSAT-1C, the in orbit spare satellite for INSAT-1B, was launched in July 1988 using an ARIANE launch vehicle. This satellite is currently located at 93.5 degrees East. The satellite has suffered a short circuit in one of the two power buses resulting in the non availability of some transponders and redundant subsystems. As far as the meteorological mission is concerned, the radiometer is available with one of its two transmitters along with one data relay transponder.

According to present estimates, INSAT-1B is expected to remain in operation up to 1989. India plans to launch **INSAT-ID** in March/April 1989 as a replacement. INSAT-1C will remain a standby spare satellite.

INSAT-1C and ID are functionally identical to INSAT-1B, with a design life of 7 years.

2.2.1.3 JAPAN

GMS is located at 160 degrees East however the imaging radiometer in no longer operable. Only limited station keeping is possible. Because of various system malfunctions **GMS-2** was de-orbited in November 1987. **GMS-3** is operated as the prime satellite at 140 degrees East. Following an upgrade of the ground facilities stretched VISSR operations commenced in March 1988.

2.2.1.4 USA

GOES-2 (no VISSR) is located at 113 degrees West and is a stand-by satellite for the relay of WEFAX and DCS.

GOES-3 (no VISSR) is located near 130 degrees West and is used as a stand-by satellite for the relay of WEFAX and DCS.

GOES-4 was de-activated and de-orbited in November 1988.

GOES-5 (no VAS imager/sounder) is located at 65 degrees West and is used to relay mode A VISSR and WEFAX data from GOES 7 and supports the DCS.

GOES-6 was operated until its failure in January 1989 as the prime satellite in the West position (135 degrees West). It will now be used as a standby relay satellite.

GOES-7 was launched in February 1987 and was operated in the East position (75 degrees West). Following the failure of GOES-6 it will operate in the "one GOES" central position (either 98 degrees or 108 degrees West depending upon the season).

2.2.2 Inter-regional contingency plans

2.2.2.1 Contingency Plan for the METEOSAT DCS

METEOSAT-1, originally capable of DCS support, has exhausted its supply of station-keeping fuel and is no longer operated.

METEOSAT-2 could not support the DCS because of an on-board failure of the transponder at launch.

To remedy this interruption of DCS service, the USA moved its GOES-4 spacecraft to a position over the Atlantic Ocean near 43 degrees West. The spacecraft continued to support the Meteosat DCS for nearly three years until the Summer of 1988. It was controlled by the USA but the reception and relay of DCP messages was performed by ESA on behalf of EUMETSAT.

METEOSAT-3 currently supports the operational collection and relay of DCP messages.

2.2.3 Global Contingency Plans

2.2.3.1 Contingency Plans for the FGGE

The first global contingency plans were developed and implemented for the FGGE.

In view of the fact that the USSR GOMS spacecraft would not be launched until after the experiment, at the request of the WMO discussions took place between USA and ESA on possible joint efforts for closing the gap in observations over the Indian Ocean. The discussions led to the agreement by USA to move the GOES-1 satellite to the Indian Ocean area where it was operated at 58 degrees East by ESA.

The principal features of that plan were:

a) USA and ESA jointly augmented existing ESA facilities to provide a European GOES data acquisition and control capability;

b) ESA operated the satellite system for the period of the FGGE;

c) The USA processed image data acquired on tapes produced by ESA to derive winds for the FGGE data set.

Routine operations of this satellite (re-named GOES-Indian Ocean for the experiment) commenced on 1 December 1978 and finished on 30 November 1979, the last day of FGGE. The spacecraft was then drifted eastwards back to the USA.

2.2.3.2 General discussion

At CGMS X, Japan remarked that the most desirable contingency plan would be for each operator to have an in orbit spare always available, but that the great expense involved made this impractical. There were two possible solutions:

(a) to have international financial support for the satellite operators,

(b) CGMS to undertake the study of the feasibility of having common back-up satellites with the second generation of geostationary satellites.

The first solution was considered impracticable.

All operators expected their present series of satellites to last until about 1995. CGMS XI recommended that serious consideration should be given to the development of common interface specifications between second generation satellite systems.

Two working groups were created to study specific areas of common interface.

One group, led by ESA, reviewed telemetry, command and frequency management aspects. Standardisation and compatibility schemes would be expected to cover:

a) the frequency range of up and down-links

b) the ground station G/T and EIRP

c) the housekeeping telemetry and command formats

d) the satellite transponder bandwidth for dissemination and ranging

The other group led by USA reviewed imaging parameters and proposed:

i) a definition of minimum image parameters

ii) the need for agreement on a common communications interface

iii) the establishment of a standard data interface

iv) the establishment of a standard housekeeping format

At CGMS XII, USA proposed using the 2500 IR lines/image, being already the European and Japanese standard.

At CGMS XIV WMO defined a set of services for remote sensing, direct broadcast and data collection which might lead to the requirements specification of a common backup satellite. It was agreed that CGMS members should develop this concept further within their own user communities.

It was further recommended that satellite operators consider incorporating frequencies of 2034 MHz for telecommand and 2209 MHz for telemetry on next generation satellites as this would enable the control of satellites during emergencies through the NASA Deep Space Network (DSN) anywhere in the world.

Satellite operators were also asked to consider the inclusion of a transponder capable of receiving the Search and Rescue (406 MHz) transmissions in next generation spacecraft to expedite the location of sources of emergency broadcasts.

At CGMS XV Japan stated that it intended to maintain the geostationary meteorological satellite service with at least one GMS located at 140 degrees East. In addition, it was reported that the Australian Bureau of Meteorology and the Japan Meteorological Agency had agreed informally to cooperate in order to maintain a geostationary meteorological service over the Western Pacific Region well into the 1990s.

At this same meeting the WMO presented an evaluation of alternative strategies to achieve reliability and continuity of coverage from a global network of geostationary meteorological satellites. The alternatives were:

a) redeployment of operating satellites;
b) moveable spare satellites;
c) "fail-soft" overlapping coverage.

It was agreed that the redeployment of operating satel- lites was not a viable strategy due to the inability to rationalise the needs for geographical coverage by different users.

CGMS members endorsed the idea of promoting increased direct participation in geostationary meteorological satellite operations especially among countries such as Australia and PRC who were considering such possibilities. It was recognized that such additional satellites would provide some overlapping coverage and thus provide the basis for a "fail-soft" system over some geographical areas. It was also recognized that this type of global network would take a very long time to develop.

EUMETSAT, attending CGMS XV for the first time, introduced four specific recommendations to satellite operators to facilitate the use of neighbouring satellites to fill gaps left by satellite failure.

Taking note of the various plans described during CGMS XV, it appeared that in the next decade there could be as many as 13 geostationary meteorological satellites:

Europe	1 operational / 1 standby
India	1 operational / 2 standby
Japan	1 operational
PRC	1 operational
USSR	1 operational / 2 experimental
USA	2 operational / 1 standby

Although the deployment would not be optimal, there was room for optimism that the reliability of the global network could be greatly enhanced, provided that all geostationary meteorological satellite operators con- tributed to the needs of the global meteorological community.

2.3 Administrative Liaison between Satellite Operators

The need for coordination between the satellite systems entails a certain amount of administrative liaison between the satellite operators. CGMS VII recommended a procedure for notifying other operators when normal operations of a satellite were suspended.

WMO agreed that addressed messages on the GTS (administrative) could be used in accordance with the provisions of paragraph 2.4, Part II, Volume I of the Manual on the GTS.

2.4 Engineering Contact

At CGMS XI it was suggested and agreed that each satellite operator nominate an engineering contact to discuss common spacecraft problems.

The list of these points of contact is provided in Annex 11.

2.5 Glossary of Terms

Over the years CGMS working groups have recommended the precise definition of certain terms which play a role in the design of the geostationary satellite system.

The complete list of terms, as accepted for common use by all CGMS participants, is given in Annex 1.

2.6 Satellite Systems Operations Reports

CGMS members have agreed to exchange regular quarterly reports describing spacecraft operations.

3 COORDINATION OF DISSEMINATION

3.1 Dissemination via Satellites

3.1.1 Technical Standard

High resolution visible and infrared image data generated by the geostationary meteorological satellites are transmitted and broadcast in several different ways and at different levels of quality, i.e.

1. direct transmission of raw image data to a unique sophisticated Central Station or to a limited number of moderately sophisticated Data User Stations

2. retransmission of pre-processed high resolution image data to a limited number of moderately sophisticated Data User Stations

3. retransmission of low-resolution image data (or other meteorological data) to a large number of simple APT and Data User Stations (WEFAX dissemination)

4. retransmission of image or other meteorological data digitally encoded to a large number of low cost Data User Stations

Types 1 and 2

The precise configuration and performance of the USA, European, Indian, Japanese and Russian satellite systems differ from each other depending upon their specific design; no standardisation of these transmission schemes has been attempted, however, CGMS members are regularly kept informed on the status of each system and it has to be noted that some exchange of high-resolution image data between neighbouring satellite systems, after reformatting and retransmission, is possible through dedicated ground relay stations. Such a facility exists in Lannion, France, for the acquisition of GOES-East image data. The images are received in Lannion, reformatted and retransmitted to users via METEOSAT.

Type 3

WEFAX Dissemination allows many thousands of users worldwide (mainly concerned with the visual exploitation of images) to have easy access to image data and other meteorological information relayed by the satellite systems.

It was therefore vital that agreement could be reached on a common set of technical standards for image transmission bearing in mind the desire of the user community, for financial reasons, to operate simple ground stations. It noted that already many potential users operated VHF APT receiving stations acquiring imagery from polar orbiting meteorological satellites.

The standards developed for WEFAX dissemination were such that image data could be received by most existing APT Stations with relatively minor modification. Interest in the WEFAX service has grown significantly over recent years and the number of commercial and amateur manufacturers of WEFAX/APT ground- stations still shows a steady rise.

The worldwide WEFAX dissemination frequency is 1691.0 MHz

Type 4

a) Digital WEFAX

The concept of digital WEFAX was introduced by WMO at CGMS XIV. It is presently being studied by several satellite operators, however, because of the large user community its implementation is not foreseen on any permanent basis for several years and probably not before the next generation of geostationary meteorological satellites.

At CGMS XVII EUMETSAT introduced some further considerations on digital WEFAX. It was shown that it was possible to disseminate WEFAX images using digital techniques and employing existing international standards in tele-communications and data processing. WMO strongly supported the idea of a common standard for digital WEFAX and noted that because of the very large user community an adequate change-over period would have to be considered. The meeting agreed that a working group should be set up to study the matter.

b) MDD

Also at CGMS XVII EUMETSAT provided a description of the Meteorological Data Distribution (MDD) mission to be implemented on the MOP satellites. Meteorological data will be transmitted from two uplink stations in Europe using up to four possible discrete transmission channels at 2400 bits per second. The data will be in the form of alphanumeric characters, bit orientated data streams and graphical information, and will be relayed via the satellite to relatively low cost user stations. The MDD service is being established primarily to meet the needs of national meteorological services in Africa.

3.1.2 Operational Considerations

The aim of coordinating satellite dissemination is to provide user stations with meteorological data in an optimised manner. Some of the areas inviting coordination are:

a) the dissemination of image data taken by a geostationary satellite

b) the dissemination of other meteorological data, e.g. meteorological charts

c) the dissemination of data from one geostationary satellite via a neighbouring geostationary satellite

d) the dissemination of data directly from a polar orbiting satellite

e) the relay of data taken from a polar orbiter through a geostationary satellite

The possibility of coordinating these different methods of providing data to user stations have been studied in depth by CGMS.

It became clear in early CGMS meetings that the last two types had to be left un-coordinated as their inclusion in a general coordination pattern is either impracticable or, for the time being is technically unfeasible.

Bearing in mind that user stations, even outside the communication range of a geostationary satellite, may have a requirement for data from neighbouring satellite areas, CGMS has so far recommended that such data requirements be handled through bilateral arrangements.

Thus, in the METEOSAT transmission schedule, provision is made for image data from GOES-East, to be relayed via Lannion and METEOSAT. A pre-requisite for this bilateral arrangement between ESA and NOAA was the coordination of sub-satellite positions so as to ensure that the GOES satellite was visible from Lannion.

In complement, USA dissemination schedules now include several METEOSAT images.

At CGMS XIV, the interest of CGMS members in receiving broadcast INSAT-1B data for operational purposes on a real-time basis was clearly identified and India was asked to investigate the possibility of making INSAT data available for retransmission to CGMS members. Some possibilities for the retransmission of INSAT images via METEOSAT were presented by EUMETSAT at CGMS XVII.

At CGMS XV the USA announced its plans for a data dissemination scheme using Domestic Communications Satellites. Implementation of this scheme was currently scheduled to begin in 1987 and be completed by the early 1990s. It would result in a third dissemination method for GOES data (both East and West) in addition to WEFAX and Mode AAA. A pricing policy would be established for the reception of these (DOMSAT) transmissions.

CGMS has recommended that WMO be given information on the transmission schedules established by the various satellite operators on a regular basis. This information has in turn been published by the WMO in its regularly updated Publication No. 411 - Information on Meteorological Satellite Programmes operated by Members and Organisations.

3.1.3 Status of High Resolution Image Dissemination

3.1.3.1 EUMETSAT

High resolution METEOSAT image formats and some GOES-East image formats are disseminated in a digital data stream at 166.6 kbits/second to Primary Data Users Stations (PDUS).

3.1.3.2 INDIA

Eleven full earth disc images from the INSAT-1B VHRR are transmitted daily to New Delhi. Additional hourly and half hourly high resolution images are commanded during special activity periods such as the monsoon months or adverse weather/cyclone situations. So far the maximum number of images commanded in a single day has been twenty seven.

3.1.3.3 JAPAN

High resolution image dissemination is accomplished by both the direct read-out of stretched VISSR data and analogue transmissions, called HR-FAX, containing processed VISSR images and somewhat similar to WEFAX transmissions. There are 21 stations receiving High Resolution dissemination, including 17 stations located outside Japan.

The current HR-FAX dissemination will be discontinued in January 1989.

3.1.3.4 USA

High resolution image dissemination is only possible via the direct readout of stretched-VISSR data. Currently, there are 13 direct readout facilities capable of receiving stretched VISSR or VISSR Atmospheric Sounder (VAS) data. These are located in Brazil, Canada, France, Mexico and USA.

Mode AAA dissemination was implemented operationally in March 1987 for the retransmission of GOES VAS data following the launch of GOES-7.

3.1.4 Low Resolution (WEFAX) Iage Dissemination

3.1.4.1 EUMETSAT

Meteosat dissemination channel 1 (1694.5 MHz) is, for the time being, used for the dissemination of analogue (WEFAX) data. There are over 1000 stations receiving these data, including more than 80 meteorological service stations. Some GOES-East imagery is included in the dissemination.

At the request of CGMS, EUMETSAT will adopt the 1691 MHz frequency channel for WEFAX dissemination following the launch of METEOSAT-4 in 1989.

3.1.4.2 INDIA

Low resolution analogue images are transmitted every three hours from INSAT-1B to about 20 Secondary Data Utilization Centres (SDUC) in India using leased communications links.

As part of a national Disaster Warning Scheme (DWS) India has deployed about 100 DWS stations on an experimental and demonstration basis, each capable of receiving warning messages relayed by the satellite.

3.1.4.3 JAPAN

WEFAX image data is received by a total of 221 user stations in Japan of which 16 are meteorological offices.

Outside Japan 25 meteorological services are known to recieve the data.

Because of the similarity between GMS LR-FAX and WEFAX provided by the other satellite operators LR-FAX transmissions have been renamed WEFAX transmissions.

IR WEFAX images are enhanced for easier identification of low cloud patterns during the night and for immediate discrimination of hazardous cumulonimbus cloud clusters. A digital annotation for automatic recognition of products by user stations has been implemented.

Since March 1987 the 7 sectorised low resolution images were reduced to four. Sectorised projections are now polar stereographic in the region of Japan.

3.1.4.4 USA

The US WEFAX service normally uses three satellites to relay image data.

Before its failure GOES-6, the imaging satellite located at 135.5 degrees West, was broadcasting a WEFAX schedule on 1691 MHz. The East imaging satellite GOES-7 was located at 74.5 degrees West, and broadcast a full WEFAX schedule including some Meteosat image formats. The Central relay of WEFAX imagery was initially carried out using GOES-5.

From March 1988, GOES-5 was drifted eastwards to a position close to 65 degrees West to support the eastern WEFAX service. Following the GOES-6 failure, GOES-7 is slowly being drifted to the central position (either 98 or 108 degrees West depending upon the season).

3.1.5 Disseminated DCP Data

EUMETSAT has been disseminating unprocessed Data Collection Platform messages via the METEOSAT WEFAX channel since 1983. This system provides a near real-time (four minutes maximum delay) relay of messages to suitably modified WEFAX receiving stations.

3.2 Dissemination via the GTS

3.2.1 Types of Messages

The Global Telecommunication System (GTS) of the WMO, with its worldwide extension and high capacity, provides an excellent means for further dissemination of satellite meteorological information and products. CGMS have identified four tasks which can only be implemented adequately by means of the GTS.

These are:

a) dissemination of numerical meteorological data derived from imagery

b) dissemination of DCP reports

c) relay of administrative messages

d) relay of basic meteorological data

Except for the last function where bilateral arrangements are necessary, agreement has been reached between the satellite operators and WMO on the role of the GTS with regard to the future operation of geostationary meteorological satellite systems.

3.2.1.1 Dissemination of Meteorological Products

The satellite operators or associated meteorological services derive several meteorological parameters from satellite image data, e.g. cloud motion winds, sea surface temperatures, cloud analysis, upper troposheric humidity, and radiation balance.

Satellite processing centres disseminate their products in coded form on a regular basis to various meteorological centres. The data are used for the preparation of analysis charts and as input to the analysis schemes of numerical forecast models.

3.2.1.2 Dissemination of DCP Reports

The International Data Collection System (IDCS) is designed to relay messages from DCPs mounted on ships, aircraft, balloons and ocean buoys, i.e. they are mobile DCP likely to move within the fields of view of several geostationary meteorological satellites. Time slots for messages are normally 1.5 minutes (including two 15 second guard bands, therefore the total message cannot be longer than 60 seconds. For DCPs admitted to the IDCS prior to 1986 and for ASDAR the message length remains 2 minutes (a one minute message plus two 30 second guard bands).

33 channels have been allocated to the IDCS (with centre frequencies spaced 3 KHz apart) each using the same frequencies within the band 402.0 - 402.1 MHz regardless of the satellite.

IDCS Admitting Authorities have tried, where possible, to allocate time slots to DCPs between HH+OO and HH+30 (HH being the synoptic hour in a 3-hourly or 6-hourly sequence). Disseminations of ship and other reports over the GTS are scheduled as soon as possible thereafter, i.e. in the time interval between HH+00 and HH+60.

ASDAR-equipped aircraft transmit reports at hourly intervals within allocated time slots. A report consists of several measurements taken every 7 minutes over one hour. The satellite operator (or associated processing centre) compiles all the ASDAR reports into bulletins for dissemination via the GTS. Users need not separate the bulletins from individual satellite operators since duplicated ASDAR reports from overlapping zones are easily detectable.

ASAP messages (surface and upper air data) from ships are normally based on measurements taken at 00 and 12 UTC, however additional measurements at 06 and 18 UTC are becoming commonplace. In order to allow sufficient time for the total balloon ascent and computation of results ASAP messages are usually relayed to the GTS at about HH+60 minutes. Back-up slots for delayed messages are also made available about one hour later.

3.2.1.3 Relay of Administrative Messages

CGMS identified the need for a system of notification to other operators and the user community whenever normal operations of a satellite were suspended. WMO agreed that for notification between satellite operators, addressed messages on the GTS could be used in accordance with the provisions of paragraph 2.4, Part II, Volume I of the Manual on the GTS. As regards notification to users, this would be done via the normal practices of the satellite operators, i.e. broadcast plain language ADMIN or operations bulletins, telex, newsletters, electronic bulletin board etc.

3.2.1.4 Relay of Basic Meteorological Data

At CGMS V ESA announced a requirement for the relay of basic meteorological data, particularly from the southern hemisphere part of the METEOSAT field of view, which were needed for the derivation of meteorological products.

As the GTS was the only suitable means for transmitting this data from World Meteorological Center (WMC) Washington to the METEOSAT ground station in Darmstadt, CGMS agreed that:

a) the amount and type of data to be provided would be agreed between ESA and NOAA

b) the impact on the GTS would be considered by the appropriate WMO bodies

After further review WMO advised the CGMS that the expected load on the GTS was well within its capabilitiesties.

3.2.2 Code Formats

The transmission of DCP messages or meteorological information derived from satellite data on the GTS is carried out using established WMO code formats. These codes are outlined in Annex 2.

3.3 Dissemination Policy

At CGMS XIV, USA confirmed its Government's intention to continue to share meteorological data on a no-cost/non-discriminatory basis and to support open international data exchange and cooperation. This would include the provision of weather satellites and derived or communicated data free-of-charge to individual foreign ground stations through direct read-out, in such forms as WEFAX, DBS, APT and HRPT broadcasts.

4 COORDINATION OF DATA COLLECTION

4.1 General Description of the IDCS

The purpose of the Data Collection Systems is to gather environmental data measured in-situ by remote DCPs using the satellites as telecommunication relays. Collected data are acquired and handled by central ground facilities and then distributed to the different users in various ways.

From a functional point of view, DCPs which can be operated by various satellite systems are of two main types:

a) self-timed DCPs which transmit their reports automatically within pre-set times and frequency slots and which are driven by an internal stable clock

b) alert DCPs which transit messages only when certain parameter thresholds have been exceeded

DCPs of either class can be either land-based, sea-based (buoys, ships) or airborne.

The mode of access of DCPs to the Data Collection Systems is by frequency and time division multiple access, with fixed pre-assignment of frequency and time slots.

From an administrative point of view, and because the satellite systems form part of a world-wide network in the framework of the WWW, a further distinction is made between:

i) International DCP which are mobile and can be operated by any one of the satellite systems;

ii) Regional DCP which are under responsibility of, and operated by, a single satellite operator.

4.1.1 Coordination of International and Regional DCP

The operation of the International Data Collection System has been coordinated by CGMS, with frequencies and bandwidths being selected to avoid any risk of interference with Regional Data Collection Systems.

The frequencies allocated are:

International	402.0 to 402.1 MHz
Regional	
USA and USSR	401.7 to 402.0 MHz
Japan and EUMETSAT	402.1 to 402.4 MHz

CGMS VII agreed that the distribution of international and regional channels would not be rigid and could be discussed at future CGMS meetings, taking into account the real usage of the allocated bandwidth.

Up to the present there has been no requirement to make any adjustment, but it was noted that the International channels could be used more efficiently if the ship reporting interval could be extended from the present HH +/- 30 minutes (where HH is a synoptic hour: 00, 03, 06, 09, ... 21 GMT).

CGMS XII, recalling that the IDCS was to be used operationally for mobile DCPs only, agreed that fixed DCPs could be admitted for up to one year on an experimental basis (depending upon satisfactory arrangements between users and the satellite operators concerned).

Japan proposed at CGMS XV the idea that if all regional channels for a given satellite were in use but not all international channels are being used, then it might be possible to allocate some unused international channels for use with regional DCP. CGMS confirmed, however, that presently agreed frequency allocations would be reserved for regional and international DCPs. The situation would be reviewed at the time when an operator or operators were experiencing problems in allocating channels on either regional or international bands.

4.1.2 Standardisation of the International Data Collection System

The precise characteristics of Regional data collection systems differ from one to another and are under the responsibility of each satellite operator.

CGMS realized that it was necessary to adopt a common standard for the IDCS, enabling every IDCP to operate with any of the satellite systems. In the past this matter has received considerable attention by CGMS working groups with particular emphasis on technical characteristics of IDCPs, operational procedures and administrative aspects.

ESA expressed the need for a common IDCS Users Guide at CGMS IX. The need for such a document was agreed and ESA presented the first draft for consideration by the other operators at CGMS X (see 4.2 for details).

At CGMS IX, USA proposed to re-channel the frequencies starting at 402.002500 MHz and incrementing by exactly 3.0 KHz. This proposal change was agreed at CGMS X.

CGMS X also agreed that support for interrogated DCPs would no longer be provided.

4.1.3 IDCS Capacity and Limitations

The satellite operators agreed to set aside 100 KHz of the bandwidth available for data collection for use by the International data collection system. This bandwidth was further subdivided into thirty-three channels each 3 KHz wide. The majority of meteorological messages normally only require between 30 and 60 seconds of transmission time. This means that the system has a theoretical maximun capacity, assuming a six-hour reporting cycle and a one minute message transmission period) of 11,880 platforms (33 channels x 60 platforms/hour x 6 hours).

In practice, there are a number of limitations which limit the real operating capacity of the system, e.g.: self-timed platform system inefficiency, synoptic requirement and the message length.

4.1.3.1 Synoptic requirement

Since most meteorological observations are required within a relatively short time after the synoptic hours, the system supports a sharp peak of message traffic at these times and a relatively low use at others.

4.1.3.2 Message length

Each self-timed platform is assigned exclusive use of a specific time reporting interval on a specified channel.

If the platform is not in operation (e.g. a ship in port), no use is made of its assigned reporting interval.

The allotted reporting interval can exceed the maximum message length by up to one minute (i.e. 30 second guard bands at the beginning and end of the message) to prevent the risk of interference between messages. In practice most messages are now 1.5 minutes in length (one minute message plus two 15 second guard bands). Exceptions are some pre 1986 DCPs and ASDAR messages.

Although most meteorological messages are generally less than one minute in length, there may be some platforms which will generate significantly longer messages (e.g. ASAP) and thus require a number of sequential reporting intervals to be allocated to them in order to transmit their reports.

In order to make more efficient use of the IDCS, CGMS XIV agreed that the total time slot should be 1.5 minutes instead of 2 minutes and that an extension of the synoptic hour time slot should be considered. At CGMS XV WMO confirmed that ASAP messages could in fact be accommodated within the 1.5 minute time slots.

4.2 IDCS Users' Guide

The IDCS User's Guide, provides specifications and guidelines for the design of platforms, describes the procedures for certification and admission and details the operational support provided to platforms. Copies of this document can be obtained from the CGMS Secretariat (for the address, see Editors note at the beginning of this document).

4.3 Data Collection System Information

4.3.1 EUMETSAT

The Meteosat data collection mission was transferred to METEOSAT-3 on 20 July 1988. It may be recalled that from July 1985 up to that date the mission had been supported by GOES-4, because of a system failure on METEOSAT-2.

Six receiver channels for the international system (I12, I14, I15, I16, I17, I18 are currently in use, however, the full capacity (33 channels) will become available for use early in 1989.

Because of continuous interference I16 has been taken out of service until further notice. All attempts to identify the source (similar to an uncontrolled DCP) have so far been unsuccessful.

4.3.2 INDIA

The INSAT Data Collection System operates with Data Collection Platforms working in pseudo-random burst mode at a single frequency. Approximately 100 DCPs are currently using the system. The Data Relay Transponder is, however, experiencing external sweeping interference from terrestrial sources. Interference from voice modulated signals has also been observed on some occasions. The interference causes a data gap of about 1 to 2 hours duration daily between 1800 UTC and 0000 UTC. During this period, data from less than 10 stations are received and on some occasions none at all.

4.3.3 JAPAN

JMA now has the capability to operate 33 IDCS channels. By late 1988 I12, I14, I15, I16, I17 and I18 were regularly in use.

4.3.4 USA

Having removed many inactive DCPs from the DCS ground system data base, there are at present approximately 3000 active DCPs. System capacity remains about 5000.

Due to the limit of 80 channel receivers which can be supported by the present ground configuration and current allocations to regional channels, only four international channels (I14, I15, I16 and I17) are available for use.

By mid 1989 a new DCS Automatic Processing System (DAPS) will be installed which will support the full frequency band allocated to the IDCS.

4.4 ASDAR Support

The ASDAR experiment which began during the FGGE is expected to become an operational system by mid 1989. Some pre-operational ASDAR flight systems are still supported by satellite operators.

The operational ASDAR system is financed through a WMO trust fund to which any WMO member may contribute. ASDAR is being developed under the auspices of WMO, CAD (Consortium for ASDAR Development - the group responsible for the development of a new ASDAR platform) and OCAP (Operational Consortium of ASDAR Participants - the consortium which will purchase ASDAR units, arrange their transport and operation on-board member countries' airlines and manage their maintenance).

OCAP came into being in March 1985 with the membership of Australia, New Zealand, Spain, UK and USA. The Netherlands and Switzerland joined during 1988.

OCAP has agreed to establish a capability for the monitoring of the ASDAR system. This monitoring will include coordination with the satellite operators and involved meteorological services. Initially the UK will provide this capability through the Meteorological Office, Bracknell. The UK will develop the techniques required, including acting as the single point of contact for the satellite operators on operational ASDAR matters. After a year of operations as this centre the UK will report to OCAP which will then decide on the best procedure for long term operations.

In 1986 an initial contract for the development of new ASDAR flight units was awarded to McMichael (UK). This contract was taken over by Marconi Space Defence Systems (UK) in 1987.

At CGMS XIV WMO proposed to have the 6-character aircraft identifier changed into a 7-character identifier to permit both ASDAR unit and aircraft identification. Furthermore, it was agreed at CGMS XV that a 2 minute time slot would for the time being continue to be used for operational ASDAR units as well as for the presently operating experimental ASDAR units.

Some interference has been observed on international channels 17 and 18 currently allocated to ASDAR. USA and EUMETSAT were asked to evaluate the level of interference on these channels. No sweeping interference has so far been detected in the US sector.

The first production ASDAR achieved IDCS certification in July 1988. CAA and FAA certifications are expected early in 1989.

The number of units expected to be in operation are:

1988	7 pre-operational units
1989	plus 6-10 operational units
by 1990	up to 29 operational units

4.5 Ships

Marine meteorological programmes (e.g. the Operational WWW System Evaluation programme for the North Atlantic (OWSE-NA) will have significant impact on the IDCS over the coming years. The status of use of the IDCS for marine purposes is as follows:

4.5.1 USA

The Shipboard Environmental (Data) Acquisition System (SEAS), managed by the National Ocean Service of NOAA, is a project based on delivering real-time marine data from ships at sea.

At present SEAS units deliver marine meteorological and sub-surface temperature data (XBT) and plans exist to increase the amount information provided by the system. Allocations for about 130 SEAS systems have so far been made for operations in the Atlantic, Pacific and the gulfs of Mexico and Alaska.

4.5.2 UK

The Meteorological Office System Ship (MOSS) has been developed by the United Kingdom Meteorological Office and around 30 ships are at present operational. Firm plans exist to increase this number to 50 by the early 1990s.

4.6 ASAP

The Automated Shipboard Aerological Programme (ASAP) was developed by Canada and USA jointly and by France. A commercial version is also available from Finland. Operational use of the system began in 1985 and the numbers expected to be in use are:

1988	15
1989	17

Countries participating in the ASAP programme are Canada, Denmark, Finland, Federal Republic of Germany, France, UK and the USA.

Each ASAP station requires, in addition to regular transmission times, backup time slots for delayed transmissions.

The concept of additional variable asynoptic time slots matching polar orbiter overflights has been studied as part of the ASAP participation in the evaluation of the Baseline Upper Air Network (BUAN).

Based on general ASAP requirements, CGMS XV agreed:

a) to use a 1 minute 30 seconds time schedule on international channels I12 (North Atlantic) and I16 (elsewhere) for future ASAP admissions

b) to study the possibility for variable asynoptic time slots

4.6.1 ASAP time slots

CGMS XVI reconsidered the request of the ASAP Coordinating Committee (ACC) to provide 8 time slots per day per ship (00, 06, 12, 18 UTC plus back-up). Due to resource limitations, which varied among different satellite operators, CGMS was unable at that time to meet this requirement. It was noted that several operators were in the midst of upgrading ground data handling systems. All satellite operators confirmed at CGMS XVII that they would be in a position to support 8 time slots for ASAP in the very near future.

It was also agreed that for special projects operating over a restricted time period or in a restricted geographical region, additional time slots might be allocated. However, these situations would be handled on a case-by-case basis and might require either priority trade-offs by individual users or coordination among groups of users (e.g. the temporary suspension of certain observations to accommodate higher priority ASAP reports).

4.7 Support to Scientific Balloon Flights

At CGMS-X USA presented an experiment proposed by the National Scientific Balloon Facility (NSBF) for IDCS support of a high altitude balloon which would circle the Earth around 30 degrees South latitude for about 6 weeks. Certain requirements on reporting periods, format structure and data delivery were put forward by USA but these were not in accordance with IDCS standards and were incompatible with the Data Collection Systems of Japan and ESA. USA reported back to NSBF who consequently changed its equipment to make it compatible with IDCS standards.

Since the experiments to be carried on the balloon flight were outside the standard applications of the IDCS, ESA obtained approval from the Meteosat Programme Board to provide support.

The balloon was eventually launched from Brazil on 29 January 1981 but it failed at a height of around 15000 meters during the initial ascent. Some data were received by GOES and METEOSAT satellites.

A second NSBF balloon was launched from Australia on 19 January 1983. The westerly trajectory permitted data collection by METEOSAT-1 some 41 hours after launch. Data were received over a period of about 7 days. On 7 February, METEOSAT re-acquired the balloon on its second orbit of the earth. The balloon finally failed on 10 February 1983.

The balloon DCP transmitted 55 second messages every minute on channel I16. Support from GMS, GOES-E, GOES-WEST and METEOSAT-1 was instrumental in making this flight a success.

It was agreed at CGMS XIV that support to scientific balloon flights would in future only be given on international channel 16 (as in the past) if it was not being used for ship reports.

At CGMS XV some members were not prepared to dedicate a specific channel to this type of experiment but agreed to allocate frequencies and time slots on an as-required basis.

In February 1988 NSBF carried out a further balloon flight from Australia to Brazil. IDCS channel I13 was activated exceptionally for this experiment. Data were received by the METEOSAT DCS via the GOES-4 satellite.

4.8 Interference

At CGMS XV members noted that they had been experiencing interference on many frequencies used for the Data Collection System. CGMS, noting that both the importance and utilization of these frequencies would continue to increase, felt that the meteorological user community needed effective use of the complete frequency band without interference from non authorised users. It was agreed that there should be detailed documentation of all interference events.

It was further agreed at CGMS XV that the WMO Secretariat would compile information received from the satellite operators and informally discuss the matter with the ITU.

5 COORDINATION AND RETRIEVAL OF ARCHIVED DATA

5.1 Introduction

The most obvious characteristic of data flowing from geostationary satellites is its immense quantity which presents formidable archiving problems.

There are two distinct categories of data:

a) image data, and image derived data (wind vectors, SST, etc.)

b) data collected from DCPs via the satellites

5.2 Image Data

The vast quantity of image data poses severe storage problems if it is wished to archive all data in digital form. Operators have been urged to archive at least some of the digital data, but in general the problem is so great that the form and extent of each archive has been dictated largely by local interests rather than by any agreement within CGMS.

The most usual solutions proposed include a full photographic archive plus storage of selected images in digital form. There has been a trend towards more comprehensive digital archives in recent years as storage technology develops.

A measure of standardisation of data formats on magnetic tape has been achieved. CGMS agreed to adopt as a standard the format used to deliver METEOSAT image data on 6250 bpi CCTs.

CGMS XVII noted that the advances being made with the development of efficient data archive technology were not keeping pace with the expected production of data from the next generation of earth observation satellites. The main problem was still the space needed to store the large volume of image data (e.g. for METEOSAT, ESOC has over 18000 data tapes in store)

Also at CGMS XVII several members indicated that they were considering adopting the cartridge magnetic tape system for the archive of image data in the future. The meeting noted that this system had already been successfully implemented by Japan.

5.3 Image Derived Data

The problems of archiving image derived products (wind vectors, sea surface temperatures, etc.) are less severe. Proposals by individual operators permit the full retention of these data in digital form. WMO has stressed the need to have products permanently stored in a form suitable for easy computer access.

5.4 DCP Data

There have to date been no firm agreements between operators to archive DCP data, although it has at times been suggested that certain of these data should be stored in raw unprocessed form for some limited time, or for selected areas, in order to support scientific research.

5.5 Catalogues and User Procedures

It was agreed at CGMS XIV that it was extremely important to establish an easy access to data archives, and to catalogue their contents. Satellite operators have presented details of their archives, together with the policies and procedures governing their use.

5.6 Reference grids

CGMS has recommended that all image archives should be accompanied by some form of reference grid. This could be added to the image or be in the form of a separate overlay. The grid should be sufficiently accurate for general research, but no standard grid interval has been determined.

5.7 Systems operated by members

Several papers describing present and proposed archives have been reviewed by to CGMS, and are summarised below.

5.7.1 EUMETSAT

The Meteosat System Guide, Volume 11 - Meteosat Data Service, describes the archiving system whilst Volume 12 - Magnetic Tape and File Descriptions, provides the necessary information to read the digital archived data. Requests for these documents, should in the first instance be directed to EUMETSAT, at the address shown at the beginning of this document.

Routine requests for archived data should be addressed to:

Mr J Le Ber
OD/MEP/DAT, ESOC
Robert Bosch Str 5
6100 Darmstadt,
Federal Republic of Germany

The digital archiving system is based on 6250 bpi CCTs. The photographic archive contains two METEOSAT image slots per day. Images for other slots can be generated from the original digital data on request.

The range of products presently available includes:

a) the Meteosat Image Bulletin available on subscription

b) full spatial resolution digital image on 1600 bpi CCTs

c) reduced spatial resolution digital image on 1600 and 6250 bpi CCTs

d) special 1600 or 6250 bpi CCT's ordered in advance

e) photographic images (20 x 20 cm and 40 x 40 cm) original negative or positive contact prints

Floppy disks and optical disk storage devices are being studied for possible future use with archived material.

5.7.2 INDIA

INSAT data are archived on 1600 bpi magnetic tape and film. Data for the first year of operation was partially archived however all data has been archived since 1985. The long-term retention policy for the INSAT data is being reviewed.

Data is available from:

India Meteorological Department
Lodi Road
New Delhi
110003 India
(attention: Director of Satellite Meteorology).

5.7.3 JAPAN

Following the upgrade of the computer system in March 1987 VISSR image data is stored on cassette tapes using a cartridge magnetic tape system. This system is, however, not compatible with IBM and other systems.

All archived data including printed pictures from film negatives can be purchased from:

Japan Weather Association
Dept. of Data Service
1-3-4 Otemachi
Chiyoda-ku, Tokyo 100
Japan

The reader should note, however, that use of the cartridge tape system does not prohibit the availability, by special request, for image and other data on 6250 bpi CCTs.

The Data Archive comprises:

a) photographic images - original negative film (full disk, polar stereographic and WEFAX), microfilm, animated film and VIR,

b) digital data on cartridge magnetic tape (800 ft, 32000 bpi) - raw VIS and IR data, VISSR histogram data, cloud mesh data and NOAA HRPT (TOVS/AVHRR),

c) digital data on magnetic tape (2400 ft, 6250 bpi) cloud motion vectors, SST, cloud amount, TBB, SEM, TOVS and NOAA SST (around Japan)

Archives are documented in monthly reports from the Meteorological Satellite Centre and in specialised Technical Notes.

5.7.4 USA

The Satellite Data Services Division (SDSD) of the NOAA/NESDIS National Climatic Data Center is responsible for archiving data from a wide range of environmental satellites including the operational GOES. Also, as part of NOAA participation in the five year International Satellite Cloud Climatology Project (ISCCP), SDSD is acting as the ISCCP Central Archive. To support these activities, SDSD is implementing a new data processing system, the Geostationary Archive and Retrieval System (GARS).

5.7.4.1 GARS

The GARS consists of an IBM 4341 computer and specialized recording and retrieval hardware and software fabricated by the Space Science and Engineering Center (SSEC) of the University of Wisconsin. The IBM 4341 was installed in May 1985 and has been used to support polar orbiter activities since June 1985. The GOES data handling functions of the GARS will not be integrated until January 1987. At that time SDSD will begin to record GOES Mode-AAA data at full resolution. Until the integration is complete the SSEC will continue to record and process requests for GOES data. After integration, SDSD will service requests for data from that date the GARS, and SSEC will process requests for older GOES data.

Once the GARS is completely installed SDSD will become the Sector Processing Center for the GOES-West satellite. This means that SDSD will be producing 3-hourly visible and IR data at (nominally) 30 km resolution (ISCCP level B2 data).

5.7.4.2 ISCCP activities

Acting as the ISCCP Central Archive, SDSD archives B1 and B3 data from GOES, METEOSAT and GMS. (B3 data are B2 data normalized to the AVHRR instrument on NOAA polar orbiting satellites). SDSD now has the capability to produce subsets of B1 data from any of the geostationary satellites involved in the ISCCP. Users will be able to request sectors of B1 data based on date, time, and latitude/longitude. The output for these subsets will be a modified GARS format.

Archived data is available from:

> Satellite Data Services Division (E/CC6)
> Room 100, World Weather Building
> NOAA/NESDIS
> Washington DC 20233
> USA

5.7.5 USSR

The full archiving system for GOMS has not yet been fully defined, however the archive of all images in photographic format and of selected image data on 800 bpi magnetic tape is planned. Image data will be archived indefinitely.

5.8 Exchange of Satellite Photographs

CGMS VIII agreed to institute a monthly exchange of satellite photographs so that the satellite operators would be in a better position to promote the concept of a truly global system. CGMS XI agreed that a quarterly exchange was sufficient and that photographs, corresponding to local noon on 15 March, 15 June, 15 September and 15 December, should be mailed to:

Mr. J Le Ber	ESOC (On behalf of EUMETSAT)
Mr. Nobuhiko Murayama	Japan (JMA)
Mr. T. N. Pike	USA (NOAA)

In addition, CGMS has recommended that images depicting significant meteorological events might be exchanged together with a short description of the phenomena.

6 COORDINATION OF SATELLITE DATA CALIBRATION

6.1 General

CGMS has recognised the need for calibration of satellite data and this topic is regularly discussed at CGMS meetings.

6.2 Visible Data Calibration

6.2.1 Requirements

WMO informed CGMS XIV that calibrated visible data from geostationary satellites is required by the Agrometeorological and Climatological communities and the World Climate Research Programme's International Satellite Land Surface Climatology Project (ISLSCP) and International Satellite Cloud Climatology Project (ISCCP).

6.2.2 JAPAN

Japan uses a desert area in Australia as a target for monitoring the performance of the GMS visible detector. Only marginal degradation of detectors has been noticed.

6.2.3 USA

At CGMS XVII, USA reported on the normalisation of the eight channels of the GOES visible sensors, needed to prevent the image from being degraded by artificial stripes. Normalisation was performed by using look-up tables in the ground processing.

6.3 Infra-Red Data Calibration

6.3.1 EUMETSAT

The calibration of the Meteosat infra-red channel was originally performed by comparing SST extracted from image data with conventional ship data.

In the past some attempts were also made to calibrate the METEOSAT infra red and water vapour channels using the moon as a target. A bi-channel pyrometric method was used and an initial effort to qualify this method was performed in 1983. The resulting calibration factors were checked against those used operationally for meteorological parameters extraction. Results have indicated a divergence between the two and a high sensitivity of the pyrometric method to input inaccuracies. The method is not used operationally.

At CGMS XVII ESA announced that the IR channel calibration scheme had changed and calibration data was now derived by comparing the METEOSAT SST data with the global SST analysis from NMC Washington, instead of conventional SST data received via the GTS. ~~The method has been used operationally since September 1987~~

Also at CGMS XVII ESA provided information about a new scheme for WV channel calibration making use of the ESOC radiation scheme to calculate pseudo-radiances from radio-sonde data and then relating them to WV counts with which they are collocated. The new scheme allowed a physically consistent calibration and took account of the contribution function of the WV channel. Both methods have been used operationally since September 1987.
Since November 1988, IR and WV calibration are performed every 3 hours.

6.3.2 INDIA

A black body calibration is performed at the end of each image frame which is then used to calibrate the data.

6.3.3 JAPAN

GMS VISSR infra-red calibration has been regularly monitored. It was discovered that varying thermal conditions on-board the spacecraft were affecting the response of the sensors. This phenomenon was very noticeable during eclipse periods, when the spacecraft was cooled due to the interruption of solar illumination. The estimated calibration error reached about 4 degrees K for images taken just after eclipse.

To cope with this problem a new calibration procedure was developed, differing from that originally in use, where-by a calibration table is created for each time zone of the day (i.e. for each image) separately. In the original procedure only one calibration table was applied to all images. The new procedure has reduced the calibration errors occurring during eclipse periods to about 1degree K.

Routine electrical staircase and deep space calibrations are now found to be very stable. Furthermore, the performance of the IR shutter calibration has been satisfactory and predictable.

Since March 1987 JMA have used a new calibration scheme. Calibrations are performed at 3-hourly intervals. They are also used as forecasts for the same/or nearest image time the following day.

6.3.4 USA

GOES IR data are calibrated weekly and provide a temperature resolution of about 0.5 K.

Difficulties exist when operating the spacecraft in the Transparent VAS Mode (TVM); IR image are sometimes striped and diurnal variations in calibration cannot be tracked. Following the introduction of AAA Format in 1987, calibration data is transmitted in near real-time.

6.4 Intercalibration Between Satellites

The major problem in achieving an accurate and stable inter-comparison among different geostationary satellite data is due to the different sensor specifications, in particular, the spectral response function.

The Centre de Météorologie Spatiale (CMS) in Lannion, France, acting as a Satellite Calibration Centre (SCC) for the International Satellite Cloud Climatology Project (ISCCP) has continued to develop methodology for providing periodic satellite-to-satellite radiance normalisation. The technique being used involves the overlap of coincident polar orbiting and geostationary satellite images and the regression of multiple common target brightness temperatures and directional reflectivities. First results are encouraging and stable with respect of time.

7 COORDINATION OF METEOROLOGICAL PARAMETER EXTRACTION

At CGMS XV WMO, with the assistance of EUMETSAT, preseneted a draft revised version of WMO Publication No. 411 "Information on Meteorological Satellite Programme Operated by Members and Organisations". A request was made to all satellite operators to provide updated information on their satellite programmes and, in particular, information on image products.

A revised edition will be published early in 1989.

7.1 Cloud Wind Vectors

7.1.1 International Comparison of Satellite Winds

CGMS has agreed on the need for international intercomparison of satellite winds in order to assess the homogeneity and accuracy of this product. Two forms of comparison have been proposed and accepted:

a) direct intercomparison between satellite winds in the areas of overlap between adjacent satellites,

b) intercomparison with conventional data

Intercomparison between adjacent satellites is achieved by all participants sending wind data on magnetic tape to the USA, where collocations are found and results computed. The comparisons with conventional data are the responsibility of each operator, but results are mailed to the USA for inclusion in a coordinated report. The first comparison took place in July 1978. Where possible comparisons are carried out in two periods each year.

At CGMS IX, two problems were outlined:

a) the precise size of the collocation boxes used for the comparison between satellite and conventional data. By CGMS X, ESA and USA agreed to retain the CGMS III collocation box and Japan agreed to increase the radius of its collocation circle to 310 km,

b) the screening of non-satellite data for gross errors. The value for rejection threshold of 30 m/sec was adopted at CGMS X

CGMS X reviewed the results achieved so far and concluded that wind data from all three Agencies were for the most part compatible.

Because of the peculiar characteristics of wind derivation, interpretation of comparison statistics could be made only by taking into account the different data reduction procedures used by different Agencies.

CGMS has since come to the following general conclusions concerning wind vector differences:

a) the principal source of difference between all wind sets is the assignment of vector height which appears to mainly affect upper level winds,

b) the difference stemming from the use of low resolution infra-red images in one set and high resolution visible images in a compared set is also important; wind vectors at middle levels being the most affected by this comparison

CGMS X agreed to continue the international comparison programme with the following modifications:

a) biased Rawin sonde reports would be eliminated by analysing Rawin stations to identify those with persistent errors and omitting those reports from the comparison programme,

b) the "collocation box" would be refined. This could be done by using an elliptical collocation area whose major axis was oriented along the wind direction and whose length was proportional to the wind speed. Sharply reducing the length of the minor axis would minimise the comparison on winds that lay on opposite sides of shear lines and remove statistical differences which were real-time space variations.

CGMS agreed upon the following collocation ellipse parameters:

Wind Speed	Major Axis	Minor Axis
High & medium level winds		
less than 10 m/s	225 km	175 km
from 10 to 25 m/s	250 km	160 km
greater than 25 m/s	300 km	100 km
Low level winds		
any speed	225 km	175 km

CGMS abandoned the rejection threshold concept which had been shown to distort comparison statistics.

At CGMS XII, ESA pointed out that they were continuing to use latitude-longitude collocation boxes for the comparison of Meteosat satellite winds and rawinsonde data. Several tests had been carried out using the elliptical collocation area as recommended at CGMS XI. However, the number of comparisons thus obtained was considered to be too few to have any statistical significance.

WMO recalled at CGMS XIV the requirements for satellite winds as defined by its Expert Meeting on Satellite Data and Services. Of particular concern was the speed and direction biases of satellite winds which not only affected day-to-day meteorological operations but also climatological analysis.

7.1.2 Possible Standardisation of Wind Extraction Methods

Three principal errors in derived winds were reported by USA to CGMS IX:

a) mis-registration of images
b) selection of the wrong height
c) non-representative target selection

Registration procedures are governed by the data handling system used and therefore cannot be standardised. However, regular checks on landmark motion can be used to control such errors. Height assignment systems vary widely and each appears to offer some possibility of error. Furthermore, a "best" system is far from being established. Finally, the data set available to each operator differs, making standardisation difficult.

After considerable discussion, CGMS agreed that standardisation was still difficult. Furthermore, it was not clear to what extent the lack of standardisation affected the use of the derived winds by the meteorological services. It appeared that the most useful step now was for each satellite operator to produce a short description of the method used to derive winds (suitable for field forecasters), including the limitations of each system, which would then be provided to WMO for general distribution.

At CGMS XI, Japan described a new procedure for assigning heights to clouds based on a statistical approach. This method provided more accurate satellite wind vectors when compared with RAWIN vectors and was implemented in December 1981. However, this method was not adequate for high level winds and required additional development. An objective target cloud selection method called Automatic Target Selection Procedure was introduced by Japan for low level winds in April 1982 to replace the previous man machine interactive procedure.

CGMS XIII agreed that a standardisation of methods for deriving cloud motion vectors was not appropriate at this time. The major unsolved problem was height assignment and it was noted that different methods were used by all three operators in assigning heights to low level winds without any superior method emerging.

At CGMS XIV, USA reported some recent advances made in producing satellite derived wind sets. The daily production of combined wind sets of GOES VAS derived gradient winds from the moisture channel and the cloud drift winds had been carried out on an experimental basis. First results were very encouraging, particularly if applied to cyclone movement forecasts. It was recognised that this method was not reliable in tropical regions but worked well in temperate latitudes.

ESA, at CGMS XVII, reported recent improvements in the calculation of cloud motion winds. A significant improvement in the bias affecting upper level winds had occurred after the introduction of the new WV channel calibration technique in September 1987. The effect of the new calibration scheme was to lower the heights assigned to high level wind vectors based on semi-transparent clouds. ESA also informed the meeting that studies were also in progress to determine the feasibility of using forecast data to determine the initial direction of automatic correlation tracking, on manual wind extraction methods, on the automatic extraction of water vapour winds and the pre-processing of image data prior to correlation matching.

During further discussion on the problems of deriving cloud motion vectors at CGMS XVII the USA reported that images used to derive the winds were frequently several hours prior to the synoptic hour for which the winds were valid. CGMS, noting this timing anomoly, urged its member to adopt image times as close as possible to the synoptic hour. CGMS also noted that the problem of wind bias affected all satellite operators and suggested that a workshop should be convened to discuss the matter further with research and operational meteorologists. The forum suggested for this workshop was the ECMWF workshop on the use of satellite data, planned to be held during 1989. EUMETSAT agreed to request that the ECMWF workshop be extended to address the problems of cloud motion wind extraction.

7.2 Sea-Surface Temperature (SST)

At CGMS IX, ESA proposed applying to SST from geostationary satellites, intercomparison procedures similar to those devised for winds. These would include comparisons in overlapping zones when available and also comparisons with ship measurements. During discussions, it appeared that a fundamental problem had to be solved first, namely that of the exact definition of the product.

Currently, Japan computes average SST values for ten-day periods on a 1 degree latitude-longitude mesh. USA produces daily fields on a 1 degree mesh as well. ESA also produces daily fields, but on a grid that is tied to the image geometry, and so varies in size on the Earth from 150 to 250 km. This comes from the fact that objectives are different in each case. Comparisons in such a situation are difficult to organise, and it was agreed that ESA's proposal was premature at this stage. It was recognised, however, that each operator was, in any case, performing some assessment of the quality of its own product, and that this information should be exchanged.

CGMS X confirmed that since there was no accepted "ground truth" available, the differences between satellite derived and ship reported sea-surface temperatures should not be considered errors but merely systematic differences.

USA sea surface temperatures are derived from the GOES data base which resides in the NOAA central computer in Suitland, Maryland. The system became operational in August 1981 but is only available to NOAA users who have access to the NOAA central computer. Data are available at a resolution of one degree K but data are un-calibrated.

CGMS XIII noted that intercomparison of SST could be made in a relatively simple way using NOAA-derived SST observation from polar orbiting satellites.

7.3 Climate Data

At CGMS X, WMO presented a draft document concerned with Planning Guidance for the World Climate Data System. At that time they indicated that the World Climate Programme was only in the initial stages and that discussions were in progress to determine exactly which data were needed for the programme.

CGMS agreed that in principle they wished to cooperate with the World Climate Programme, but their exact participation would depend on an assessment of a more precise definition of data requirements. The participation of CGMS members in the Climate Data Programme was reviewed at CGMS XI.

The potential participants in this programme recognised the problem of processing vast amount of data and proposed data compression methods. However, the main decision to be taken was how to obtain these data. It appeared too costly to reproduce them from archive and the other alternative was to obtain them from the operational data stream.

Information from geostationary satellites which CGMS considered useful for the climate programme included cloud type and coverage, cloud wind vectors and possibly radiation budget estimates.

At CGMS XII, ESA announced that it would support the International Satellite Cloud Climatology Project (ISCCP) by acting as a Sector Processing Centre (SPC) for METEOSAT data. ESA started to produce the ISCCP data set operationally as from 1 July 1983.

The importance of the project was also recognised by Japan who were actively considering participation in the ISCCP. At CGMS XIII, Japan announced that JMA would also participate as an SPC for GMS, producing the agreed data sets, and would continue to do so until at least June 1988.

ESA and USA also reported that they intended to continue their support to the ISCCP for the foreseeable future by supplying the necessary data sets to the various collection centers.

7.4 Other Parameters

7.4.1 Use of VAS Data

During 1982 and 1983 the USA carried out an evaluation to check upper and lower level humidity, thickness fields between the 850 to 500 mb and 850 to 200 mb constant pressure levels, stability fields, thermal winds and advective fields. Many of these fields could be used for numerical forecasts, severe convective storm warnings, aviation warnings, etc.

The USA informed CGMS XVII that various products based on VAS data were currently under development at the VAS Data Utilisation Centre (VDUC) and would be reported on in the near future.

7.4.2 Precipitation Data Extraction

At CGMS XII, USA reported that the Climate Analysis Center (CAC) of National Weather Service (NWS)/National Meteorological Center (NMC) was computing and archiving a precipitation index from geostationary satellite imagery.

The GOES Precipitation Index (GPI) makes use of the full resolution daily IR data contained in the VISSR Data Base. Eight images/day from each satellite at 3-hour intervals are included. Spatial coverage extends from 175 degrees East to 25 degrees West and from 50 degrees North to 50 degrees South with the transition between satellites set at 105 degrees West. The GPI is defined to be a linear function of the monthly mean fractional coverage of 2.5 degrees x 2.5 degrees areas (called boxes) by pixels with an equivalent black body temperature lower than 235 K. A frequency distribution containing 12 classes of 5 K width from 211 to 270 K and 4 broader classes at the extremes is computed for each 2.5 degrees x 2.5 degrees box in each image and summed over the half month. Then the number of pixels with an equivalent black body temperature colder than the chosen threshold in a box is divided by the total number of pixels in that box.

The current GPI in mm representing accumulation during the period is then obtained from:

$$GPI = 71.2 \, Nd \, Fc$$

where Nd is the number of days in the period and Fc is the fractional coverage of cold cloud. It should be noted that zero fractional coverage corresponds to zero precipitation. The archives include the histograms (20,480 per day) and the GPI.

CGMS XIV was informed that Japan had begun production of an index similar to that used at CAC and India expressed interest in starting a similar exercise. The significance of the precipitation index had only been submitted to limited verification but this was largely due to the inadequacy of other means for large-scale rain measurements.

At CGMS XV, ESA introduced its scheme for producing the ESOC Precipitation Index (EPI) from Meteosat image data. Validation of the index using conventional rainfall would be carried out using observations from several African countries.

7.4.3 Solar Insolation

At CGMS XI, USA reported that estimates of Solar Insolation were being derived from GOES Digital Satellite data.

Hourly insolation estimates were being made for seven hours distributed about local noon. Hours between these seven were filled with interpolated values for all hours that the sun was above the horizon. The interpolations were made using a technique that weights the interpolated value by the cosine of the solar zenith angle. The estimated and interpolated values were summed to give a daily total.

Hourly estimates were made for targets centered on the intersection of 1 degree interval latitude and longitude lines. The target consisted of 5 x 5 pixel arrays of visible VISSR data. The mean of these 25 pixel values was then used in a regression equation to estimate hourly total insolation. Other predictors used in the equation were solar zenith angle and the cloud-free brightness of the target.

Satellite estimates showed an error of 10-15% when referred to pyranometer measurements. The error tended to be larger on overcast days.

Estimates have been produced and archived since July 1980. The product is mainly used by the agricultural community.

7.4.4 Cloud Analysis

At CGMS XII, ESA described the derivation of its cloud analysis product. The basic data were the cloud radiance clusters already extracted during bi-dimensional histogram processing and identified as SST. Two corrections were applied to the IR radiances. One for the effect of absorption by atmospheric water vapour lying above the cloud top by use of a radiative transfer model, the second for the attribution to semi-transparent cirrus the IR radiance equivalent to a sheet of cirrus of emissivity 1.

The basis of this latter correction was to compute the relationship between the IR and WV radiances for cloud layers at different vertical levels in a standard atmospheric profile and for different surface temperatures. For opaque scenes (clouds, sea, land) pairs of IR and WV values tended to be clustered around an idealised curve. For a semi-transparent cloud over a warmer background, the IR/WV radiance pairs lay on a straight line joining the points corresponding to the background and to the completely opaque cirrus.

The mechanism for correction was to check whether the line joining the background radiance point with the supposed semi-transparent cloud cluster point intersected the idealised curve and, if so, the corrected IR value was read off at the intersection point and the corresponding temperature determined.

Following quality control, the cloud amount and temperature were encoded into WMO FM 88 SATOB code and distributed over the GTS.

Japan annouced at CGMS XVII that it was routinely producing a Cloud Amount Anomoly chart which would be used for climate studies.

7.4.5 Water Vapour Imagery

At CGMS XII, USA reported advances made in the use of 6.7 micron water vapour imagery in identifying upper level circulation features such as jet streams, shortwave troughs, upper lows and deformation zones.

7.4.6 Upper Tropospheric Humidity

to be updated

At CGMS XII, ESA explained how the Upper Tropospheric Humidity (UTH) product was derived.

The method employed the basic philosophy that for cloud free areas the WV radiance varied in a known manner with the amount of water vapour in the atmosphere and with the temperature profile. The state of the atmosphere was obtained from the European Center for Medium Range Weather Forecasts (ECMWF) and for each model there were tables describing the relationship between the relative humidity and the WV and IR measurements for a variety of surface temperatures for each satellite zenith angle. The UTH product was arbitrarily defined to be the mean humidity within a layer roughly bounded by the 700 mb and 300 mb levels.

Following manual quality control, the UTH values were encoded into WMO FM 88 SATOB code and transmitted via the GTS.

The UTH product was validated by comparison with mean radiosonde humidity between 700 and 300 mb. This comparison was used for calibrating the WV channel.

7.4.7 Operational and Experimental Use of Digital Data by USA

Frost forecasts: data available only to users having access to NOAA central computers.

Snow mapping: uses visible data to compare snow cover over a series of images.

Hurricane rain potential: uses thermal slicing of data to determine rain potential.

7.4.8 Satellite Cloud Information Chart (SCIC) and satellite derived Index of Precipitation Intensity (SI)

Japan reported that SCIC were being produced from a grid point cloud data set derived as part of the regular processing of imagery. The product was now produced on a regular basis following the installation of new processing facilities in 1987 and included cloud information which was derived both automatically and interactively by meteorologists. There were two types of products, one covering an area close to Japan, the other the Far East region. The product was routinely distributed to local forecast offices via land-line.

JMA has also tested a new precipitation estimation technique based on the least-squares multivariant linear regression (third order polynomial expression of infra-red and visible data). Correlation coefficients derived in the comparison with digital radar echo intensities averaged around 0.69. This estimate of precipitation intensity is called Satellite-derived Index of Precipitation (SI) ,and will be distributed to the forecast division of JMA with effect from March 1989.

7.4.9 Deep Convection

USA informed CGMS XVII that considerable interest was being shown in the parameterisation of regions of deep convection since it appeared that this was a valuable input to numerical forecast model assimilation schemes. CGMS, noting that global coverage of this parameter was not yet available, requested that satellite operators study the possibility of extracting information on deep convection from image data.

8 TELECOMMUNICATIONS

8.1 Frequency Allocation

AT CGMS X, WMO reported on the favourable outcome of the attempt to modify the definition of the Earth Exploration Service at the 1979 meeting of WARC. The change in the definition, requested by CGMS and WMO, resulted in a more precise definition of the type of data to be distributed within the specified bandwidths.

Also at CGMS X, Japan proposed that, in the future, representatives of ITU and, if necessary, of national telecommunications authorities should be invited to participate in CGMS meetings. CGMS agreed that any delegation may include a representative of its national telecommunications authority and that WMO may invite a representative from ITU.

At CGMS XI, in preparation of the Space WARC to be held in 1985/1986 in Geneva, USA recalled that geostationary meteorological satellites provided valuable data for all countries and allowed easy access to data. Geostationary meteorological satellites should, therefore, be exempt from any restricting protocol that might apply to geostationary communications satellites.

At CGMS XII there was discussion on possible collaboration between CGMS and the Space Frequency Coordination Group (SFCG). It was agreed that the CGMS secretariat should have technical contacts with that of SFCG in order to be advised of relevant frequency allocations.

AT CGMS XIII, ESA reported on the fourth meeting of SFCG and stated its position on frequency management, i.e. the preservation of frequency bands at present allocated to the "Meteorological Satellite Service".

USA presented CCIR Group 2 Report 395-3 "Radiocommunications for Meteorological Satellite Systems" which concerned the radio frequency requirements of the present system of Low Earth Orbiting and Geostationary spacecraft using passive sensors for the infrared and microwave portions of the electromagnetic spectrum. Also, reference was made to frequencies required for the use of active sensors for standard atmospheric measurements and for sea state, winds at multiple heights, and profiles of temperature and moisture throughout the atmosphere.

At CGMS XV, ESA reported on the sixth meeting of the SFCG which was held on 21-25 April 1986. Two resolutions were of interest to CGMS members:

C/6-2E: Interference criteria for Earth Observation Meteorological Satellites.

C/6-2J: Interference in the Data Collection System working in the 401-403 MHz Band of the Meteorological Satellite Service.

Also at CGMS XV Japan described a possible use of GMS telecommunication facilities for data dissemination. Three studies were in progress:

a) using the vacant VHF channel for dissemination of products from Tokyo Regional Specialised Meteorological Center

b) using the LR-FAX channel by multiplexing a subcarrier modulated by these digital products

c) using vacant DCP-I and DCP-R channels for point to point communication

USA expressed its concern that such use of the Japan DCS frequency bands might interfere with the GOES DCS bands.

In 1987 EUMETSAT, became a member of the SFCG thus providing a direct link between SFCG and CGMS through its secretariat activities. Conversely the interests of the CGMS would also be represented in the SFCG.

8.2 Interference

8.2.1 Degradation Effects on VISSR Data by WEFAX on GOES Satellites

At CGMS VIII, USA reported on tests conducted to determine whether they could successfully make simultaneous transmission of WEFAX and VISSR without having a degrading effect on the VISSR data. The need for these tests was the steadily increasing demand for continuous VISSR operations on the Eastern GOES which also had a severe impact on the WEFAX schedule.

It was determined that WEFAX transmissions at 250 watts power could be maintained without affecting VISSR. Unfortunately, the resulting WEFAX signal could not be received effectively by a normal APT station, but requires an S-band antenna of 4 metres or more to obtain sufficient gain.

Intermodulation products which had been present on earlier GOES spacecraft and which affected the DCS during simultaneous VISSR (VAS)/WEFAX operations on GOES-3 were not present on later GOES satellites.

8.2.2 Possible Interference with Radiosonde

The frequency bands in the region of 400 MHz and in the upper part of band 9 (1670-1695 MHz) are shared between the geostationary meteorological satellites and the meteorological aids services. Potential risks of interference have been considered in the Comité Consultatif International Radio (CCIR) report 541 (Rev. 76).

CGMS has noted the following:

a) USA has had serious problems with radiosondes, operating near the Command and Data Acquisition (CDA) station (in the upper part of band 9), when wide band VISSR signals are being received,

b) ESA also experienced potentially serious problems with radio-sondes operating in the upper part of band 9 near the Data Acquisition, Telecommand and Tracking Station,

c) Interference with the Japanese Command and Data Acquisition Station (CDAS) is not critical. However, significant interference has been observed at UHF frequencies between radio theodolites or radio rain gauges and the satellite UHF receiver. Since the launch of GMS, no interference has been detected.

Some interference tests performed in the past by ESA showed a significant deterioration in raw image and spacecraft housekeeping signals by radiosondes launched by the Swiss meteorological service and by the US Army in Germany. Both radiosonde types transmitted in the 1670 to 1700 MHz band. In practice, however, since the launch of METEOSAT, no interference has been detected which could be ascribed to the operation of radio-sondes since, from 1980, both of these radio-sonde operators exclusively used radiosondes operating in the 403 MHz band.

8.2.3 Interference on GOES-West Domestic DCP Interrogation Signal

At CGMS X, USA reported some interference problems which were particularly severe in urban areas. CGMS members agreed that USA may shift the GOES-West domestic DCP interrogation frequency from 468.825 MHz to 468.8125 MHz, placing it in the guard band between the land mobile channels at 468.800 MHz and 468.825 MHz.

8.2.4 Interference in the DCP Report Up-Link Frequency Band

Interference in the METEOSAT DCP report up-link frequency band has been reported by ESA since CGMS X. The band was disturbed by an interfering signal which had a very high stability (1 x 10 E-9) and a repetition rate of almost exactly 10 Hz. This signal, whose source was unknown, did not affect DCP report signal quality.

At CGMS XV, several members noted that they had been experiencing interference in the frequencies used for the Data Collection System. CGMS agreed that there needed to be an improved documentation of these interference events.

The WMO representative agreed that the WMO Secretariat would compile information received from satellite operators and informally discuss the matter with the ITU.

8.3 <u>Propagation Problems</u>

8.3.1 Scintillation Effect

Japan reported on a signal loss of 10-12 dB during some hours on 14 February 1978 on the GMS S-band link. This decrease in signal level was correlated with the same effect on VHF and C-band links of other satellites. A probable cause was the scintillation effect in the ionosphere.

ESA also reported on a similar but not identical problem of signal attenuation in February 1978 but at a different date.

Significant signal attenuation has been noted in the past by USA in S-band with polar-orbiting satellites, received at Gilmore Creek, ascribed to aurora effects.

No correlation of signal loss with scintillation had been observed with the other geostationary meteorological satellites.

At CGMS X, Japan reported the results of their investigations of ionospheric scintillations. Their study highlighted the seasonal and time dependency of the frequency of occurrence of scintillation. The occurrence was more frequent in the summer period and the peak appeared at midnight. These scintillations were thought to be caused by F layer conditions.

At CGMS XII, Japan stated that the margin on the communications link between spacecraft and CDAS was so large that operations could be maintained with little degradation from scintillation. However, users who operated stations with 3 to 4 dB margin were more likely to be affected. Japan would continue its investigation especially with the cooperation of users in various regions as the occurrence and magnitude of scintillation could vary with both ground station location and antenna orientation.

8.3.2 Impact of Solar Noise

ESA, USA and Japan have all reported the effects of solar noise when the sun, the spacecraft and the ground stations were co-linear.

Japan did not intend to operate the spacecraft during the short period corresponding to such a situation.

ESA and USA did not interrupt operations, but continued with degraded quality for the few affected images.

9 RECENT SATELLITE SYSTEM INFORMATION (CGMS-XVII)

9.1 Status of the Satellite System of EUMETSAT

The reader should note that the Meteosat Operational Programme (MOP) is now the responsibility of EUMETSAT, however, the system will continue to be operated and exploited, on behalf of EUMETSAT, by ESA.

9.1.1 MOP satellites

METEOSAT-2

Meteosat-2 is currently located at about 2 degrees West and serves as a back-up to Meteosat-3. It is still capable of performing routine imaging and image data dissemination. It now has very little propellant for station keeping and no further control of the orbit inclination is possible. The orbit inclination of the satellite at the end of 1988 was 2.0 degrees and increasing at a rate of about 1.5 degrees per year. The satellite will probably be de-orbited later in 1989.

METEOSAT-3

Launched on 15 June 1988 from Kourou on the first Ariane-4 test flight, this satellite is an old prototype and is now the prime satellite supporting all Meteosat missions. There is an anomaly with the electronically despun antenna which causes periodic reductions in radiated power however the reception of image data by PDUS and SDUS designed to the ESA specification is not degraded.

METEOSAT-3 is also equipped with special reflectors in order that it can be used for experiments in precision time transfers (the LASSO mission) within Europe and ultimately (when it no longer supports the Meteosat missions) across the Atlantic. For the latter experiment the satellite will be located near 27 degrees West.

METEOSAT-4

The first of the EUMETSAT operational series of satellites is being made ready for launch on the 28th February 1989. The imaging radiometer has similar specifications to Meteosat-3, except that the 6 um water vapour channel will be available continuously and not be time shared with one of the two visible channels as was the case with Meteosats 1, 2 and 3.

There will be full redundancy in all channels. Data will be coded in eight bits thus resulting in a higher data rate for the transmission of raw image data (333 Kbps).

It should be noted that this raw data stream is not a user supported service. There are presently no plans to change routine image data transmissions to users in spite of this change in raw data rate.

The Meteorological Data Dissemination (MDD) mission will be implemented on Meteosat-4 and the following satellites in this series, enabling the broadcast of general meteorological data primarily to Africa and the Middle East. Arrangements are being made to install two new MDD up-link stations in the UK and in Italy. Prototype MDD user stations are under development.

After launch and commissioning Meteosat-4 will replace Meteosat-3 as the primary satellite.

METEOSAT-5, METEOSAT-6

These satellites are under construction and are scheduled for launch in 1990 and no sooner than 1992 respectively.

A set of spares is also available, to be assembled into a satellite (**METEOSAT-7**), if there is a launch failure of one of the earlier Meteosat satellites.

9.1.2 METEOSAT Second Generation (MSG)

Several studies at pre-phase A level have been performed within the ESA Earth Observation Preparatory Programme (EOPP) to define an advanced three-axis stabilized satellite, including an all weather sounding capability. Further studies will be performed in 1989 to define alternative concepts without a microwave sounder. Current planning foresees phase A studies (system definition) beginning later in 1990.

The operational missions currently foreseen are:

- an imaging mission
- a sounding mission
- a data circulation mission

Various options including a three-axis stabilised and a spin scan are still being studied.

The operational missions would be supplemented by a package of ESA scientific experimental payloads.

The launch of the first MSG is expected in the second half of the 1990s.

9.2 Status of the Satellite System of India

9.2.1 Satellites in orbit

INSAT-1B

Launched on 31 August 1983 and located at 74 degrees West, has been operating successfully since commissioning in October 1983 and for the last five years has generated eleven full disk images daily as routine, with up to 27 on special occasions. The 401 MHz data collection transponder is in use by some 100 Indian data collection platforms.

Processed meteorological image data are regularly transmitted to 20 remote stations in the country on voice grade telecommunication lines. Processed images are also broadcast over HF facsimile from the New Delhi station. Actions are in progress to use IR data for estimation of outgoing long wave radiation.

Winds for 0600 UT are transmitted on the GTS and estimates of SST and precipitation index are being derived from image data on an experimental basis.

An experimental Disaster Warning System (DWS) has been implemented along the East coast of India for dissemination of disaster warning messages directly to the affected people. The system comprises:

a) An Area Cyclone Warning Centre (ACWC) located at Madras

b) An uplink from the Madras Earth Station

c) A C/S band transponder on board INSAT-1B

d) Disaster Warning System (DWS) receivers located in the DWS operational area.

The cyclone warning is originated from the ACWC and is transmitted to the nearest INSAT Earth Station of DOT using dedicated communication links between ACWC and the Earth Station. By making use of Broadcast Satellite Service (BSS) uplink equipment installed at the Earth Station, the warning is uplinked in C-band to the C/S band transponder on board

INSAT-I, which in turn rebroadcasts the warning over the Indian subcontinent in S-band. 100 suitable Disaster Warning Receivers installed in the field receive the warning message directly from the satellite. The system incorporates a selective addressing scheme in which only a particular group of receivers located in the areas likely to be affected by the cyclone receive the cyclone warning. Other receivers located in other areas not likely to be affected do not respond to the warning. At present, the scheme is being implemented on a limited experimental demonstration basis.

INSAT-1C

This satellite, launched on 22 July 1988, has been located at 93.5 degrees East and will be the in-orbit spare for INSAT-IB. The satellite has suffered a short circuit in one of the two power buses resulting in non availability of some transponders and redundant subsystems. As far as the meteorological mission is concerned, the radiometer is available with one of its two transmitters along with one data relay transponder.

INSAT-ID

The satellite is in an advanced stage of fabrication. It is expected to be ready by the end of 1988. Its launch is currently scheduled for the period March/April 1989 on a Delta 4925 launch vehicle. INSAT-ID will initially be placed at 83 degrees East and eventually it will replace the currently operational INSAT-IB satellite.

9.2.2 INSAT-II

During the 1990s an INSAT-II series of geostationary telecommunications/meteorology satellites will replace the currently operational INSAT-I satellite system. The construction of the first two satellites of the INSAT-II series is already well advanced. The first INSAT-II satellite is expected to be launched during late 1990 and a second in late 1991, using Ariane launch vehicles. Present plans call for three more INSAT-II satellites to follow.

INSAT-II satellites will be multi-functional and three-axis stabilised but will be larger and much heavier than those of the INSAT-I series. The new Indian built radiometer will have horizontal resolution of 2 km in the VIS channel and 8 km in the IR channel.

The current 401 MHz data collection transponder will be continued, but INSAT-II will also carry a 406 MHz Search and Rescue (SAR) distress alert transponder to aid the international satellite (COSPAS/SARSAT) search and rescue programme.

9.3 Status of the Satellite System of Japan

9.3.1 Satellites in orbit

GMS

GMS was the first geostationary meteorological satellite from Japan but the imager scan mirror is no longer operable. The remainder of the satellite systems are still serviceable. It is stationed at 160 degrees East. The current inclination is 6.44 degrees and no north-south station keeping is possible.

GMS-3

GMS-3, launched on 16 August 1984, is currently the operational satellite and is positioned at 140 degrees longitude. Stretched VISSR image dissemination, replacing high resolution analogue image broadcasts, was introduced after the installation of a new computer system at the Meteorological Satellite Centre (MSC) in Spring 1987. Full disc VISSR images continue to be taken at three hourly intervals, and additional hourly observations for the Northern Hemisphere are regularly made.

9.3.2 GMS-4 and beyond

GMS-4 is now in preparation ready for launch in the summer of 1989. The GMS-4 mission will be identical with that of GMS-3.

Work has also started on the development of GMS-5, to be launched in 1994. The new satellite will add a water vapour channel to the existing imaging channels. The wave-lengths of the VISSR will be 0.55-0.90 um in the Visible channel, 10.5-11.5 um and 11.5-12.5 um in the infrared window channel, and 6.5-7.0 um in the water vapour channel.

9.4 Report on the Status of the USA Satellite System

9.4.1 Satellites in orbit

GOES-2

GOES-2 is located at 113.0 degrees West and is in standby mode with fully operational communications but with the VISSR imager inoperative. Orbit inclination is 6.4 degrees.

GOES-3

GOES-3 is located at 129.9 degrees West and is in standby mode with fully operational communications but with the VISSR imager inoperative. Orbit inclination 5.3 degrees.

GOES-5

GOES-5, currently located near 65 degrees West, is used as an additional GOES East relay, providing VAS and WEFAX services and acting as back-up for the data collection system. The VAS imager/sounder system is inoperative. Orbital inclination is 1.8 degrees.

GOES-6

GOES-6 was launched in May 1983 and by December 1988 the VAS imager/sounder system was operating on the last of its 4 scan mirror position encoder bulbs with the prospect of imminent failure. On 21 January 1989 the last lamp failed and all GOES-6 operations were terminated. Up to this time the satellite had been operated as the GOES-West satellite. For the time being GOES-6 will remain at 135 degrees West for dissemination of stretched VAS, WEFAX and DCP data. The last possible North/South station keeping manoeuvre was executed in March 1988 and the orbit inclination is increasing at a rate of approximately 1 degree per year.

GOES-7

GOES-7 was launched in February 1987 with nominal end of life predicted for 1992. The satellite was originally located at 73.9 degrees West, where it functioned as GOES-East, operating VAS, DCS, WEFAX and SEM. (The VISSR on this satellite has been modified to carry two bulb and two LED encoders). The orbit inclination is well controlled and currently about 0.07 degrees. The satellite also carries a

406 Mhz transponder for Search and Rescue (SAR) distress calls as an experimental addition to the international (COSPAS/SARSAT) search and rescue programme. At the present time this satellite is being slowly drifted westwards. Following the failure of GOES-6 this satellite has now become the prime and will be located initially at 108 degrees West. The satellite is expected to reach this position on the 21 February 1989.

(A one-GOES operational plan has been formulated and is now being implemented. GOES-7 is slowly being moved to the central location at 108 degrees West. Depending upon the season the satellite will be positioned at either 108 degrees West or 98 degrees West. GOES-5 will remain at its current location near 65 degrees West for dissemination of VAS, WEFAX and DCS data. GOES-5 may have to be moved to 75 degrees West if DCS support is degraded at the present location).

9.4.2 GOES NEXT

GOES I-M

The design of the GOES-Next (GOES I-M) series is now largely completed. The spacecraft Critical Design Review was held during August 1988 and the go-ahead was given for manufacture of all systems. These satellites will be a new three-axis stabilised design incorporating an imager developed from the AVHRR design and a fully independent infra-red sounding instrument.

General Dynamics has been selected to provide the launch services for these new satellites, using its Atlas Centaur vehicle.

The new satellites will include the following instrumentation:

- A five channel imager

VIS	.55 to 0.75 um	1 km resolution
IR	10.2 to 11.2 um	4 km
IR	11.5 to 12.5 um	4 km
IR	3.8 to 4.0 um	4 km
WV	6.5 to 7.0 um	8 km

This imager will take 20 minutes to scan the full earth disc in all five channels.

- A twelve channel sounder:

The filter wheel IR sounder will have a resolution of 8 km and will take 4 hours to cover the full earth disc but can be programmed to cover an area of 3000 X 3000 km in 40 minutes.

The possibility of replacing the above sounder with a High-resolution Interferometer Sounder (HIS) on GOES L and M is also being considered.

The first launch in the series will be the launch of GOES-I on an ATLAS-I (ATLAS-CENTAUR) commercial launch vehicle, currently scheduled for July 1990. The planned launch dates for the entire GOES-I to M series are shown below:

GOES-I		July 1990
GOES-J		November 1991
GOES-K	(120 day call-up)	May 1992
GOES-L	(120 day call-up)	1996
GOES-M	(120 day call-up)	1997

9.5 Report on the Status of the USSR Satellite System

GOMS

The Soviet geostationary meteorological satellite programme will see a major milestone at the end of the 1980's with the planned launch of GOMS to be followed by a series of similar spacecraft after the design and test of the first. The first GOMS is provisionally planned for launch later in 1989 or early 1990 and will be located at 76 degrees East. Two other experimental GOMS, possibly on occasion located at 14 degrees West and 166 degrees East are under consideration.

EUMETSAT is currently coordinating, through the mechanism provided by the ITU, the frequencies to be used by the GOMS satellite during the period when it might operate within the field of view of Meteosat ground-stations. Similar frequency coordination is being carried out by Japan.

The GOMS system will incorporate, as the space segment, a three axis stabilized satellite with high-resolution scan imager instruments, providing full disk images in visible (0.4-0.7 um) and infrared (10.5-12.5 um) with spatial resolution of 1.25 and 5 km respectively at the sub-satellite point. The useful coverage of these images will extend to over 60 degrees around the sub-satellite point. Full images will be generated in less then 20 minutes and repeated up to

24 times daily. The minimum time interval between successive images will be 30 minutes. It will be possible to produce 3 series of 4-5 of these images daily.

Other instruments on the spacecraft will include a measurement system for the registration of solar and outer space particle flows, solar electromagnetic radiance and variations in the earth's magnetic field (magnetometer, energetic particle sensor, solar X-ray sensor).

GOMS will perform the following main functions:

- image taking of the Earth's surface and cloud coverage (in visible and infrared) and the extraction of meteorological information,
- dissemination of images and other meteorological information to user stations,
- collection and relay of data transmitted by fixed or mobile Data Collection Platforms located on the Earth's surface.

GOMS Ground Receiving and Processing Center

The ground processing centers for GOMS will be based in Moscow (the main computing center), Tashkent and Khaborovsk.

These centers will include receiving stations allowing the reception and operational quality control of satellite data and the creation and relay of data streams for the respective computing centers.

Data Collection and Dissemination

Automatic hydrometeorological stations, drifting or fixed buoys and ship stations, both Soviet or International, will use the GOMS data collection system.

The collection and relay of DCP messages will take place 8 times daily at the synoptic hours: 00, 03, 06, 09, 12, 15, 18, 21 UTC.

The transmission of DCP data will be made possible via 100 regional and 33 international channels at a data rate of 100 bps. The length of a message relaying data from all of the DCPs will not be greater than 30 minutes in a time slot +/- 15 minutes from the synoptic hour.

Dissemination of Meteorological Data

The dissemination of various types of meteorological data (via a GOMS re-transmission system) will be accomplished using 2 channels each for alphanumeric and WEFAX data.

9.6 Status of the Geostationary Satellite System of the Peoples Republic of China

FY-2

The Peoples Republic of China (PRC) is now seriously considering the development of a geostationary meteorological satellite system. At present, the programme is in the stage of system design. It is planned to have an experimental geostationary meteorological satellite launched in the mid-1990's. Development work will be carried out with higher priority than that for the continuation of the polar orbiting satellite (FY-1) programme.

This first experimental geostationary meteorological satellite system will comprise five parts, a geostationary meteorological satellite called FY-2, a launch vehicle, a launch facility, a tracking and control centre, a command and data acquisition station and a data processing centre.

Since facilities for satellite launch, tracking and control are now well established in the PRC, special attention is now being paid to the development of the FY-2 satellite itself, the command and data acquisition station and the data processing center.

The data acquisition and processing system will be multi-functional and capable of real time operations, and will include a Command Data Acquisition Station (CDAS), a Data Process Center and System Operational Control Center (DPC-SOCC), Ranging stations (one primary station, two secondary station), widely dispersed data collection platforms (DCP), Mid-range Data Utilization Stations (MDUS) and Small-range Data Utilization Stations (SDUS), WEFAX or cloud image receiving stations, and a ground communication system.

The satellite will perform the following main tasks:

remote sensing, cloud picture broadcasting, data transmission, data collection and relay, satellite telemetry and command functions, attitude and orbit control.

The location of the FY-2 satellite is planned to be between 105 and 110 degrees East.

Satellite functions will include:

(1) Obtaining visible and infrared cloud images from a scanning radiometer. After data processing the following products will be derived: sea surface temperatures, cloud analysis charts, cloud top temperatures and wind vectors;

(2) Collecting and relaying observational data from widely dispersed meteorological, oceanographic and hydrological data collection platforms

(3) Broadcasting either WEFAX from the Beijing Meteorological Center, or processed cloud images;

(4) Accepting Space Environmental Monitor data from satellite.

Sensors on board the satellite:

(1) Visible and infrared (water vapour) spin scan radiometer. It will obtain day and night visible and infrared cloud pictures and water vapour distribution charts. Full earth disk coverage will be possible every 30 minutes.

(2) The on-board space environment monitor (SEM) will monitor the space environmental in real time, providing corresponding monitored data.

(3) A data collection system (DCS), configured in accordance with WMO standard format and transmission characteristics, will relay data from data collection platforms.

Radio frequency allocation:

<u>Downlinks</u>: (MHz)

CDAS: Command and Data Acquisition Station:

1671.6-1691.6; 1701.5-1703.5; 1708.9-1709.4.

Dissemination of data from DCP, transmission of meteorological information and trilateral ranging telemetry:

TT&C: Tracking, Telemetry and Command: 4182.0-4200.0.

DCP: 468.4-468.9.

DUS: Data Utilization Station 1686-1688; 1690.5-1691-5; 1699.4-1699.6.

<u>Uplinks</u>: (MHz)

CDAS: Command and Data Acquisition Station: 2040-2070.

Dissemination of data from DCP, transmission of meteorological information and trilateral ranging data.

TT&C: Tracking, Telemetry and Command station: 5925-5943.

DCP: 401.0-401.5; 402.0-402.1.

10 UNRESOLVED MATTERS

The major items concerned with the design and implementation of the present international system were resolved by 1977. There are, however, a number of points which for one reason or another are still outstanding. These unresolved points fall into one of four categories:

a) short-term matters arising from the most recent meetings of the CGMS and which are expected to be resolved as "action items" before the next full meeting

b) long-term matters in which a decision has been postponed to a later date

c) current matters which need repeated updating

d) items indefinitely postponed pending development of unforeseeable duration and outcome

For an overview of each class of action the reader is recommended to refer to the actions lists attached to the official report of each CGMS meeting.

ANNEX 1

GLOSSARY OF TERMS AND LIST OF ACRONYMS

1. GLOSSARY OF TERMS

Admitting Authority

Those entities authorized to admit DCPs into a data collection system. For IDCPs, this would be any one of five entities (the four satellite operators and the WMO). For RDCPs, it would be the satellite operator providing the data collection service for the geographical location to be served.

Annotation

Some additional information, e.g. grid, coastlines, indication of time, name of satellite, sub-satellite point, grey scale, etc, complementing image data and attached to some samples in the image format or its surroundings.

APT Services

The direct broadcast from a satellite, in the VHF band, of cloud images with a resolution of the order of 2-6 km.

ASCII

American Standard Code for Information Interchange. A seven-unit coded character set designed for automatic data processing systems.

Automated Platform

A platform where all or part of the message is composed, encoded and entered into the transmitting equipment by automatic services.

BCH Code

Bose, Chaudhuri, Hocquenghem Code. A code designed so that a code word of 31 bits can contain two errors and still be recognized.

Brightness Normalization

The process of adjusting, when necessary, the brightness or radiance value of each element of an image data set with the aim of producing the value it would have had in some standard conditions, such as, for instance, "sun at local zenith".

Calibration

Application of the information to convert the transmitted data into the likely value of the original physical parameter.

Certification

Official confirmation by CGMS members that an international DCP radio equipment meets a minimum standard of performance.

Data Collection Platform Operators

Those members of WMO or organisations which establish data platforms in accordance with the admission procedures for collection by geostationary satellites.

Deconvolution

The operation of adjusting the value of each element of a data set to compensate for those imperfections in the optical and electronic system that have the effect of blurring the image (attenuating the higher spatial frequencies). Deconvolution is designed to restore the value of each element to that which it would have had if the normalised modulation transfer function of the system had been unity up to some frequency selected for the overall system design optimisation.

Eclipse Operation

The operation of a geostationary satellite while it is in the shadow of the earth. The eclipse begins 24 days before each equinox, increases daily to a peak period of 72 minutes at the equinox, and then gradually decreases reaching zero 24 days after equinox.

EUMETSAT

European organisation to establish, maintain and operate European systems of operational meteorological satellites.

Gridding

The implantation of a latitude-longitude grid (and often some coastline) into satellite imagery.

Housekeeping Telemetry

Radio signals received from a satellite that pertain to the engineering or physical status of the spacecraft platform and sensors rather than to sensor data per se.

HR-FAX

High Resolution FACSimile which will be broadcast from GMS and has a resolution corresponding to that of the HRPT service.

HRPT Service

High Resolution Picture Transmission which will be direct broadcast from a satellite in the S-band (about 1700 MHz), of cloud images of high resolution in the order of 1 km.

International Alphabet n° 5

The international version of ASCII.

International Data Collection Platform

Platforms for which responsibility will have to be transferred from one control and data acquisition centre to another.

Interrogated DCP

Those platforms which provide their data message in response to a command from the spacecraft.

LR-FAX

Low Resolution FACSimile : Japanese WEFAX.

Manchester Code

A method of encoding data so that a transition occurs at the centre of every bit period. Also known as split-phase coding.

Manned Platform

A platform where all or part of the message is composed, encoded and entered into the transmitting equipment by a human operator.

Maximum Linear Sequence

A synchronisation sequence that has the property that when the sequence is shifted, the number of agreements differs from the number of disagreements by exactly one except for perfect synchronisation.

METEOSAT

European geostationary meteorological satellite.

NAVAIDSONDE

An atmospheric sounding system for shipboard use employing modern navigation aids and the data collection capability of satellites.

Phase Adjustment

Translation of individual lines so as to suppress the jitter of the line start angle. Depending on the accuracy required, this may necessitate an interpolation between line elements.

Projection Conversion, Mapping

Geometrical transformation bringing each element of a data set to the position it would have had in some geographical projection system (e.g. Mercator, etc).

Regional Data Collection Platform

Platforms which always remain under the control of the same data acquisition centre.

Real Time Data

Data that are made available for use at essentially the same time that the observation is made or that the event occurs; APT service is an example.

Rectification

Operation on an actual image data set to produce the data set that would have been obtained if the sampling geometry had been perfect.

Registration

Geometrical operation performed to bring the two or three data sets from various spectral bands of a given image or data sets from successive images to coïncidence.

Satellite Operator

Those entities (Members of WMO or international organisations) which manage and operate geostationary satellites participating in the collection of data from IDCPs and RDCPs.

Sectorisation

Division of the whole image into several pre-selected geographical areas.

Self-timed DCP

Those platforms which transmit their message at regular time periods controlled by an internal clock.

Stretched VISSR

Reduced bandwidth high resolution digital transmission to DUS through GOES.

TEMP SHIP

The atmospheric sounding code used to report soundings made by ships at sea.

User Considerations Working Group

The earlier name for the Operations Working Group of CGMS.

WEFAX

The transmission through a geostationary satellite of environmental data in analogue format receivable by an APT ground station (SDUS in the ESA and Japanese systems).

ANNEX 1

2. LIST OF ACRONYMS

AAA	Sounding/image data transmission format (GOES)
ACWC	Area Cyclone Warning Centre
ADMIN	Admin. messages over WEFAX, GTS Telex etc.
A/D	Analogue to Digital
AIREP	Aircraft Report
AMDAR	Aircraft Meteorological Data Relay
APT	Automatic Picture Transmission
ARIANE	European satellite launcher vehicle
ASAP	Automated Shipboard Aerological Programme
ASCII	American Standard Code for Information Interchange
ASDAR	Aircraft to Satellite Data Relay
ATS	Applications Technology Satellite
AVHRR	Advanced Very High Resolution Radiometer
BBC	Black Body Count
BCD	Binary Coded Decimal
BCH	Bose, Chaudhuri, Hocquengham code
BER	Bit Error Rate
Bpi	Bits per inch
bps	Bits per second
BUAN	Baseline Upper Air Network
C	Celsius (degrees)
CA	Cloud Analysis
CAA	Civil Aviation Authority (UK)
CABALS	Carrier Balloon System
CAC	Climate Analysis Centre (USA)
CAD	Consortium for ASDAR Development
CBCC	Carrier Balloon Control Centre
CBS	Carrier Balloon System
CBS	Commission for Basic Systems (WMO)
CCIR	Comite Consultatif International pour la Radio
CCT	Computer Compatible Tape
CDA	Command and Data Acquisition
CDAS	Command and Data Acquisition Station (Japan)
CEOS	Committee for Earth Observation Satellites
CGMS	Committee for the Co-ordn. of Geos. Met. Satellites
CMS	Centre de Meteorologie Spatiale (Lannion)
CMV	Cloud Motion Vector
CODAR	Coded Aviation Report
CTH	Cloud Top Height

DAMS	Data Acquisition and Monitoring System
DAPS	DCS Automatic Processing System
DATTS	Data Acquisition Telemetry & Tracking Station
DBS	Direct Broadcast Satellite
dBm	Decibels above a milliwatt
DCLS	Data Collection & Location System
DCP	Data Collection Platform
DCPR	DCP Reply
DCPRS	DCP Radio Set (DCP telecoms package)
DCS	Data Collection System
DOMSAT	Domestic (telecommunications) Satellite (USA)
DMSP	Defence Meteorological Satellite Programme
DP	Data Processing
DPCM	Differential Pulse Code Modulation
DPSS	Data Processing & Services Sub-system
DRS	Data Relay Satellite
DRT	Data Relay Transponder (India)
DSB	Direct Satellite Broadcast
DSN	Deep Space Network (USA)
DTRS	Data Transmission & Routing System
DUS	Data Utilization Station (Japan)
DWS	Disaster Warning System
EC	Executive Committee (WMO)
ECMWF	European Centre for Medium range Weather Forecasts
EDA	Electronically Despun Antenna
EGSE	Electrical Ground Support Equipment
EIRP	Effective Isotropic Radiated Power
EMI	Electro-Magnetic Interference
EOPP	ESA Earth Observation Preparatory Programme
EOT	End of Tape/Transmission
EOT	End of Text (DCP and telex communications)
EPI	ESOC Precipitation Index
ERBI	Earth Radiation Budget Instrument
ERS	ESA Remote Sensing satellite
ESA	European Space Agency
ESM	Equipment Support Module
ESOC	European Space Operations Centre
ESRO	European Space Research Organization (old name of ESA)
ESTEC	European Space Research & Technology Centre
EUMETSAT	European Meteorological Satellite Organization
FAA	Federal Aviation Authority
FAG	Fine Adjustment of Gain
FEC	Forward Error Correction
FGGE	First GARP Glob. Experiment.(glob. wx experiment)
FM	Frequency Modulation
FM	Form (WMO code)
FOV	Field Of View

GAC	Global Area Coverage
GARS	GOES Archive and Retrieval System
GARP	Global Atmospheric Research Programme
GATE	GARP Atlantic Tropical Experiment
gca	Great Circle Arc
GDPS	Global Data Processing System
GMS	Geostationary Met. Sat. (Japan)
GMT	Greenwich Mean Time (UTC more common now)
GOES	Geost. Operational Environ. Sat.
GOMS	Geostationary Oper. Met. Satellite (USSR)
GOS	Global Observing System
GPCP	Global Precipitation Climatology Project
GPI	GOES Precipitation Index
GSFC	Goddard Space Flight Centre
G/T	Gain to Temperature (Noise) Ratio
GTS	Global Telecommunications System
HH	Synoptic Hour
HCMM	Heat Capacity Mapping Mission
HDT	High Density Tape
HIRS	High Resolution Infra-Red Sounder
H/K, HK	Housekeeping
HR	High Resolution
HRPT	High Resolution Picture Transmission
Hz	Cycles per Second
I	International (DCP Channel)
IA5	International Alphabet no.5
ICAP	Intnl. Committee for ASDAR Participants
ICG	Implementation Co-ordination Group
ICSU	Internat. Council of Scientific Unions
ICWG	Intl. Coordination W G of Space Station Partners
ID	Identification Number
IDCP	International DCP
IDCS	Internat. Data Collection System
IF	Intermediate Frequency
IFEOS	Intl. Forum for Earth Observation
IFRB	Intnl. Frequency Registration Board
IFOV	Instantaneous FOV
IGMSS	Intnl. Geostationary Meteorological Satellite System
IMP	Instrument Mounting Platform
INSAT	Indian Geostat. Met. Satellite
IO	Input/Output
IOC	Index of Cooperation
IOC	Intergov. Oceanographic Commission
IOC	Initial Orbit Configuration
IODE	Intnl Oceanographic Data Exchange
I/P	Input
IPOMS	Intnl Polar Orbiting Meteorological Satellite Group
IR	Infra-Red
IRS	Indian Remote Sensing Satellite

IRS	Information Retrieval Service
ISCCP	Intnl. Satellite Cloud Climatology Project
ISLSCP	Intnl. Satellite Land Surface Climatology Project
ITU	International Telecomms. Union
JMA	Japanese Meteorological Agency
JOC	Joint Organizing Committee
JPS	Joint Planning Staff (for GARP)
JWG	Joint Working Group(CGMS)
KB	Keyboard
Kbs	Kilo Bits per Second
Km	Kilometre(s)
LAC	Local Area Coverage
LASSO	Laser Synchronisation from Synchronous Orbit
LCP	Left Hand Circular Polarization
LNA	Low Noise Amplifier
LR	Low Resolution
LSB	Least Significant Bit
Mbs	Mega Bits per Second
MDD	Meteorological Data Distribution
MDUC	Meteorological Data Utilization Centre (India)
MDUS	Medium Scale Data Utilization Centre (Japan)
MDUS	Meteorological Data User Station
MEP	Meteosat Exploitation Project
MF	Main Frame (computer)
MGCS	Meteosat Ground Computer System
MHz	Mega Hz
MIEC	Meteosat Information Extraction Centre
MLS	Maximal Linear Sequence
MOCC	Meteosat Operations Control Centre
MOP	Meteosat Operational Programme
MOSS	Meteorological Office System Ship (UK)
MR	Medium Resolution
MSB	Most Significant Bit
MSG	Meteosat Second Generation
MSG	Meteosat System Guide
m/sec	Meters per Second
NA	North Atlantic
NAOS	North Atlantic Ocean Stations
NASA	National Aeronautics & Space Administration (USA)
NCAR	Nat. Centre for Atmospheric Research (Boulder)
NESDIS	Nat. Env. Sat. & Data Information Service (USA)
NMC	National Meteorological Centre
NOAA	Nat. Oceanographic & Atmospheric Administration (USA)
NRZ	Normal Return to Zero (signal)
NRZ	Non-Return to Zero Level
NSBF	National Scientific Balloon Facility (USA)

NWP	Numerical Weather Prediction
NWS	National Weather Service
OCAP	Operating Consortium of ASDAR Participants
ODAS	Ocean Data Acquisition System
OECD	Organization for Economic Cooperation and Development
O/P	Output
OPS	Operations
OWG	Operations Working Group (CGMS)
OWS	Ocean Weather Station
OWSE	Operational WWW Systems Evaluation
PCM	Pulse Code Modulation
PDUS	Primary Data User Station (Meteosat HR data)
PFD	Power Flux Density
PIA	Pseudo International Alphabet
pixel	Picture Element
PLL	Phase Locked Loop
PM	Phase Modulation
P/No	Power to Noise Density Ratio
PRC	Peoples Republic of China
PRN	Pseudo Random Noise
PSK	Phase Shift Key
PTT	Post and Telecommunications Authority
PTT	Platform Transmitter Terminal
QC	Quality Control
RCP	Right Hand Circular Polarization
RDCP	Regional DCP
rev	Revolution
RF	Radio Frequency
RFI	Radio Frequency Interference
RHC	Right Hand Circular
RMC	Regional Meteorological Centre
RPM	Revolutions per Minute
RTH	Regional Telecommunications Hub (GTS)
RX	Receiver
SAR	Synthetic Aperture Radar
SAREP	Satellite Report
SARSAT	Search & Rescue Satellite
SATOB	Satellite Observation (WMO code)
S-band	Satellite RF Band (between 1.6 and 2.1 GHz)
SBUV	Solar Backscatter Ultraviolet Instrument
S/C	Spacecraft
SCC	Satellite Calibration Centre
SCIC	Satellite Cloud Information Chart (Japan)
SDSD	Satellite Data Services Division (USA)
SDUC	Secondary Data Utilization Centre (USA)
SDUS	Secondary Data User Station (Meteosat analogue data)

SDUS	Small Scale Data Utilization Centre (Japan)
SEAS	Shipboard Environmental (data) Acquisition System
SEM	Space/Solar Environment Monitor
SFCG	Space Frequency Coordination Group
SHF	Super High Frequency (S-band)
SI	Satellite Index of Precipitation (Japan)
SMS	Synchronous Met. Satellite (USA)
S/N	Signal to Noise Ratio
SOP	Special Observing Period (FGGE)
SPC	Sector Processing Centre (ISCCP)
SP-L	Split Phase Level
SPOT	Satellite probatoire d'observation de la terre
SSEC	Space Science and Engineering Centre (USA)
ssp	Sub Satellite Point
SST	Sea Surface Temperature
SSU	Stratospheric Sounding Unit
sw	Software
SYNC	Synchronization (data word)
TBD	To be Defined
TBS	To be Specified
TBUS	Teletype Bulletin - US
TC	Telecommand
TDRS	Tracking and Data Relay Satellite
TIP	TIROS Information Processor
TLM	Telemetry
TIROS	Television Infra-Red Observing Satellite
TOGA	Tropical Ocean Global Atmosphere
TOPEX	Topography Experiment
TOVS	TIROS Operation Vertical Sounder
TVM	Transparent VAS Mode
TX	Transmitter
UHF	Ultra-High Frequency (around 400MHz)
UK	United Kingdom
USA	United States of America
USSR	Union of Soviet Socialist Republics
UTC	Universal Time Coordinated
UTH	Upper Tropospheric Humidity
VAS	VISSR Atmospheric Sounder
VCP	Voluntary Cooperation Programme
VDU	Visual Display Unit
VHF	Very High Frequency (from 137 to around 149 MHz)
VHRR	Very High Resolution Radiometer
VIS	Visible Spectrum (approx. 0.5um to 0.9um)
VISSR	Visible and Infra-Red Spin Scan Radiometer

WARC	World Administrative Radio Conference
WCRP	World Climate Research Programme
WDC	World Data Centre
WEFAX	Weather Facsimile
WG	Working Group
WMC	World Meteorological Centre
WMO	World Meteorological Organization
WV	Water Vapour
WWC	World Weather Centre
WWW	World Weather Watch
XBT	Sub-Surface Temperature Data

ANNEX 2

WMO CODES FOR GTS

WMO CODES FOR GTS

The following code shall be used for the input of meteorological products by the satellite ground stations into the GTS.

Winds	FM 88 - VI Ext. SATOB*
Sea-surface temperatures	idem
Cloud top heights	idem
Cloud analysis	idem
Radiation balance	idem
Upper air humidity	idem

Note

* No CGMS recommendation exists up to now for this allocation.

ANNEX 3

POSITION VIS-A-VIS RADIO-REGULATIONS

Position vis-à-vis Radio-Regulations

1. INTRODUCTION

Under this general heading, several different items concerning the Power Flux Density (PFD) produced by the CGMS satellites, and the possible interferences caused (or suffered) by them to (or from) other services either occupying neighbouring frequency bands or sharing the same frequency bands, have been considered and discussed. These are :

- PFD produced by the WEFAX Dissemination links
- PFD produced by the DCPs Interrogation links
- Protection of ITOS-VHRR receiving stations
- Protection of Radio Astronomy (RA) receiving stations.

2. PFD PRODUCED BY THE WEFAX DISSEMINATION LINKS

At the frequency selected for international WEFAX Dissemination (1691 MHz), the maximum admissible PFD is governed by Article 2557 of the Radio Regulations. This limitation applies to the countries* listed in Articles 740 and 741, where the frequency band of interest is also allocated to the Fixed and Mobile Services. This limitation varies with the elevation angle, and its lowest threshold, $-154/dBW/m^2$ in 4 kHz, applies whenever one of the countries listed in the footnote is viewed from any satellite at elevation angles $\leq 5°$. It was generally recognised that, according to the selected WEFAX standards, all CGMS satellites (except Japan) exceed the $-154/dBW/m^2$ in 4 kHz at the 1691 MHz (and 1694.5 MHz for METEOSAT) WEFAX frequency. The amount by which the ITU regulation is exceeded varies among satellites, but can be as much as 9 dB for the USA GOES. **Despite this excess of PFD, the various notification procedures have been completed successfully.** The CGMS working group recognised however that PFD still represents a potential problem for future developments of the satellite systems; if PFD must be reduced in the future, contingency possibilities considering in particular :

- wide band FM with threshold extension
- digital encoding

could be envisaged, but additional cost would be incurred in any case to each user WEFAX Dissemination.

The CGMS recommended that members should act through their own channels to propose appropriate amendments to the Radio Regulations at the forthcoming CCIR-study Group II (September 1977), as well as to the competent World Administrative Radio Conference (1979). Should the help of WMO be needed in this respect, WMO should be informed early enough prior to the mentioned meetings.

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* Afghanistan, Austria, Bahrain, Bulgaria, Congo, Costa Rica, Cuba, Czechoslovakia, Egypt, Ethiopia, Germany (Dem. Rep.), Guinea, Hungary, India, Iran, Iraq, Israel, Jordan, Kenya, Kuwait, Lebanon, Malaysia, Mauritius, Mongolia, Oman, Pakistan, Poland, Qatar, Romania, Saudi Arabia, Singapore, Somalia, Sri Lanka, Syria, Thailand, Tanzania, United Arab Emirates, USSR, Yemen (Arab Rep.), Yemen (People's Dem Rep.), Yugoslavia

3. PFD PRODUCED BY THE DCPs INTERROGATION LINKS

This subject has been considered but has not been recognised as a problem by the CGMS SEWG, because the Meteorological service in the 469 MHz band is assigned as a secondary user, and as such must relinquish their transmission when requested by a primary user regardless of the PFD situation.

4. PROTECTION OF ITOS-VHRR RECEIVING STATIONS

These stations operate in the 1697 - 1698 MHz band. It has been agreed that in order not to degrade their S/N ratio by more than 1 dB in the worst case, EIRP produced by CGMS satellites in the 1697 - 1698 MHz band should be -54 dBW/Hz.

5. PROTECTION OF RADIO ASTRONOMY RECEIVING STATIONS

All CGMS satellites are using the frequency band 1670-1700 MHz. According to the Radio Regulations, the neighbouring frequency band 1660-1670 MHz is in particular allocated to radio astronomy, for the observation of hydroxyle radiations in the vicinity of 1665 and 1667 MHz.

According to the CCIR recommendation 314.3 (Rev. 76) concerning the "protection of frequencies used for radio astronomical measurements", the technical criteria concerning harmful interference should be those set out in the tables on Annex 1 to draft report 224.3 (Rev. 76). For the 1660-1670 MHz frequency band, the harmful interference level is set out at -237 dBW/m^2/Hz.

In general, this condition is considered a very severe one; however, it was estimated that, in the worst case, the main beam of radio astonomy stations when aimed at the galactic centre would include any CGMS satellite for a maximum of 8 minutes per day during two brief periods each year. If compliance with CCIR 314.3 is ensured during these periods, it is estimated that the spirit of the recommendation would be met. Work, however, is done to minimise adverse effects to the greatest possible extent. The particular situation of CGMS satellites regarding this recommendation is the following :

(a) METEOSAT picture transmission is nominally at a relatively low bit rate of only 166 kb/s. Spurious emission in the 1660-1670 MHz band is, therefore, caused mainly by intermodulation between the various transmissions; they are decreased at levels compatible with CCIR recommendation by means of a band-reject filter.

(b) GMS picture transmission is at 14 Mb/s (4 phases) and a band-reject filter is also provided for radio astronomy protection.

(c) The subject is under study for GOMS.

(d) GOES has the most serious problems since the main 28 Mb/s (4 phase) spectrum extends into the RA band. However, all future GOES spacecraft after GOES 3 are specified to provide protection below -237 $dBW/m^2/Hz$.

CGMS recommended that USA in particular continues to study the radio astronomy problem in the form of the radio astronomy community with a view towards establishing meaningful and workable specifications for the establishment of PFD limits. It is further recommended that USA, on behalf of CGMS members, pursue this work within the framework of the CCIR with the ultimate objective of revising report 224.3 to a point that is mutually acceptable to both the satellite and the radio astronomy interests.

A N N E X 4

LIST OF CGMS WORKING - PAPERS

CGMS-I : No working papers

CGMS-II Working Papers

1. System Engineering Working Group

Ref.	Title	Submitted by
CGMS/II/SE/WP 1	Data Collection System Compatibility	NOAA
CGMS/II/SE/WP 2	ESRO Meteosat Project	ESRO
CGMS/II/SE/WP 3	Data Collection System Coordination	ESRO
CGMS/II/SE/WP 4	WEFAX Dissemination Coordination	ESRO
CGMS/II/SE/WP 5	Environmental Warning (Alert) Frequency Channel Allocations	NOAA
CGMS/II/SE/WP/6	Data Rates (DCP)	NOAA
CGMS/II/SE/WP 7	Data Format (DCP)	NOAA
CGMS/II/SE/WP 8	Address Codes (DCP)	NOAA
CGMS/II/SE/WP 9	Power Received at the Spacecraft	NOAA
CGMS/II/SE/WP 10	Engineering Aspects of Transfer of Responsibility and Assessment of Facilities Required for Moving Platforms	NOAA
CGMS/II/SE/WP 11	Impact of Data Processing Requirements	NOAA
CGMS/II/SE/WP 12	WEFAX Frequency, Signal, Modulation and Data Format	NOAA
CGMS/II/SE/WP 13	General Paper	JMA/NASDA

CGMS-II Working Papers

2. User Consideration Working Group

Ref.	Title	Submitted by
CGMS/II/UC/WP 1	Input of Processed Meteosat Data in the GTS	ESRO
CGMS/II/UC/WP 2	Requirements for Rapid Relay of Data from Polar Orbiting Satellites	ESRO
CGMS/II/UC/WP 3	Requirements for the Geostationary Sub-system for the Global Experiment	GARP
CGMS/II/UC/WP 4	Introduction	NOAA
CGMS/II/UC/WP 5	Operational Procedures	NOAA
CGMS/II/UC/WP 6	Estimates of Accuracies of Data, in particular Winds	NOAA
CGMS/II/UC/WP 7	Discussion of Wind Data Format	NOAA
CGMS/II/UC/WP 8	Codes for Dissemination of Data from all Types of DCPs	NOAA
CGMS/II/UC/WP 9	Administrative Communications	NOAA
CGMS/II/UC/WP 10	Location of Satellite Subpoints	NOAA
CGMS/II/UC/WP 11	Coordination of APT Services	NOAA
CGMS/II/UC/WP 12	Archival Procedures	NOAA
CGMS/II/UC/WP 13	Telecommunication Scheduling	NOAA
CGMS/II/UC/WP 14	Requirements for Rapid Relay of Data from Polar Orbiting Satellites	NOAA
CGMS/II/UC/WP 15	Role of the Geostationary Satellites in Determination of the Atmospheric State in the Tropics	JPS

CGMS-II Working Papers

Ref.	Title	Submitted by
CGMS/II/UC/WP 16	Draft Paper for Working Group on Users Considerations	JMA + NA
CGMS/II/UC/WP 17	Assessment of the Number of Platforms that might Report through Geosynchronous Satellites	WMO
CGMS/II/UC/WP 18	Codes for Use in Satellite Data Collection	WMO
Appendix 1 to CGMS/II/UC/WP 6	Convective clouds as tracers of air motion	NOAA
Appendix 2 to CGMS/II/UC/WP 6	Wind estimation by tracking clouds on images from geosynchronous satellites	NOAA
Appendix 3 to CGMS/II/UC/WP 6	Progress in estimating winds from geosynchronous satellite data.	NOAA

CGMS-III Working Papers

Ref.	Title	Submitted by
CGMS-III/UC/WP 1	Working Paper for CGMS-III	Japan
CGMS-III/UC/WP 2	Coordination of APT Services	ESRO
CGMS-III/UC/WP 3	Coordination of Procedures for Computation of Radiation Balance	ESRO
CGMS-III/UC/WP 4	Archiving	ESRO
CGMS-III/UC/WP 5	Working Group on Users Consideration STATUS REPORT by ESRO	ESRO
CGMS-III/UC/WP 6	Comments on STATUS REPORT by UC Group of Japan	ESRO
CGMS-III/UC+SE/ WP 7	Training and Exchange of Information	USA
CGMS-III/UC+SE/ WP 8	Glossary of DCP Terms	USA
CGMS-III/UC/WP 9	United States Comments for Consideration by the Working Group on Users Consideration CGMS-III	
CGMS-III/UC/WP 10	Comments on Archiving and Retrieval of Geostationary Satellite Data	WMO
CGMS-III/UC/WP 11	The WMO Executive Committee Panel on Meteorological Satellites	WMO

CGMS-IV Working Papers

1. System Engineering Working Group

Ref.	Title	Submitted by
WP No. 1	Acquisition sweep for DCPs	USA
WP No. 2	Acquisition sweep for DCPs	ESRO
WP No. 5	Time required for acquisition sweep for DCPs	Japan
WP No. 6	Short time phase jitter of DCP transmitter	Japan
INF No. 5	Operation in eclipse	USA
INF No. 6	Eclipse operations	Japan
WP No. 3	Radio-frequency interference by radio sondes	ESRO
WP No. 7	Protection of radio-astronomy station	Japan
WP No. 4	The carrier balloon system in FGGE and the role of geostationary satellites in its operation	JOC
INF No. 1	Study and experiment on multi-path propagation	ESRO
INF No. 2	UHF transmission loss estimates for GOES	USA
INF No. 3	The effects of increased spin phase modulation on the DCPRS and CDA equipment	USA
INF No. 4	GOES/DCPRS/CDA compatibility test	USA
INF No. 7	Certification procedure for DCP radioset	USA

CGMS-IV Working Papers

2. User Considerations Working Group

Ref.	Title	Submitted by
1	Meteosat transmission schedule	ESRO
2	Data collection areas of responsibility	NOAA
3	Assignment of the responsible area for data collection	Japan
4	Assignment of the responsible area for data collection	ESRO
5	Operational procedures for ship platforms	NOAA
6	Operational procedures for ship platforms	Japan
7	Operational procedure for ship platforms	ESRO
8	Admission procedure for international DCPs	Japan
9	The carrier balloon system in FGGE and the role of geostationary satellites in its operation	GARP/JPS
10	Glossary of terms	ESRO
11	Estimates of the planetary radiation budget from the GARP geostationary satellite system	GARP/JPS
12	Eclipse operation	Japan
13	Satellite transmission schedules	USA
14	Administrative communciation procedures	USA
15	Admission procedure for international data collection platforms	USA

CGMS-IV Working Papers

Ref.	Title	Submitted by
16	Archiving and retrieval	USA
17	Suggested additions to glossary	USA
18	Eclipse operation	USA
19	Assignment of areas of responsibility for data collection	WMO
20	Administrative communication contents and procedures	WMO
21	Codes for dissemination of data from all types of DCPs	WMO

CGMS-V Working Papers

1. System Engineering Working Group

Ref.	Title	Submitted by
	SMS/GOES Operations	
A.1.1	Data Collection System Test Report (SMS-1)	USA
A.1.2	Data Collection System Test Report (SMS-2)	USA
A.1.3	SMS-1 - 90 Days Post Launch Test Results	USA
A.1.4	SMS-2 - 30 Days Post Launch Test Results	USA
A.1.5	Synchronous Meteorological Satellite System	USA
A.2.1	UHF Multipath Phenomena in a Marine Environment	USA
A.2.2	Campaign carried out to measure the effect of Multipath	ESRO
B.1.1	Interference caused by Radio-sondes	ESRO
B.1.2	Interference caused by Radio-sondes	Japan
B.2.1	Radio Interference - Radio Astronomy Protection	WMO
B.2.2	Technical Considerations for RA Protection from GOES/SMS	USA
B.2.3	Out of Band Transmission into 1660 - 1670 MHz from GMS	Japan
C.1	Acquisition Sweep for DCP Receivers	USA
C.2	Acquisition Sweep for DCP RX Minimum Time for Carrier Acquisition	ESRO
D.1	Short-term Stability of DCP Transmitter Carrier	ESRO

CGMS-V Working Papers

Ref.	Title	Submitted by
	WEFAX Power Flux Density	
F.1	Certification of International DCPs	USA
F.2	Certification of International DCPs	WMO
F.3	Certification of International DCPs	ESRO
F.4	Certification of International DCPs	Japan
G.1	Alert DCPs	ESRO
H.1	DCPs on Ships	ESRO
H.2	Sown-link Budget	Japan
I.1	The Carrier Balloon System in FGGE	JPS
J.1	Recommendation for Interrogation Frequency Selection for Data Collection Platforms	USA
K.1	Interrogation Message for Meteosat DCPs	ESRO
L.1	Recommendation for DCS Modulation Index Change	USA

CGMS-V Working Papers

2. Operations Working Group

Ref.	Title	Submitted by
1	Meteosat Transmission Programme	ESRO
2	Operational Procedures for Ship Platforms	ESRO
3	Admission Procedures for International DCPs	WMO
4	Comments on Admission Procedures	USA
5	Comments on admission Procedures	ESRO
6	Provision of basic meteorological data for Satellite Centres	ESRO
7	Satellite Archiving Plan	USA
8	MGCS Image Archiving Subsystem	ESRO
9	Method for Calculation of Radiation Balance in the Meteosat System	ESRO
10	Calibration Methods for Meteosat Radiometer	ESRO
11	Engineering Aspect of Ship Platforms	ESRO
12	The Carrier Balloon System in FGGE	JPS
13	Admission Procedures for International DCPs	USA
14	GMS Facsimile Transmission Schedule	Japan
15	Operational Procedures for Ship Platforms	Japan
16	The Carrier Balloon System and its Operation by Geostationary Satellites	Japan
17	Glossary of Terms	Japan
18	Protection of Radio Astronomy	Japan
19	Requirements for Radiation Balance Data	JPS

CGMS-VI Working Papers

1. Systems Engineering Working Group

Ref.	Title	Submitted by
J/1	Radio Astronomy Protection	USA
J/2	Report of the Informal Meeting on FGGE Special Observing Systems and the use of GMS for Data Collection	WMO
J/3	Action Items from CGMS V	CGMS V
J/4	Description of the International DCS	WMO
J/5	Radio Astronomy Protection	Japan
1	GOES Operational Results	USA
2	Sea Surface Multipath at VHF-Theory and Experiment	USA
3	Satellite Operating Characteristics	USA
4	Specification for Ground Equipment Required to Receive Direct Broadcasts	USA
5	Interference by Radiosondes	USA
6	DCS Interrogation Messages	USA
7	WEFAX Index of Cooperation	USA
8	Objectives and Missions of the Meteosat Program	ESA
9	Dissemination Format Structure	ESA
10	The Dissemination Mission, The Receiving Stations (PDUS & SDUS)	ESA
11	DCP Report Messages Format	ESA

CGMS-VI Working Papers

Ref.	Title	Submitted by
12	Index of Cooperation for WEFAX/APT Direct Broadcast	ESA
13	Post Launch Communications Test Results	USA
14	Status of GMSS Program	Japan
15	GMS System Configuration	Japan
16	Satellite Operating Characteristics	Japan
17	Specifications for Ground Equipment Required to Receive Direct Broadcasts	Japan

CGMS-VI Working Papers

2. Operations Working Group

Ref.	Title	Submitted by
J/1	Radio Astronomy Protection	USA
J/2	Report of the Informal Meeting on FGGE Special Observing Systems and the use of GMS for Data Collection	WMO
J/3	Action Items from CGMS V	CGMS V
J/4	Description of the International DCS	WMO
J/5	Radio Astronomy Protection	Japan
1	GOES WEFAX Transmission Schedules	USA
2	Operational Procedures in a Self-timed DCP System	USA
3	Glossary of Terms	USA
4	Certification Procedures	USA
5	The International DCS Policy Statement	USA
6	Questionnaire for Prospective Platform Operators	USA
7	Draft Memorandum of Agreement	USA
8	Meteosat Transmission Schedule	ESA
9	Satellite Transmission Schedule: Amendments	ESA
10	Admission Procedures	ESA

CGMS-VI Working Papers

Ref.	Title	Submitted by
11	Allocation of Addresses, Frequencies, and Time-Slots to IDCP's	ESA
12	MGCS Image Archiving Subsystem	ESA
13	Glossary of Terms	ESA
14	Satellite Transmission Schedules and Formats for Direct Broadcasts	Japan
15	Archiving and Retrieval	Japan

CGMS-VII Working Papers

1. System Engineering Working Group

Ref.	Title	Submitted by
S.1	GOES Data Collection System Bit error rate & Signal Amplitude/ phase ripple investigation	USA
S.2	Implementation of the International DCS by the United States	USA
S.3	Development of a Buoy/Shipboard Antenna for use with GOES DCS	USA
S4	GMS Satellite, status & future plan	Japan
S.5	Technical Considerations for lowering WEFAX PFD	USA
S.6	Review of System Engineering Considerations	USA
S.7	Bit Structure of 31 bit EOT for IDCP system	Japan
S.8	Special use of interrogated channel of ASDAR time code	Japan
J.1	ASDAR	USA

CGMS-VII Working Papers

2. Operation Working Group

Ref.	Title	Submitted by
O/1	ASDAR	USA
O/2	Coordinated Use of Archived Data	ESA
O/3	Wind Determination from METEOSAT Image Data	ESA
O/4	ESA DCP Users Guide	ESA
O/5	ESA Archiving and Retrieval Users Guide	ESA
O/6	Use of SMS Tapes	ESA
O/7	Satellite Transmission Schedule	ESA
O/8	Satellite Transmission Schedule	USA
O/9	Review of DCS Operational Procedures	USA
O/10	Archiving and Retrieval	Japan
O/11	Archiving and Retrieval	USA
O/12	Contingency Plan	Japan
O/13	The Present Stage of International Cooperation of Cloud Wind Vector through SMS Imagery Data	Japan
O/14	The GMS Wind Operation System	Japan
O/15	Admission Procedure	ESA
O/16	GOMS Transmission Schedule	USSR
O/17	Contingency Plans	USSR
O/18	Wind Calculation using Geostationary Satellite Data	USSR

CGMS-VII Working Papers

3. The Joint Sessions

Ref.	Title	Submitted by
J/1	ASDAR	USA
J/2	Allocation of Addresses, Frequencies and Time Slots	ESA
J/3	DCP Address Coding Formats for Entry into GTS	ESA
J/4	Code for Transmission of ASDAR Reports over the GTS	ESA
J/5	METEOSAT Tests and Facilities for DCP Certification	ESA
J/6	Standard Processing Support for Data Collection	ESA
J/7	Standard Processing Support for Data Collection	Japan
J/8	Summary of the CGMS Consolidated Report	ESA

CGMS-VIII Working Papers

Ref.	Title
ESA-WP-1	Status Report METEOSAT
ESA-WP-2	Contingency Plans for FGGE - Indian Ocean (joint ESA-USA paper)
ESA-WP-3	Extension of ASDAR cut-off date
ESA-WP-4	WEFAX format
ESA-WP-5	Report on results of tests on interference from radiosondes
ESA-WP-6	Report on intercomparison of winds extracted from SMS data
ESA-WP-7	Continuing intercomparison of extracted winds
India-WP-1	Status Report - INSAT
Japan-WP-1	GMS Status Report
Japan-WP-2	Operational status of GMS
Japan-WP-3	Status of ASDAR
Japan-WP-4	Report of DCP tests on-board the Marchant Ship
Japan-WP-5	Characteristics of Low-Resolution Facsimile
Japan-WP-6	Radiosonde Interference at Hatoyama Command and Data Acquisition Station
Japan-WP-7	An extraction of wind vector from the SMS tapes by using the GMS data processing system for international comparison
USA-WP-1	Proposal for a continuing intercomparison of extracted winds
USA-WP-2	Review of all Action Items from CGMS VII B

CGMS-VIII Working Papers

Ref.	Title
USA-WP-3	Review of the Consolidated Report from CGMS I-VII
USA-WP-4	Determination of Report format and Working Arrangements
USA-WP-5	Report of WEFAX tests in USA
USA-WP-6	Status Report - GOES
USA-WP-7	Contingency Plans for FGGE
USA-WP-8	ASDAR Status Report
USA-WP-9	Proposed Action of CCIR regarding Astronomy
USA-WP-10	Comparison of simultaneous, co-located Cloud Motions measured from satellites
WMO-WP-1	Contingency Plans for FGGE

CGMS-IX Working Papers

Ref.	Title
ESA-WP-1	Regular DCP Operations Reports
ESA-WP-2	Proposal for a Common IDCS Users' Guide
ESA-WP-3	International Comparison of Satellite Winds
ESA-WP-4	International Comparison of Satellite Sea Surface Temperatures
ESA-WP-5	Proposed Modification of WEFAX format
ESA-WP-6	DCPRS Certification Matters
ESA-WP-7	Proposed Modifications to the Consolidated Report
ESA-WP-8	Progress Report on Contingency Plan for FGGE
ESA-WP-9	Interference caused by weather balloons to GOES-I reception at VILSPA
ESA-WP-10	Questionnaire for Certification of DCPs
ESA-WP-11	DCPRS Certification Specification
ESA-WP-12	(Extract of) ESA Position Paper for the World Administrative Radio Conference
India-WP-1	Status Report on INSAT-1
Japan-WP-1	GMS Status Report
Japan-WP-2	Status Report of Operational Interrogated Type DCP on Board the Merchant Ship
Japan-WP-3	Status Report of GMS ASDAR Data Collection System
Japan-WP-4	The Influence of the Ionospheric Scintillation on the GMS Communication Link
Japan-WP-5	Archiving of GMS Digital Data

CGMS-IX Working Papers

Ref.	Title
Japan-WP-6	Solar Noise Interference with GMS Downlink
Japan-WP-7	Spurious Emission from Geostationary Meteorological Satellite (GMS) to Radioastronomy Band
USA-WP-1	Review of Action Items from CGMS-VIII
USA-WP-2	Report on Status of GOES Spacecraft
USA-WP-3	Relay of Galapagos Island Rawinsonde Data via GOES-DCS
USA-WP-4	Data Collection System Automated Monitoring System Design Requirements and its Applicability to the Monitoring of International Data Collection Platforms
USA-WP-5	WEFAX
USA-WP-6	Coordination of Meteorological Parameter Extraction: Winds - International Comparison of Satellite Winds
USA-WP-7	Coordination of Meteorological Parameter Extraction: Winds - Standardization of Wind-finding Procedures for Geostationary Satellites
USA-WP-8	Coordination of Meteorological Parameter Extraction: Sea Surface Temperatures
USA-WP-9	Coordination of Meteorological Parameter Extraction: Other Parameters
USA-WP-10	Summary of the Position of the United States of America at the 1979 World Administrative Radio Conference regarding Meteorological Satellite and Earth Exploration Satellite Services
USA-WP-11	Project ICEWARN

CGMS-IX Working Papers

Ref.	Title
USA-WP-12	Aircraft to Satellite Data Relay (ASDAR) Admission Procedures
USA-WP-13	Contingency Plan USA Contribution to Satellite Coverage between METEOSAT and GMS
USA-WP-14	General Problems of IDCS Rechannelization
USA-WP-15	Shipboard Environmental Data Acquisition System (SEAS)
USA-WP-16	Interference Problems
USA-WP-17	ASDAR Proposed Changes to the ASDAR System after the FGGE
USA-WP-18	Current Status of ASDAR

CGMS-X Working Papers

Ref.	Title
ESA-WP 1	Review of past action items
ESA-WP 2	METEOSAT Status Report
ESA-WP 3	Report on GOES-Indian Ocean operations for FGGE
ESA-WP 4	The meteorological aspect of the GOES-1 European Effort
ESA-WP 5	Future METEOSAT System
ESA-WP 6	International Data Collection System Users Guide - Draft Issue
ESA-WP 7	The METEOSAT Data Collection System Status Report
ESA-WP 8	Results of the experimental campaign DCP on board RSS-BRANSFIELD
ESA-WP 9	Status of METEOSAT Dissemination
ESA-WP 10	Status of METEOSAT data archive
ESA-WP 11	Report on WARC 1979
ESA-WP 12	Geostationary satellite operators and the world climate programme
ESA-WP 13	Distribution of DCP data to SDUS
Japan-WP 1	Summary of GMS control
Japan-WP 2	Status of GMS operation
Japan-WP 3	Status of GMS-2
Japan-WP 4	Report on future satellite system
Japan-WP 5	Operation of the space segment
Japan-WP 6	Ground Segment
Japan-WP 7	Constraints in ASDAR operations

CGMS-X Working Papers

Ref.	Title
Japan-WP 8	Monitoring system for DCP platforms in GMSS
Japan-WP 9	Characteristics of ionospheric scintillations on the GMS communication link
Japan-WP 10	Geostationary satellites as part of the WWW Global Observing System - Contingency Plan
Japan-WP 11	General policy on data collection from WWW stations and platforms
USA-WP 1	Review of action items from CGMS-IX
USA-WP 2	Status of USA operational satellite systems
USA-WP 3	Status and problems of IDCS
USA-WP 4	Brief background and questions on ASDAR for CGMS
USA-WP 5	GOES platform position location system
USA-WP 6	Dissemiantion via satellite - high resolution
USA-WP 7	Dissemination via satellite - low resolution
USA-WP 8	An overview of international comparison of satellite winds
USA-WP 9	Proposed change of GOES-West interrogation frequency to alleviate local interference problem
USA-WP 10	DCS interrogation link dissemination
USA-WP 11	National Scientific Balloon Facility Experimen
USA-WP 12	General policy on data collection
USA-WP 13	NOAA GOES archive plans
USA-WP 14	Contingency Plan
WMO-WP 1	Operation of the Space Segment
WMO-WP 2	Ground Segment
WMO-WP 3	General policy on data collection from WWW stations and platforms
WMO-WP 4	Report on WARC
WMO-WP 5	On operational features of present ASDAR syste and requirements for future systems

CGMS-XI Working Papers

Reference	Title
ESA-WP 1	Review of past action items
ESA-WP 2	Status report on METEOSAT-1 and -2
ESA-WP 3	Status report on ground segment
ESA-WP 4	Status of METEOSAT Operational System
ESA-WP 5	In-orbit storage philosophy
ESA-WP 6	Common back-up satellite, technical considerations
ESA-WP 7	Report on Data Collection System
ESA-WP 8	Continuation of DCS by ESA
ESA-WP 9	ASDAR reporting
ESA-WP 10	Review of the International Data Collection Systems Users' Guide
ESA-WP 11	Status report on image dissemination
ESA-WP 12	Distribution of DCP reports to Secondary Data Users Stations
ESA-WP 13	Status report on METEOSAT archive and data service
ESA-WP 14	International Satellite Cloud Climatology Project
ESA-WP 15	Letter from Professor Hunt, UCL
ESA-WP 16	METEOSAT meteorological products
ESA-WP 17	METEOSAT spacecraft charging

CGMS-XI Working Papers

Reference	Title
Japan-WP 1	Report on status of satellite systems, present status of GMS system
Japan-WP 2	Report on status of satellite systems, status of GMS operation
Japan-WP 3	Report on future satellite system
Japan-WP 4	Common back-up satellites
Japan-WP 5	Coordination of Meteorological parameters extraction, wind
Japan-WP 6	Coordination of archiving and retrievals, GMS data archive
Japan-WP 7	The measurement and analysis system of the GMS/GMS-2 telecommunication links
Japan-WP 8	High resolution facsimile dissemination
Japan-WP 9	Low resolution facsimile dissemination
USA-WP 1	Review of action item 9
USA-WP 2	Review of action item 10
USA-WP 3	Review of action item 11
USA-WP 4	Review of action item 12
USA-WP 5	Review of action item 14
USA-WP 6	Report on status of satellite systems, SMS/GOES system status
USA-WP 7	Report on status of satellite systems, NESS SMS/GOES ground processing system
USA-WP 8	Report on status of satellite systems, phantom commands
USA-WP 9	GOES-G, -H and -I spacecraft
USA-WP 10	GOES-G, -H and -I ground system

CGMS-XI Working Papers

Reference	Title
USA-WP 11	VISSR Atmospheric Sounder
USA-WP 12	Common back-up satellites imaging systems
USA-WP 13	Common back-up satellites telemetry and telecommand
USA-WP 14	GOES after the G, H and I series
USA-WP 15	Geostationary satellites as part of WWW Global Observing System
USA-WP 16	Status and problems of the IDCS
USA-WP 17	Ships
USA-WP 18	Coordination of Data Collection, ASDAR
USA-WP 19	Platform position location
USA-WP 20	General policy on Data Collection
USA-WP 21	High resolution distribution
USA-WP 22	Low resolution dissemination (WEFAX)
USA-WP 23	Coordination of meteorological parameter extraction, winds
USA-WP 24	Coordination of meteorological parameter extraction, Sea Surface Temperature
USA-WP 25	Coordination of meteorological parameter extraction, other parameters
USA-WP 26	Coordination of meteorological parameter extraction, other parameters, operational and experimental uses of digital satellite data
USA-WP 27	Coordination of archiving and retrievals
USA-WP 28	Telecommunications
USA-WP 29	Role of geostationary satellites in the World Climate Programme, in particular the Climate Data Programme

CGMS-XII WORKING PAPERS

Reference	Title
ESA-WP1	Review of Past Action Items
ESA-WP2	Review of Consolidated Report
ESA-WP3	Status Report on METEOSAT-1 and 2
ESA-WP4	Status Report on Ground Segment
ESA-WP5	METEOSAT Image Acquisition Report
ESA-WP6	METEOSAT Operational Programme
ESA-WP7	Status Report - System Concept Study for a Second Generation Meteorological Satellite
ESA-WP8	Backup Satellite - Additional Considerations related to Spacecraft Operability
ESA-WP9	Status Report on METEOSAT Data Collection System
ESA-WP10	The new ASDAR System - Proposal for Requirements on CGMS
ESA-WP11	Status Report on METEOSAT Dissemination Mission
ESA-WP12	Dissemination of adjacent Satellite Image Data
ESA-WP13	Coordination of Meteorological Parameters Extraction Winds
ESA-WP14	Sea Surface Temperatures
ESA-WP15	Upper Tropospheric Humidity and Cloud Analysis
ESA-WP16	Status Report on Archive and Data Service
ESA-WP17	The collection of ISCCP Data at ESOC
ESA-WP18	Implications of Stereoscopic Observation on METEOSAT System
ESA-WP19	Possible Collaboration between CGMS and SFCG
Japan-WP1	Status of Japanese Satellite System
Japan-WP2	Future Plan
Japan-WP3	Ocean Wave Observation Buoy

CGMS-XII WORKING PAPERS
(continued)

Reference	Title
Japan-WP4	On the Reception and Processing of New ASDAR Data
Japan-WP5	Dissemination of Low Resolution FSX
Japan-WP6	Current Status of Wind Derivation System
Japan-WP7	Current Status of GMS Data Archiving
Japan-WP8	Ionospheric Scintillation which disturbed the GMS Communication Link
Japan-WP9	Participation for the International Satellite Cloud Climatology Project
USA-WP1	Review of Consolidated Report
USA-WP2	Report on Status of Satellite System
USA-WP3	Report on Future Satellite Systems
USA-WP4	Review of IDCS Users' Guide
USA-WP5	Status of the GOES Data Collection System
USA-WP6	Problems of the International Data Collection System
USA-WP7	Shipboard Environmetal Data Acquistion System (SEAS) : a marine utilisation of the GOES DCP
USA-WP8	ASDAR Development Project
USA-WP9	Review of IDCS Users' Guide
USA-WP10	Low Resolution Dissemination (WEFAX)
USA-WP11	DCP Data Dissemination
USA-WP13*	International Comparison of Satellite Winds
USA-WP14	Sea Surface Temperatures
USA-WP15	Estimating Solar Insolation from GOES Digital Satellite Data

* USA-WP12 does not exist

CGMS-XII WORKING PAPERS
(continued)

Reference	Title
USA-WP16	Precipitation and Cloud Cover Data Extraction
USA-WP17	Advances in the use of 6.7 micron Water Vapour Imagery during the past year
USA-WP18	Coordination of Archiving Retrievals
USA-WP19	Observation and Reporting of Volcanic Ash Plumes
USA-WP20	Electronic Use of GOES Satellite Data
USA-WP21	Direct Readout Users Conference
WMO-WP1	Consideration for Future International Cooperation in a Global Meteorological Satellite System
WMO-WP2	ASDAR Programme Report
WMO-WP3	Cloudiness and Radiation

CGMS-XIII WORKING PAPERS

Reference	Title
ESA-WP1	Review of Past Action Items
ESA-WP2	Review of Consolidated Report
ESA-WP3	Status Report on METEOSAT Spacecraft Operations
ESA-WP4	The METEOSAT Operational Programme
ESA-WP5	METEOSAT Second Generation
ESA-WP6	Review of Action Items from SEWG Meeting
ESA-WP7	Status Report on METEOSAT Data Collection Mission
ESA-WP8	ASDAR Coding Scheme
ESA-WP9	Status Report on METEOSAT Dissemination Mission
ESA-WP10	Retransmission of DCP Data
ESA-WP11	Satellite Wind Extraction
ESA-WP12	Sea Surface Temperature Extraction
ESA-WP13	CGMS SST Comparison
ESA-WP14	Precipitation Index Extraction
ESA-WP15	Cloud Analysis and Upper Tropospheric Humidity Products
ESA-WP16	METEOSAT Archive and Data Service
ESA-WP17	Report on SFCG Fourth Meeting
ESA-WP18	Review of IDCS Users' Guide
Japan-WP1	Report on Status of Japanese Satellite Systems
Japan-WP1.1	Report on Status of Japanese Satellite Systems
Japan-WP3	Coordination of Meteorological Parameter Extraction (Winds)
Japan-WP4	Report on Future Satellite Systems of Japan
Japan-WP5	Role of Geostationary Satellites in the World Climate Programme

CGMS-XIII WORKING PAPERS
(continued)

Reference	Title
USA-WP1	Report on Status of Spacecraft Systems
USA-WP2	Report on Future Satellite Systems GOES Ground System
USA-WP3	Coordination of Data Collection Status and Problems of IDCS
USA-WP4	Coordination of Data Collection (Ships)
USA-WP5	Coordination of Data Collection ASDAR
USA-WP6	Coordination of Data Collection Review of IDCS Users' Guide
USA-WP7	Coordination of Data Dissemination Low Resolution (Weather Facsimile)
USA-WP8	Coordination of Data Dissemination DCP Data
USA-WP9	Coordination of Meteorological Parameter Extraction - Winds
USA-WP10	Precipitation and Cloud Cover Data Extraction
USA-WP11	Coordination of Meteorological Parameter Extraction - Other Parameters (Precipitation Estimation Techniques)
USA-WP12	Coordination of Meteorological Parameter Extraction - Other Parameters (Insolation)
USA-WP13	Coordination of Meteorological Parameter Extraction - Other Parameters (Moisture Channel)
USA-WP14	Coordination of Meteorological Parameter Extraction - Other Parameters (Research Spacecraft Operations)
USA-WP15	Other Products (WEFAX Image Enhancement)
USA-WP16	Coordination of Archivals and Retrievals

CGMS-XIII WORKING PAPERS
(continued)

Reference	Title
USA-WP17	Telecommunications- Protection Criteria for METSAT Frequencies
USA-WP18	Telecommunications - Use of METEOSAT Uplink Frequencies
USA-WP19	Telecommunications - CCIR Study Group 2 Report 395-3
USA-WP20	Telecommunications - CCIR Paper for Space WARC
USA-WP21	Role of Geostationary Satellites in the World Climate Programme
USA-WP22	Miscellaneous Operational VAS Mode AAA Format
WMO-WP1	ASDAR Status Report
WMO-WP2	ASDAR. Transition from Prototype to Operational ASDAR System
WMO-WP3	Information Paper on the work of the Satellite Calibration Centre for the International Satellite Cloud Climatology Project
WMO-WP4	A Progress Report on ASAP
WMO-WP5	ASDAR Coordination of Data Collection

CGMS-XIV WORKING PAPERS

Reference	Title
ESA-WP1	Review of Past Action Items
ESA-WP2	Status of ESA in orbit Satellites
ESA-WP3	Status of the METEOSAT Operational Programme Space Segment
ESA-WP4	Status of ESA Data Collection System
ESA-WP5	ASDAR Status Report
ESA-WP6	Review of IDCS Users Guide
ESA-WP7	METEOSAT High and Low Resolution (WEFAX) Status Report
ESA-WP8	METEOSAT Dissemination of DCP Data via WEFAX Channel
ESA-WP9	METEOSAT Data Dissemination via GTS
ESA-WP10	Preliminary Report on Moon Calibration
ESA-WP11	Status Report on METEOSAT Meteorological Products
ESA-WP12	The New METEOSAT Automatic Wind Quality Control Scheme
ESA-WP13	Status Report on METEOSAT ISCCP Operations
ESA-WP14	Intercalibration between Satellites
ESA-WP15	A Progress Report on the French Involvement in ASAP
ESA-WP16	Review of CGMS Consolidated Report
India WP1	Status of INSAT-IB
India WP2	Report on Future Satellites systems

CGMS-XIV WORKING PAPERS
(continued)

Reference	Title
Japan-WP1	Status of Japanese Satellite System
Japan-WP2	Future Plan
Japan-WP3	The Satellite Report (SAREP) of Tropical Cyclone
Japan-WP4	International use of GMS DCP Communications Channel
Japan-WP5	Coordination of Data Collection - Plan for GMS DCP Data Format Change
Japan-WP6	Coordination of Data Collection ASDAR - Status and Problem of ASDAR Data Processing System
Japan-WP7	Status of GMS-3 Calibration
Japan-WP8	GMS-3 VISSR in-orbit Performance Summary
Japan-WP9	Current Status of GMS Wind Derivation
Japan-WP10	Planned Changes of FAX Dissemination Schedules via GMS accompanying Replacement of Computer System of DPC and Stretched VISSR Data Dissemination
Japan-WP11	Review of Consolidated Report
USA-WP1	Preliminaries - Review of Consolidated Report
USA-WP2	Report on Status of Satellite Systems
USA-WP3	Report on Future Satellite Systems Status of GOES-Next Procurement as of 5.10.85
USA-WP4	Report on Future Satellites Systems 406 MHz Search and Rescue Satellite Experiment
USA-WP5	Common Backup Satellites
USA-WP6	Geostationary Satellites as part of WMO Programmes - Other Programmes, TOGA
USA-WP7	Coordination of Data Collection - Status and Problems of IDCS

CGMS-XIV WORKING PAPERS
(continued)

Reference	Title
USA-WP8	Coordination of Data Collection - Ships, Automated Shipboard Aerological Programme
USA-WP9	Coordination of Data Collection - Ships, SEAS Programme
USA-WP10	ASDAR Summary
USA-WP11	Coordination of Data Collection - Review of IDCS Users' Guide
USA-WP12	Coordination of Data Dissemination - Low Resolution (Weather Facsimile)
USA-WP13	Other Dissemination
USA-WP14	Coordination of Satellite Data Calibration
USA-WP15	Advances in Producing Satellite-derived Wind Sets
USA-WP16	Coordination of Meteorological Parameter Extraction - Semi-Annual Comparison of Winds
USA-WP17	Coordination of Meteorological Parameter Extraction - Other Parameters, Precipitation and Cloud Cover Data Extraction
USA-WP18	Coordination of Archivals and Retrievals
USA-WP19	Telecommunications
USA-WP20	Miscellaneous - Second International Direct Broadcast Conference
USA-WP21	Miscellaneous - International Polar-Orbiting Meteorological Satellite Group
USSR-WP1	Report on Future Satellite System

CGMS-XIV WORKING PAPERS
(continued)

Reference	Title
WMO-WP1	Geostationary Satellite Data and Major Products Guide
WMO-WP2	Status of the International Satellite Cloud Climatology Project (ISCCP)
WMO-WP3	Common Global Services as a Basis for Development of Common Backup Satellites
WMO-WP4	Low Resolution Dissemination via Satellite, Some Considerations for the Future
WMO-WP5	Summary on Satellite Data Calibration
WMO-WP6	Summary on Satellite Winds
WMO-WP7	The Operational WWW Systems Evaluation-North Atlantic (OWSE-NA)
WMO-WP8	Status and Problems of the IDCS, Meteorological Systems which could use the IDCS
WMO-WP9	ASAP, Progress Report on Development
WMO-WP10	ASDAR, Progress Report on Development and Implementation of an Operating Group

Annex 4

CGMS XV WORKING PAPERS

USA-WP1	USA Requirements for INSAT Data
USA-WP2	Review of Action Items from CGMS XIV: Action 17
USA-WP3	Review of Consolidated Report
USA-WP4	Report on Status of Satellite Systems GOES
USA-WP5	Report on Future Satellite Systems GOES I-M
USA-WP6	Common Backup Satellites Ground System
USA-WP7	Redeployment of Satellites
USA-WP8	Other Programmes TOGA/WCRP
USA-WP9	Status of the IDCS
USA-WP10	Ships
USA-WP11	ASDAR
USA-WP12	Review of IDCS Users' Guide
USA-WP13	Dissemination via Satellite High Resolution (Mode AAA)
USA-WP14	Dissemination via Satellite (WEFAX) Common Header Format
USA-WP15	Dissemination via Satellite Low Resolution (WEFAX) Status
USA-WP16	Low Resolution (WEFAX) Quality Control and Enhancement Wedges
USA-WP17	Other Dissemination
USA-WP18	Winds
USA-WP19	Precipitation and Cloud Cover Data Extraction
USA-WP20	VAS Products
USA-WP21	Coordination of Archiving and Retrievals
USA-WP22	406 MHz Search and Rescue Satellite Experiment

WMO-WP1	Status of International Satellite Cloud Climatology Project (ISCCP)
WMO-WP2	Satellite Redeployment versus Alternative Strategies to achieve Reliability and Continuity of Coverage from a Global Network of Geostationary Meteorological Satellites
WMO-WP3	Geostationary Satellite Data and Major Products Guide
WMO-WP4	Applications of Satellite Technology in the WMO Long-term Plan
WMO-WP5	Progress Report on Implementation of the Aircraft to Satellite Data Relay (ASDAR) Programme
WMO-WP6	Progress Report on Implementation of the Automated Shipboard Aerological Programme (ASAP)
WMO-WP7, Add. 1	Schedule for use of the International Data Collection System

CGMS XV WORKING PAPERS
(continued)

Reference	Title
ESA-WP1	Review of Past Action Items
ESA-WP2	Review of Consolidated Report
ESA-WP3	Status of the ESA Satellite System
ESA-WP4	Status of the METEOSAT Operational Programme Space Segment
ESA-WP5	Definition of a Portable CDA System
ESA-WP6	ESA Involvement in WMO Programmes
ESA-WP7	Status and Problems of the IDCS
ESA-WP8	Use of GOES-4 in the METEOSAT Data Collection System
ESA-WP9	Review of IDCS Users' Guide
ESA-WP10	METEOSAT High and Low Resolution (WEFAX) Status Report
ESA-WP11	Some Considerations on the Digital WEFAX
ESA-WP12	Considerations on Future METEOSAT Data Dissemination
ESA-WP13	Possibilities for METEOSAT Retransmission of INSAT Images
ESA-WP14	Calibration of METEOSAT-2
ESA-WP15	The METEOSAT New Black Body Calibration System
ESA-WP16	Status Report on METEOSAT Meteorological Products
ESA-WP17	METEOSAT Winds
ESA-WP18	METEOSAT Precipitation Index
ESA-WP19	Report on Space Frequency Coordination Group Meeting no. 6
ESA-WP20	METEOSAT Second Generation, Brief Status Report
EUMETSAT-WP1	A proposal for a Satellite Redeployment Strategy to Improve the Availability of the Geostationary Meteorological Satellites
EUMETSAT-WP2	Status Report on the Setting up of EUMETSAT
India-WP1	Status Report on INSAT-IB
India-WP2	Future Plans of Indian National Satellite (INSAT) System

CGMS XV WORKING PAPERS
(continued)

Japan-WP1	Review of Consolidated Report
Japan-WP2	Status of Geostationary Meteorological Satellite
Japan-WP3	GMS-4 and Beyond
Japan-WP4	Common Backup Satellites
Japan-WP5	Status and Problems of IDCS
Japan-WP6	SEAS
Japan-WP7	ASDAR
Japan-WP8	High Resolution and Low Resolution Facsimile Dissemination
Japan-WP9	Present and Future Schedule of VISSR Observation and FAX Dissemination
Japan-WP10	The Formats of LR-FAX Pictures
Japan-WP11	DCP Data
Japan-WP12	Status of GMS-3 VISSR Calibration Attachment: GMS-3 VISSR IR Calibation by Hideyuki SASAKI and Hideyuki HASEGAWA
Japan-WP13	Status Report of GMS Wind Derivation
Japan-WP14	Coordination of Meteorological Parameter Other Parameters Attachment I: Advanced Tbb Contour Chart by Toshihiro MOTOKI Attachment II: Comparison between Visible and Infrared Analysis of Dvorak's Technique for Tropical Cyclone Intensity Estimation by Shuhei AKASHI, Hiroyuki KOBA, Tomoyuki HARADA and Takashi ICHINARI, Attachment III: An Estimation of Precipitation Intensity from GMS Data by using Digital Radar Echo Intensity by Shingo OSANO, Toshihiro MOTOKI and Kazuhumi SUZUKI
Japan-WP15	Coordination of Archiving and Retrievals
Japan-WP16	Use of GMS Telecommunication Facilities for Data Dissemination Attachment: Utilization of GMS UHF Communication Capability
Japan-WP17	Renewal Plan of DPC Computer System and Telecommunication Facilities at Meteorological Satellite Center
Japan-WP18	Information on Transmission of the Stretched VISSR Data of the GMS Attachment I: Transmission Characteristics of GMS Stretched VISSR Data Attachment II: VISSR Observation and Dissemination Schedule Attachment III: Medium Scale Data Utilization Stations
Japan-WP19	Retransmission of INSAT Image Data
PRC-WP1	Report on Future Satellite Systems

LIST OF WORKING PAPERS SUBMITTED TO CGMS XVI

AGENDA ITEM	SOURCE/ REF	TITLE
A	**PRELIMINARIES**	
A3	Japan WP-1	Review of actions items from CGMS XV
A3	USA WP-1	Review of actions items from CGMS XV
A4	ESA WP-10	Review of Consolidated Report
A4	Japan WP-2	Review of Consolidated Report
A4	USA WP-2	Review of Consolidated Report
A4	WMO WP-9	Review of Consolidated Report
B	**REPORT ON THE STATUS OF SATELLITE SYSTEMS**	
B1	EUMETSAT WP-1	Meteosat-2
B3	Japan WP-3-1	Status of GMS VISSR observation
	Att 1	The Australian monsoon experiment (AMEX), record of the 7th session of the Japan-Australia GMS Joint Committee 29 Julyl August 1986
B3	Japan WP-3-2	Status of Geostationary Meteorological Satellite
B4	USA WP-3	Report on Satellite Status
C	REPORT ON FUTURE SATELLITE SYSTEMS	
C1	EUMETSAT WP-2	Status the Meteosat Operation Programme, Space Segment
C1	EUMETSAT WP-3	Requirements for Meteosat Second Generation
C3	Japan WP-4	Future Satellite System in Japan
C5	USA WP-04	GOES I-M Data Formats
C7	EUMETSAT WP-4	Common Backup Satellites
C7	Japan WP-5	Common Backup Satellites
C7	USA WP-05	Common Backup Satellites
D	GEOSTATIONARY SATELLITES AS PART OF WMO PROGRAMMES	
D	WMO WP-1	Summary of Satellite-Related Items

		in Tenth WMO Congress
D1	EUMETSAT WP-5	World Weather Watch Programmes
D1	WMO WP-2	WMO Plan for Operational WWW Systems Evaluation Africa (OWSE-AF)
D2	ESA WP-6	Comments on the status of ISCCP
D2	EUMETSAT WP-6	EUMETSAT Involvement in Other Programmes
D2	USA WP-06	Other Programmes
D2	WMO WP-3	Status of the International Satellite Cloud Climatology Project (ISCCP)
E	<u>COORDINATION OF DATA COLLECTION</u>	
E	USA WP-09	SEAS
E1	ESA WP-1	Status and problems of the IDCS
E1	USA WP-07	Status of IDCS
E1	WMO WP-7	Some Aspects of Alleviating Interference in the DCS Frequency Band (CGMS-XV Action Item 5)
E2	Japan WP-7	Ships
E2	USA WP-08	Ships
E2	WMO WP-4	Development of the Automated Shipboard Aerological Programme (ASAP)
E2	WMO WP-8	Baseline Upper-Air Network (BUAN)
E3	Japan WP-8	ASDAR
E3	USA WP-10	ASDAR
E3	WMO WP-5	Progress Report on Implementation of the ASDAR Programme
E4	Japan WP-9	Review of IDCS Users' Guide
E4	USA WP-11	Status of IDCS Users' Guide
E4	WMO WP-9	Review of IDCS Users' Guide
F	<u>COORDINATION OF DATA DESSEMINATION</u>	
F1.1	ESA WP-2	Meteosat high and low resolution (WEFAX)status report
F1.1	Japan WP-10	HR-FAX
F1.1	USA WP-12	Mode AAA
F1.2	Japan WP-11	LR-FAX
F1.2	USA WP-13	WEFAX Common Header
F1.2	USA WP-14	WEFAX Schedules
F1.2	USA WP-15	WEFAX Enhancement Wedge
F1.3	Japan WP-12	DCP Data
F1.4	EUMETSAT WP-7	Some further considerations on digital WEFAX
F2	Japan WP-13	Dissemination via GTS

F3	Japan WP-14	Other Dissemination
F3	USA WP-16	NOAAPORT Phase I
F3	USA WP-17	NOAAPORT Phase II
G	<u>COORDINATION OF SATELLITE DATA CALIBRATION</u>	
G	ESA WP-4	Calibration of Meteosat-2
G	USA WP-18	GOES I-M
H	<u>COORDINATION OF METEOROLOGICAL PARAMETER EXTRACTION</u>	
H1	ESA WP-8	Cloud Motion Winds
H1	Japan WP-15	Satellite-Wind
H1	USA WP-19	Winds
H1	WMO WO-6	Quality and Quantity of Satellite Winds
H1	ESA WP-3	Status Report on Meteosat Operational Products
H2	USA WP-20	Sea-Surface Temperature
H3	ESA WP-5	Atmospheric Corrections
H3	ESA WP-7	Upper Tropospheric Humidity
H3	Japan WP-16	Other Parameters
H3	USA WP-21	Precipitation & Cloud Cover
H3	USA WP-22	VAS Products
I	<u>COORDINATION OF ARCHIVING AND RETRIEVALS</u>	
I	ESA WP-9	Possible use of a system based on digital optical disks for Meteosat Archiving
I	Japan WP-17	Coordination of ARchiving and Retrievals of Japan
I	USA WP-23	GOES
J	<u>TELECOMMUNCATIONS</u>	
	No papers were submitted under this heading	
K	<u>MISCELLANEOUS</u>	
K	Japan WP-18	Summary of New DCP Computer System at MSC
K	Japan WP-19	Renewal Plan of the Ground Telecommunication Facilities
K	Japan WP-20	Corrrection of Information on Transmission of the Stretched VISSR Data of the GMS
K	USA WP-24	Search & Rescue

WORKING PAPERS SUBMITTED TO CGMS XVII

WORKING PAPER	TITLE
ESA	
ESA-WP-1	Meteosat-P2 Launch and commissioning
ESA-WP-2	Report on the Status of Satellite Systems
ESA-WP-3	Geostationary Satellite as Part of WMO Programmes - Status Report on the Contribution of Meteosat Data to the ISCCP and GPCP
ESA-WP-4	Status and Problems of the IDCS
ESA-WP-5	DCP Data
ESA-WP-6	Dissemination via GTS
ESA-WP-7	Meteosat High and Low Resolution (WEFAX) Status Report
ESA-WP-8	Dissemination of High Resolution Data Via Meteosat - Compression and Encryption of Digital Image Data
ESA-WP-9	Coordination of Satellite Calibration - The Current Status of Calibrating the Meteosat Radiometric Channels
ESA-WP-10	Coordination of Meteorological Parameter Extraction - Meteosat Cloud Motion Winds
ESA-WP-11	Coordination of Meteorological Parameter Extraction - Status of Meteosat Meteorological Products
ESA-WP-12	Coordination of Meteorological Parameter Extraction - The Comparison of Meteosat Cloud Motion Winds with Collocated Radiosonde Winds
ESA-WP-13	Coordination of Archiving and Retrieval

EUMETSAT

EUMETSAT-WP-1	Review of Action Items
EUMETSAT-WP-2	Review of Consolidated Report
EUMETSAT-WP-3	Meteosat Second Generation
EUMETSAT-WP-4	EUMETSAT Polar System
EUMETSAT-WP-5	INSAT relay
EUMETSAT-WP-6	GOES relay
EUMETSAT-WP-7	Report on ASDAR Coordination meeting
EUMETSAT-WP-8	Some further considerations on digital WEFAX
EUMETSAT-WP-9	Report on Future Satellite Systems
EUMETSAT-WP-10	The Meteosat MDD mission

INDIA

India-WP-1	Report on the Status of the INSAT-I System
India-WP-2	Report on Future Satellite Systems

JAPAN

Japan-WP-1	Review of Action Items from CGMS XVI
Japan-WP-2	Review of Consolidated Report
Japan-WP-3-1	Status of GMS-3 VISSR Observations
Japan-WP-3-2	Status of Geostationary Meteorological Satellites
Japan-WP-4	Future Satellite System
Japan-WP-5	Status and problems of IDCS
Japan-WP-7	Shipboard weather data via DCS
Japan-WP-8	ASDAR
Japan-WP-9	HR dissemination

Japan-WP-10	Consideration of digital WEFAX
Japan-WP-11	Renaming of GMS LR-FAX
Japan-WP-12	DCP Data
Japan-WP-13	Dissemination via GTS (SAREP)
Japan-WP-14	Satellite-Winds
Japan-WP-15	Ocean surface wind for a Typhoon
Japan-WP-16	Other Parameters
Japan-WP-17	Index of precipitation intensity
Japan-WP-18	Cloud amount anomaly chart
Japan-WP-19	Coordination of Archiving and Retrievals
Japan-WP-20	Cartridge tape system
Japan-WP-21	Plans for the dissemination of WWW data via GMS

Peoples Republic of China (PRC)

PRC-WP-1	Status of PRC Satellite Systems
PRC-WP-2	Report on Future PRC Satellite Systems

USA

USA-WP-1	Comments on the Agenda
USA-WP-2	Review of Action Items from CGMS XVI
USA-WP-3	Review of Consolidated Report
USA-WP-4	Report on US Satellite Systems
USA-WP-5	GOES I-M
USA-WP-6	Weatherwatch International
USA-WP-7	Status of IDCS
USA-WP-8	ASDAR update
USA-WP-9	Reviews of IDCS Users' Guide

USA-WP-10	HR data - GVAR
USA-WP-11	GVAR and direct readout user
USA-WP-12	LR-WEFAX
USA-WP-13	Report on DCS interference
USA-WP-14	Quality of VAS data
USA-WP-15	New DCS ground system
USA-WP-16	Normalisation of GOES VIS image data
USA-WP-17	CGMS satellite winds
USA-WP-18	Improving the quality and quantity of NESDIS satellite winds
USA-WP-19	Monitoring of CMVs at the NMC
USA-WP-20	Report on semi-annual comparison of satellite winds
USA-WP-21	Current NESDIS procedures for producing operational satellite winds
USA-WP-22	VAS Products
USA-WP-23	Precipitation and cloud cover
USA-WP-24	GOES next data archive plan
USA-WP-25	Global Geosynchronous Search and Rescue System

<u>WMO</u>

WMO-WP-1	Status and planning for the OWSE-Africa
WMO-WP-2	Automated Ship-board Aerological Programme
WMO-WP-3	Implementation of the operational ASDAR Programme
WMO-WP-4	Status of the International Satellite Cloud Climatology Project (ISCCP)

A N N E X 5

CGMS AGENDAE

CGMS-I

Joint Session

Ref.	Title
A	General
A.1 A.2	Introduction
A.3	Description of meteorological requirements and satellite systems planned
B	Data Collection Compatibility Considerations
B.1	Requirements for compatibility
B.2	Standardization
B.3	Transfer of responsibility
B.4	Data processing and dissemination
C	Other System Interfaces
C.1	Imagery from satellite
C.2	WEFAX
C.3	Locations of satellite subpoints
C.4	Space to space communication links
D	Continuing Coordination

CGMS-II

1. System Engineering Working Group

Ref.	Title
A.	Data Collection Compatibility
A.1	Standardization of frequencies
A.2	Data rates
A.3	Data format
A.4	Address codes
A.5	Power received at the spacecraft
A.6	Emergency frequency channel allocations
A.7	Engineering aspects of transfer of responsibility from one spacecraft to another.
B.	WEFAX Capability
B.1	Frequency allocations
B.2	Signal modulation
B.3	Data format

CGMS - II

2. User Considerations Working Group

Ref.	Title
A.1	Operational procedures
A.2	Estimates of accuracies of data, in particular winds
A.3	Discussion of wind data format
A.4	Assessment of number of platforms
A.5	Codes for dissemination of data from all types of DCPs
A.6	Administrative communications
A.7	Location of satellite sub-points
A.8	Reserve plans
B	Coordination of APT services
C	Archival procedures
D	Telecommunication scheduling
E	Requirements for rapid relay of data from polar orbiting satellites

CGMS-III

1. System Engineering Working Group

Ref.	Title
A	Technical Specifications for DCP System
B.1	Power Flux Density of the DCP
B.2	Alert Channel Allocation
B.3	Required Multipath Margin
C.1	Sensitivity Characteristics of WEFAX Stations
C.2	Power Flux Density of WEFAX Systems
C.3	Protection of ITOS Receiving Stations and Radio-astronomy
D	Operation Procedures for DCP
E	Training and Exchange of Informations

CGMS - III

2. User Coordination Working Group

Ref.	Title
A.1	WEFAX Time Scheduling
A.2	Operational Procedures for DCP
A.3	Positions of Spacecraft
A.4	Codes for Dissemination of Data from all Types of DCP's
A.5	Administrative Communications
B	Coordination of APT Services
D	Requirements for the rapid Relay of data from Polar Orbiting Space-crafts
E	Training and Exchange of Information
F	The problem of the Coordination Procedures for Computation of Radiation Balance
G	The WMO Executive Committee Panel on Meteorological Satellites

CGMS-IV

1. System Engineering Working Group

Ref.	Title
A	WEFAX power flux density
B	Acquisition sweep
C	Short term stability for DCP transmitter
D	Operations in eclipse
D1	Image data collection
D2	DCP data collection
D3	DCP data interrogation
E	Radio interference
E1	Radio frequency interference with radio-sondes
E2	Protection of radio-astronomy
F	Engineering feasibility of information relayed from carrier balloons
G	Information papers
G1	Study and experiment on multipath propagation and scintillation
G2	Study on spin modulation
G3	Results of data collection system compatibility tests
G4	Certification procedure for DCP radioset

CGMS - IV

2. User Considerations Working Group

Ref.	Title
A	Overall operational coordination
A1	Satellite transmission schedules
A2	Operational Procedures for DCPs
A2.1	Assignment of the responsible area for data collection
A2.2	Operational procedures for ship platforms
A2.3	Administrative communication procedures
A3	Admission procedures for international data collection platforms
A4	Codes for dissemination of data from all types of DCPs
A5	The carrier balloon system and its operation by geostationary satellites
B.	Archiving and retrieval
C.	Additions to glossary of terms
D.	The problem of the coordination procedures for computation of radiation balance
E.	Eclipse operation
E1	Image data collection
E2	DCP data collection
E3	DCP interrogation

CGMS-V

1. Systems Engineering Group

Ref.	Title
A.	Experimental results
A.1	GOES operations
A.2	DCP multipath experiment
B.	Radio interference
B.1	Interference caused by radio-sondes
B.2	Radio astronomy protection
C.	Acquisition sweep for DCP receivers
D.	Short-term stability of DCP transmitters
E.	WEFAX
E.1	Power flux density
E.2	Data transmission standards
F	Certification of international DCPs
G.	Alert platforms
H.	DCPs on ships
I.	Carrier balloon system
J.	Interrogation frequency plan
K.	Data collection system interrogation messages
L.	DCP modulation index

CGMS - V

2. Operations Working Group

Ref.	Title
A.	Overall Operational Coordination
A.1	Satellite Transmission Schedule
A.2	Ship Platforms
A.2.1	Operational Procedures for Ship Platforms
A.2.2	Engineering Aspects of Ship Platforms
A.3	Mission Procedures for International Data Collection Platforms
A.4	Provision of Basic Meteorological Data for Satellite Centres
A.5	Carrier Balloon System and its Operation by Geostationary Satellites
B.	Archiving and Retrieval
C.	Glossary of Terms
D.	Problem of the Coordination Procedures for Computation of Radiation Balance
E.	Protection of Radio Astronomy
F.	Procedures for the Certification of DCPRS
G.	Self-timed Ship DCPs

CGMS-VI

1. Systems Engineering Working Group

Ref.	Title
A.	Information Paper
A.1	GOES Operational Results
A.2	DCP Multipath Experiments
A.3	Satellite Operating Characteristics
A.4	Specifications for Ground Equipment to receive direct broadcasts
B.	Radio Interference
B.1	Interference caused by radio sondes
B.2	Power Flux Density Problems
C.	Certification Specifications
D.	Data Collection System Messages
D.1	Report messages
D.2	Interrogation messages
E.	WEFAX
E.1	WEFAX Index of Cooperation
E.2	WEFAX Format
F.	Special Use of Interrogation Link for ASDAR
F.1	Time code transmission on interrogation link
F.2	Length of unmodulated interrogation carrier preamble

CGMS - VI

2. Operations Working Group

Ref.	Title
A.	Overall Operational Coordination
A.1	Satellite Transmission Schedules and Formats for Direct Broadcasts
A.2	Operational Procedures in a Self-Timed DCP System
A.3	Completion of Admission Procedures
B.	Archiving and Retrieval
C.	Glossary of Terms
D.	Certification Procedures
E.	Contingency Plans
F.	Report on Wind Processing Programs

3. Joint Session

Ref.	Title
A.	Review of all action Items of both Working Groups
B.	Review of work of the drafting Ad Hoc Group
C.	Radio Astronomy Protection
D.	ASDAR (Aircraft to Satellite Data Relay)
E.	NAVAIDSONDE System

CGMS-VII

1. System Engineering Working Group

Ref.	Title
A.	Information Papers
A.1	GOES Operational Results
A.2	GOES International System Implementation
A.3	Buoy/shipboard UHF Antenna Development
A.4	GMS Status
B.	WEFAX
B.1	Power Flux Density
B.2	Finalisation of Transmission Characteristics
C.	Finalisation of DCP Transmission Characteristics
C.1	Interrogation format
C.2	Reply format
D.	Special Use of IDCS for ASDAR
D.1	Time code
D.2	Carrier preamble
D.3	Format
E.	Allocation of Frequency Channels to DCPs
F.	Completion of DCPRS Certification Specifications

CGMS - VII

2. Operations Working Group

Ref.	Title
A.	Overall Operational Coordination
A.1	Satellite transmission schedules and formats for direct broadcasts
A.2	Operational procedures in a DCP system
A.2.1	Ships
A.2.2	ASDAR
A.3	Admission Procedures
B.	Archiving and Retrieval
C.	Glossary of Terms
D.	Contingency Plans
E.	Report on Wind Processing Programmes
F.	Information Papers
F.1	ESA DCP Users' Guide
F.2	ESA Users' Guide to the METEOSAT Archive
F.3	Use of SMS tapes
G.	Supplements to former CGMS-reports
G.1	Redefinition of the Term "Administrative"
G.2	Dissemination of Quantitative Products on the GTS

CGMS-VII

3. Joint Session

Ref.	Title
A.	IDCS Support
A.1	IDCS requirements in support of the FGGE
A.2	Support to ASDAR
B.	Relay of Image Data between Geo-stationary Satellite Systems
C.	Allocation of Addresses, Fre-quencies and Time Slots
C.1	Within satellite systems
C.2	For entry in the GTS
D.	DCPRS Certification Facilities and Execution
E.	Interferences with Radiosondes
F.	Standard Processing Support for Data Collection
G.	Consolidated Report

CGMS-VIII

A. Opening of the Meeting

A.1 Selection of the Working Group/Senior Officials Chairmen
A.2 Adoption of the Agenda
A.3 Review of the Consolidated Report from CGMS I-VII
A.4 Determination of Report format and Working Arrangements

B. Review of all Action Items from CGMS VII

C. Status Reports

C.1 GOES
C.2 GMS
C.3 METEOSAT
C.4 GOMS
C.5 INSAT

D. Contingency Plans for FGGE

E. Status of FGGE Requirements for Data Collection System Support

E.1 Operational procedures for ASDAR
E.2 Selected times for test transmitter usage in testing ASDAR
E.3 ASDAR finalisation and extension of cut-off data
E.4 Review of bandwidth/channel allocation of international use
E.5 Report on DCP ship tests
E.6 DCP Certification procedures

F. WEFAX

F.1 Report on WEFAX tests
F.2 WEFAX power flux density
F.3 WEFAX format

G. Radio Interference

G.1 Report on results of tests on interference on radiosondes
G.2 Proposed action of CCIR ref. Astronomy
G.3 Other CCIR documents

CGMS-VIII AGENDA (contd)

H. Wind-processing Programs

H.1 Report of intercomparison of winds extracted from SMS tapes
H.2 Proposal for a continuing intercomparison of extracted winds

I. Use of GTS to distribute notifications of emergency changes in DCS Operations

J. Exchange of Operating/Engineering Information between Satellite Operators

J.1 Satellite Systems Operations Report
J.2 IDCS Admission Information
J.3 General Interest Information

K. Miscellaneous Informational Papers

K.1 Final report on buoy work by the New Mexico State University
K.2 Report on GMS S-band link interruption caused by scintillation

L. Preparation of Report

M. Date and Place of Meeting for CGMS IX

N. General Matters

CGMS-IX

A. Opening of the Meeting

- A.1 Selection of the Working Group/Senior Officials Chairmen
- A.2 Adoption of the Agenda
- A.3 Review of action items from CGMS-VIII
- A.4 Review of the Consolidated Report

B. Report on Status of Spacecraft

- B.1 GMS
- B.2 GOES
- B.3 METEOSAT
- B.4 GOMS
- B.5 INSAT

C. Contingency Plan

D. Coordination of Data Collection

- D.1 General Problems of IDCS
- D.2 Ships
- D.3 ASDAR

E. Coordination of Dissemination

- E.1 Dissemination via satellite
- E.2 Dissemination via GTS

F. Coordination of Meteorological Parameter Extraction

- F.1 Winds
- F.2 Sea-surface temperatures
- F.3 Other parameters

G. Coordination of Archiving and Retrievals

H. Telecommunications

- H.1 Interference problems
- H.2 Propagation problems
- H.3 Preparation for WARC

I. Miscellaneous

J. Time and Place of Next Meeting

CGMS-X AGENDA

A. PRELIMINARIES

A.1 Election of Chairman
A.2 Adoption of Agenda
A.3 Review of action items from CGMS-IX
A.4 Review of Consolidated Report

B. REPORT ON STATUS OF SATELLITE SYSTEMS

B.1 ESA
B.2 India
B.3 Japan
B.4 USA
B.5 USSR

C. REPORT ON FGGE

C.1 Contingency plan used for FGGE
C.2 Contribution of the geostationary satellites to FGGE
C.3 FGGE experience related to WWW Global Observing System

D. REPORT ON FUTURE SATELLITE SYSTEMS

D.1 ESA
D.2 India
D.3 Japan
D.4 USA
D.5 USSR

E. GEOSTATIONARY SATELLITES AS PART OF WWW GLOBAL OBSERVING SYST

E.1 Operation of the Space Segment
E.2 Ground Segment
E.3 Contingency Plans

F. COORDINATION OF DATA COLLECTION

F.1. Status and problem of IDCS
F.2 Ships
F.3 ASDAR
F.4 Platform position location
F.5 General policy on data collection from WWW stations and platforms

G. COORDINATION OF DISSEMINATION

G.1 Dissemination via satellite

G.1.1 High resolution
G.1.2 Low resolution (WEFAX)

G.2 Dissemination via GTS

CGMS-X AGENDA (contd.)

H. COORDINATION OF METEOROLOGICAL PARAMETER EXTRACTION

- H.1 Winds
- H.2 Sea-surface temperatures
- H.3 Other parameters

I. COORDINATION OF ARCHIVING AND RETRIEVALS

J. TELECOMMUNICATIONS

- J.1 Report on WARC
- J.2 Interference problems
- J.3 Propagation problems

K. ROLE OF GEOSTATIONARY SATELLITES IN THE WORLD CLIMATE PROGRAMME, IN PARTICULAR THE CLIMATE DATA PROGRAMME

L. MISCELLANEOUS

- L.1 DCS interrogation link dissemination
- L.2 National Scientific Balloon FAcility Experiment
- L.3 Distribution of DCP data to SDUS

M. DATE AND PLACE OF NEXT MEETING

CGMS XI AGENDA

A. PRELIMINARIES

A.1 Election of Chairman
A.2 Adoption of Agenda
A.3 Review of action items from CGMS X
A.4 Review of Consolidated Report

B. REPORT ON STATUS OF SATELLITE SYSTEMS

B.1 ESA
B.2 India
B.3 Japan
B.4 USA
B.5 USSR

C. REPORT ON FUTURE SATELLITE SYSTEMS

C.1 ESA
C.2 India
C.3 Japan
C.4 USA

- C.4.1 GOES G, H and I
- C.4.2 VISSR Atmospheric Sounder
- C.4.3 GOES after the G, H and I series

C.5 USSR
C.6 Common back-up satellites

D. GEOSTATIONARY SATELLITES AS PART OF WWW GLOBAL OBSERVING SYSTEM

E. COORDINATION OF DATA COLLECTION

E.1 Status and Problem of IDCS
E.2 Ships
E.3 ASDAR
E.4 Review of IDCS Users' Guide
E.5 Platform position location
E.6 General Policy on Data Collection

F. COORDINATION OF DATA DISSEMINATION

F.1 Dissemination via Satellite

- F.1.1 High Resolution
- F.1.2 Low Resolution (WEFAX)
- F.1.3 DCP Data

F.2 Dissemination via GTS

CGMS XI AGENDA (contd.)

G. COORDINATION OF METEOROLOGICAL PARAMETER EXTRACTION

- G.1 Winds
- G.2 Sea Surface Temperatures
- G.3 Other parameters

H. COORDINATION OF ARCHIVING AND RETRIEVALS

I. TELECOMMUNICATIONS

J. ROLE OF GEOSTATIONARY SATELLITES IN THE WORLD CLIMATE PROGRAMME, IN PARTICULAR THE CLIMATE DATA PROGRAMME

K. MISCELLANEOUS

L. DATA AND PLACE OF NEXT MEETING

CGMS-XII AGENDA

A. PRELIMINARIES

A.1 Election of Chairman
A.2 Adoption of Agenda
A.3 Review of Action Items from CGMS-XI
A.4 Review of Consolidated Report

B. REPORT ON STATUS OF SATELLITE SYSTEMS

B.1 ESA
B.2 India
B.3 Japan
B.4 USA
B.5 USSR

C. REPORT ON FUTURE SATELLITE SYSTEMS

C.1 ESA
C.2 India
C.3 Japan
C.4 USA
C.5 USSR
C.6 Common Backup Satellites

D. GEOSTATIONARY SATELLITES AS PART OF WWW GLOBAL OBSERVING SYSTEM

E. COORDINATION OF DATA COLLECTION

E.1 Status and Problem of IDCS
E.2 Ships
E.3 ASDAR
E.4 Review of IDCS Users' Guide

F. COORDINATION OF DATA DISSEMINATION

F.1 Dissemination via Satellite

F.1.1 High-resolution
F.1.2 Low-resolution (WEFAX)
F.1.3 DCP data

F.2 Dissemination via GTS

G. COORDINATION OF METEOROLOGICAL PARAMETER EXTRACTION

G.1 Winds
G.2 Sea-surface temperatures
G.3 Other parameters

CGMS-XII AGENDA
(continued)

H. COORDINATION OF ARCHIVING AND RETRIEVALS

I. TELECOMMUNICATIONS

J. ROLE OF GEOSTATIONARY SATELLITES IN THE WORLD PROGRAMME

K. MISCELLANEOUS

L. DATE AND PLACE OF NEXT MEETING

CGMS-XIII AGENDA

A. PRELIMINARIES

- A.1 Election of Chairman
- A.2 Adoption of Agenda
- A.3 Review of Action Items from CGMS-XI
- A.4 Review of Consolidated Report

B. REPORT ON STATUS OF SATELLITE SYSTEMS

- B.1 ESA
- B.2 India
- B.3 Japan
- B.4 USA
- B.5 USSR

C. REPORT ON FUTURE SATELLITE SYSTEMS

- C.1 ESA
- C.2 India
- C.3 Japan
- C.4 USA
- C.5 USSR
- C.6 Common Backup Satellites

D. GEOSTATIONARY SATELLITES AS PART OF WWW GLOBAL OBSERVING SYSTEM

E. COORDINATION OF DATA COLLECTION

- E.1 Status and Problem of IDCS
- E.2 Ships
- E.3 ASDAR
- E.4 Review of IDCS Users' Guide

F. COORDINATION OF DATA DISSEMINATION

- F.1 Dissemination via Satellite

- F.1.1 High-resolution
- F.1.2 Low-resolution (WEFAX)
- F.1.3 DCP data

- F.2 Dissemination via GTS

G. COORDINATION OF METEOROLOGICAL PARAMETER EXTRACTION

- G.1 Winds
- G.2 Sea-surface temperatures
- G.3 Other parameters

CGMS-XIII AGENDA
(continued)

H. COORDINATION OF ARCHIVING AND RETRIEVALS

I. TELECOMMUNICATIONS

J. ROLE OF GEOSTATIONARY SATELLITES IN THE WORLD CLIMATE PROGRAMME

K. MISCELLANEOUS

L. DATE AND PLACE OF NEXT MEETING

CGMS-XIV AGENDA

A. PRELIMINARIES

A.1 Election of Chairman
A.2 Adoption of Agenda
A.3 Review of Action Items from CGMS-XIII
A.4 Review of Consolidated Report

B. REPORT ON STATUS OF SATELLITE SYSTEMS

B.1 ESA
B.2 India
B.3 Japan
B.4 USA
B.5 USSR

C. REPORT ON FUTURE SATELLITE SYSTEMS

C.1 ESA
C.2 India
C.3 Japan
C.4 USA
C.5 USSR
C.6 Common Backup Satellites

D. GEOSTATIONARY SATELLITES AS PART OF WWW GLOBAL OBSERVING SYSTEM

D.1 World Weather Watch
D.2 Other Programmes

E. COORDINATION OF DATA COLLECTION

E.1 Status and Problem of IDCS
E.2 Ships
E.3 ASDAR
E.4 Review of IDCS Users' Guide

F. COORDINATION OF DATA DISSEMINATION

F.1 Dissemination via Satellite

F.1.1 High-resolution
F.1.2 Low-resolution (WEFAX)
F.1.3 DCP data

F.2 Dissemination via GTS
F.3 Other Dissemination

CGMS-XI AGENDA
(continued)

G. COORDINATION OF SATELLITE DATA CALIBRATION

H. COORDINATION OF METEOROLOGICAL PARAMETER EXTRACTION

- H.1 Winds
- H.2 Sea Surface Temperatures
- H.3 Other Parameters

I. COORDINATION OF ARCHIVING AND RETRIEVALS

J. TELECOMMUNICATIONS

K. MISCELLANEOUS

L. DATE AND PLACE OF NEXT MEETING

CGMS XV - AGENDA

A. PRELIMINARIES

A.1 Election of Chairman
A.2 Adoption of Agenda
A.3 Review of Action Items from Previous CGMS Meetings
A.4 Review of Consolidated Report

B. REPORT ON STATUS OF SATELLITE SYSTEMS

B.1 ESA
B.2 India
B.3 Japan
B.4 USA

C. REPORT ON FUTURE SATELLITE SYSTEMS

C.1 ESA
C.2 India
C.3 Japan
C.4 People's Republic of China
C.5 USA
C.6 USSR
C.7 Common Backup Satellites
C.8 Redeployment of Satellites

D. GEOSTATIONARY SATELLITES AS PART OF WMO PROGRAMMES

D.1 World Weather Watch
D.2 Other Programmes

E. COORDINATION OF DATA COLLECTION

E.1 Status and Problem of IDCS
E.2 Ships
E.3 ASDAR
E.4 Review of IDCS Users' Guide

CGMS XV - AGENDA
(continued)

F. COORDINATION OF DATA DISSEMINATION

F.1 Dissemination via Satellite

F.1.1 High Resolution
F.1.2 Low Resolution (WEFAX)
F.1.3 DCP Data
F.1.4 Digital WEFAX

F.2 Dissemination via GTS
F.3 Other Dissemination

G. COORDINATION OF SATELLITE DATA CALIBRATION

H. COORDINATION OF METEOROLOGICAL PARAMETER EXTRACTION

H.1 Winds
H.2 Sea Surface Temperatures
H.3 Other Parameters

I. COORDINATION OF ARCHIVING AND RETRIEVALS

J. TELECOMMUNICATIONS

K. MISCELLANEOUS

L. DATE AND PLACE OF NEXT MEETING

AGENDA FOR CGMS XVI, 28 SEPTEMBER - 2 OCTOBER 1987

A. PRELIMINARIES

- A.1 Election of Chairman
- A.2 Adoption of Agenda
- A.3 Review of Action Items from Previous CGMS Meetings
- A.4 Review of Consolidated Report

B. REPORT ON STATUS OF SATELLITE SYSTEMS

- B.1 EUMETSAT
- B.2 India
- B.3 Japan
- B.4 USA

C. REPORT ON FUTURE SATELLITE SYSTEMS

- C.1 EUMETSAT
- C.2 India
- C.3 Japan
- C.4 People's Republic of China
- C.5 USA
- C.6 USSR
- C.7 Common Backup Satellites
- C.8 Redeployment of Satellites

D. GEOSTATIONARY SATELLITES AS PART OF WMO PROGRAMS

- D.1 World Weather Watch
- D.2 Other Programs

E. COORDINATION OF DATA COLLECTION

- E.1 Status and Problems of IDCS
- E.2 Ships
- E.3 ASDAR
- E.4 Review of IDCS User's Guide

F. COORDINATION OF DATA DISSEMINATION

- F.1 Dissemination via Satellite
    - F.1.1 High Resolution
    - F.1.2 Low Resolution (WEFAX)
    - F.1.3 DCP Data
- F.2 Dissemination via GTS
- F.3 Other Dissemination

G. COORDINATION OF SATELLITE DATA CALIBRATION

H. COORDINATION OF METEOROLOGICAL PARAMETER EXTRACTION

H.1 Winds
H.2 Sea Surface Temperatures
H.3 Other Parameters

I. COORDINATION OF ARCHIVING AND RETRIEVALS

J. TELECOMMUNICATIONS

K. MISCELLANEOUS

L. DATE AND PLACE OF NEXT MEETING

AGENDA FOR CGMS XVII, 3 - 7 OCTOBER 1988

A. PRELIMINARIES

A.1 Introduction
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A N N E X 6

PRECIS OF MORE RECENT CGMS MEETINGS

This Annex contains summary reports of CGMS meetings (CGMS X to CGMS XVII)

Precis
<u>Meeting X</u>

Meeting of 17-21 March 1980
Geneva, Switzerland

The working group met on 17, 18 and 19 March 1980, the 20th being devoted to the visit of the ESA facilities in Darmstadt, Federal Republic of Germany, and the Senior Officials meeting took place on 21 March.

India did not participate.

The reports on FGGE outlined the very valuable results achieved so far and recognised the success of the contingency plan implemented by ESA and USA.

Japan suggested using a backup satellite common to the four satellite operators. It has been agreed to study and work out this proposal in the context of the preparation of the second generation satellite in the 1990s.

It was agreed to no longer provide support to interrogate the international Data Collection Platform. A long discussion was held related to the support required by the future ASDAR system.

The intercomparison of winds was still a subject of discussion and a new colocation box, elaborated by USA, has been proposed and accepted.

In future any CGMS delegation may include a representative of their national telecommunication authority and CGMS could invite ITU consultation.

The World Climate Programme has been introduced by WMO and CGMS agreed that they would wish to cooperate as far as possible but the data requirements need to be established first.

The next meeting was tentatively scheduled to take place in Washington, USA, from 15 to 19 June 1981.

Precis
Meeting XI

Meeting of 8-12 February 1982
World Weather Building
Camp Spring, Maryland

The Working Group met on 8, 9 and 10 February 1982; the visit of the NOAA/NESS facilities took place on the 11th and the Senior Officials met on the 12th.

Neither India nor USSR were represented at the meeting.

The common back-up satellites concept proposed at CGMS X by Japan was discussed at length and two working groups were set up :

- one to review the telemetry, command and frequency management aspects, under the leadership of ESA,
- the other, led by USA, to study the imaging parameters.

A list of satellite operator representatives to discuss common spacecraft problems has been initiated.

The International Data Collection System Users' Guide was carefully reviewed with the aim of making it more coherent and up to date. The new AMDAR programme, which is under development, needs the close collaboration of CGMS, and a CGMS ad hoc group has already met with the AMDAR group.

The intercomparison of winds was still a subject of discussion. CGMS confirmed its agreement for the eliptical colocation box elaborated by USA. A new method for cloud height assignment, based on a statistical approach, was reported by Japan.

WMO provided the requirements for the International Satellite Cloud Climatology.

The next meeting is tentatively scheduled to take place in Paris, France, from 14 to 18 March 1983.

Précis
Meeting XII

Meeting of 25-29 April 1983
Paris, France

The Working Group met on 25, 26 and 27 April 1983 and the Senior Officials on 28 April.

India did not participate.

The common backup satellite was discussed at length.

- USA proposed to select the 2500 IR lines/images which is the European and Japan image format as the image standard.
- USA proposed to hold a System Engineering Working Group meeting in September 1983 in Washington with the aim to standardise as many parameters as possible.

WMO recalled the importance of the present network of geostationary meteorological satellite as part of the WWW Global Observing System and the need for the continuous availability of satellite meteorological data.

The elliptical colocation box, agreed at CGMS-XI, for intercomparison of winds, is no longer usedr by ESA. Japan reported on the improvements, in quantity as well as in quality, of derived winds; this is due to the implementation of an objective target cloud selection method for low level winds and the new method of height assignment.

A long debate on the IDCP specifications concluded that the certification specifications should include not only RF parameters but also the list of authorised characters.

The development contract for the new ASDAR platform was under signature. The related operational requirements and coding scheme were presented by ESA but no agreement was reached.

CGMS members attended the COSPAR Meeting on Stereoscopic Observations using Geostationary Satellites held on the afternoon of 28 April.

29 April was available for the visit of ESOC in Darmstadt.

The next meeting is tentatively scheduled in April/May 1984, in Europe.

Précis
Meeting XIII

Meeting of 10-13 April 1984
Geneva, Switzerland

Prior to the meeting, a special session on calibration and intercomparison of satellite measurements was held; the conclusions and recommendations of this meeting were later agreed by CGMS.

The Working Group started on the 10th p.m. and continued until the 12th. The Senior Officials met on the 13th.

India did not participate.

ESA informed the meeting that the remaining fuel on board METEOSAT-1 and -2 should allow nominal operations until the launch of METEOSAT-P2, scheduled for June 1986. The available power on METEOSAT-2 is becoming marginal and seasonal limitation is expected.

The METEOSAT Operational Programme includes the procurement of a series of three satellites, their launch and exploitation. The first launch is scheduled for June 1987, the second one 18 months later and the last one late in 1990.

Japan reported that GMS-3 is scheduled to be launched in August 1984 to continue GMS and GMS-2 missions. GMS-4 and beyond are under study.

USA are expecting a VAS failure on GOES-5 by the end of 1984. Their contingency plan will be to shift GOES-6 to a USA central location for image taking. GOES-G (-7) is scheduled to be launched not earlier than May 1986 and the following satellite within the following year.

The specifications of GOES-Next have not yet been released to Industry. ESA plans for the next generation foresee the first launch in 1994 to continue the METEOSAT Operational System.

USSR stated that they are continuing the design of their geostationary meteorological satellite. It will be three-axis stabilised and the radiometer includes a two-axis scanning device. The first launch may take place in the first half of the next five-year period.

The USA data collection system includes more than 4,500 platforms and supports a random reporting scheme.

Since October 1983, ESA has been disseminating the DCP data through the satellite within the spare time between WEFAX broadcasts.

Précis
Meeting XIII
(continued)

The operational ASDAR platforms are scheduled to be available for testing in September/October 1984; certifications will take place during the first quarter of 1985 and initial deliveries are expected by mid-1985.

The coding scheme was agreed and an AIREP format was proposed.

CGMS members expressed their concern that the new Space WARC should not bring into question the use of frequencies allocated to the Meteorological and Earth Observation Satellites.

Japan proposed to host CGMS XIV in Tokyo at the end of May 1985.

Annex 6

Précis
Meeting XIV

Meeting of 20-24 May 1985
Tokyo, Japan

The Working Group met on 20, 21 and 22 May 1985 and the Senior Officials on the 24th. A visit of the Command Data Acquisition Station and the Meteorological Satellite Centre took place on the 23rd.

India, having not attended CGMS meetings for a long time, was represented at CGMS XIV thus showing its interest in being an active CGMS member.

The effectiveness of technical coordination and of close collaboration between CGMS members has once more been proven as USA planned to move GOES-4 to 10°W to compensate for the end-of-life of METEOSAT-F1 in Autumn 1985 and to support the METEOSAT Data Collection system.

USSR's plans to launch the first GOMS in the first half of the five-year period beginning January 1986 were noted with interest.

The anticipated increase of use of the Data Collection System was a major point of concern and agreements were reached for optimisation of the time slots allocation. First steps are :

- to review the definition of the synoptic hour with the aim of extending the synoptic period,
- the reduction of the time slot from 2 minutes to 1 minute 30 seconds wherever possible and in particular for IDCS Channels 16, 17 and 18.

Discussion on data dissemination concentrated on two points :

- the introduction by WMO of the concept of digital WEFAX,
- the availability of INSAT image data to other satellite operators.

The precipitation index which was proposed by USA at CGMS XII is now extracted by Japan. ESA is investigating the possibility of doing the same, and India expressed interest in starting a similar exercise.

USA offered to host a meeting to present GOES-Next in January 1986 after the System Concept Review.

The next meeting is tentatively scheduled in Autumn 1986 and could be hosted by India.

Report of CGMS XV, New Dehli 1986

1. Introduction

The fifteenth session of the Coordination of Geostationary Meteorological Satellites (CGMS) was hosted by the India Meteorological Department, New Delhi from the 3rd to the 7th of November 1986.

Following an introduction by Dr. R. P. Sarker, Director General of the India Meteorological Department, Dr. Sen Roy, Deputy Director, was unanimously voted chairman of the session.

Information on the operations of the other members of CGMS (India, Japan, Russia, USA and the Peoples Republic of China (observer)) can be found in the CGMS Consolidated Report. Copies of this regularly updated document can be supplied upon request.

2. Present and Future Satellite systems

2.1 Present Systems:

The current status of the operational programmes of each satellite operators were presented. Of particular interest was the announcement by Russia that it plans to launch its first GOMS satellite before the middle of 1988. This satellite will be operated at 76 degrees east and will have WEFAX imagery and Data Collection mission compatible with those of the other CGMS satellites.

China will launch a polar orbiting meteorological satellite, FY-1, before the end of 1989 with imaging and data distribution characteristics similar to the present NOAA series.

Insat-1B is currently operated and visible and infrared images are produced every 3 hours. Cloud motion vectors extracted at 0600 GMT are distributed on the GTS. More frequent imagery is taken during periods of cyclone activity. A data collection mission, presently serving about 100 DCPs is also a standard feature of this satellite design. A disaster warning service has been implemented, on an experimental basis, using a transponder on the satellite.

Japan is continuing operations of its GMS-3 with GMS-2 (much degraded because of an imaging radiometer malfunction) as a standby. The lifetime of this satellite is expected to be several years despite a problem with the radiometer.

The USA announced its intention to continue operations of its GOES-6 spacecraft until 1989 despite the fact that 2 of the 4 encoder lamps have failed. With the launch of GOES-7 in February 1987 at the earliest, GOES-6 will then be located over the Pacific near 108 west and Goes-7 will take the western Atlantic postition.

2.2. Future Systems:

Following ESA's presentation of definition studies for Meteosat 2nd Generation, India announced that the Insat-1 programme would be continued well into the 1990s. The next satellite to be launched (Insat-1C) is foreseen in early 1988 and the satellite will be located at 93.5°E. Insat-1D is planned to be launched after 1989. Both Insat-1C and -1D will be identical to the present operational model.

Preliminary design work has started on a new generation of 3 axis stabilised spacecraft designated INSAT-II. These will be multipurpose satellites with meteorological capabilities of earth imaging in the visible and infrared and with a data collection and relay capability. A first test satellite will be launched early in 1996 with an operational series to follow during the late 90's.

Japan plans to launch GMS-4 in August 1989. Planning work for the development of a follow on satellite designated GMS-5 will commence in 1987. CGMS members were particularly pleased to hear that Japan had informally agreed to cooperate with Australia in order to maintain a geostationary meteorological satellite service over the western Pacific region through the 1990's.

Of particular interest was an announcement by the Peoples' Republic of China that they were seriously considering the development of a geostationary meteorological satellite. An experimental model would be launched in the mid 1990's and positioned between 105 and 110°E. The Chinese stated that the facilities available on this satellite would be well coordinated with those of the other members of CGMS.

The USA is proceeding with the development of its GOES I-M satellites, expected to be launched in the 1990s. Discussion of the design is still dominated by the type of launch vehicle. Design proposals have been made for launch of the satellite with both the shuttle and expendable vehicles and with expendable vehicles only.

3. Maintenance of the global observing system

The programmes briefly outlined in section 2 above indicate that there could be as many as 13 geostationary meteorological satellites launched in the next decade. CGMS members were very aware of the need to deal with the problem of both continuity and reliability of the global satellite network during future years. Although the deployment of satellites was not optimal, the CGMS considered that it is important that all geostationary satellite operators should try and accommodate the requirements of a global observing network. Accordingly, in response to a proposal from the Director of EUMETSAT, it was agreed that he should convene a working group to study the various proposals for continuous and optimised observations from the geostationary orbit and to prepare guidelines (for adoption by the next CGMS) on the systems to be operated for the remainder of the Century. Furthermore, EUMETSAT will continue to assist the WMO with its preparation of guidance on satellite observing systems for the second (1988-1997) and for the third WMO Long Term Plan (1992-2001).

4. Data collection and dissemination

Discussions on this subject were concentrated in particular on problems with the International DCS (IDCS) and whilst it is clear that present requirements were being met by the operators, considerable growth was expected in the next few years. Satellite operators were well aware of these requirements and were taking steps to meet expected demands within one or two years. The most pressing serious problem areas highlighted during the session were interferences from outside sources and the allocation of channels to specific tasks. Several operators had experienced interference on the frequencies used for the data collection system. It was agreed that WMO would coordinate all reports of interference and make informal representation at the ITU. In view of the increasing number of projects planning to use the IDCS, it was agreed with EUMETSAT that regular reports of future DCP usage would be prepared by ESA for distribution to all satellite operators.

The CGMS were pleased to note that there was a good coordination between members on the procedure for the admission of Automated Ship-borne Aerological Programme (ASAP) and Aircraft to Satellite Data Relay (ASDAR) operators.

Following a discussion of formats for both high and low resolution imagery, it was proposed that the CGMS should encourage the development of proposals for the standardisation of high resolution data formats. This, in turn, would lead to the development of low cost reception stations. Noting the growing interest in digital fax transmissions, it was agreed that EUMETSAT, in cooperation with ESA, should be invited to define baseline standards for digital WEFAX, to be implemented within the next decade, but bearing in mind that not all users may wish to immediately convert to such a standard. A "black box" would be developed to enable those users wishing to receive the analogue broadcast to continue operations.

Sixteenth Meeting of the Coordination of Geostationary Meteorological Satellites (CGMS)

1. The sixteenth meeting of the Coordination of Geostationary Meteorological Satellites (CGMS) took place in Washington D.C. from 28 September to 2 October 1987 with participants from Japan, the USA, EUMETSAT, ESA and China (attending as an observer). The USSR and India were not represented. EUMETSAT acts as the secretariat to this group.

2. Topics during the first day included the necessary preliminaries and presentations on the status of current and future satellite systems. The initial topics included a review of a new draft of the CGMS Consolidated Report provided by EUMETSAT. Once comments have been incorporated, the new edition will be distributed to CGMS.

There was discussion of common back-up satellites but it was recognised that the concept, which has been on the agenda for some years, was far too general, representing a goal which is too distant and too difficult, making progress seem slow. For future meetings the matter will be discussed under more precise and limited agenda headings. The concept of regional "help your neighbour" schemes, proposed by EUMETSAT at the previous meeting, generated some interest and it is hoped that this can be pursued through bi-lateral discussions, between the USA and EUMETSAT in the first instance. The meeting was informed that the USA are developing a new launch strategy and it is hoped that the discussion in CGMS will be taken into account.

3. **DATA COLLECTION**

3.1 Data Collection formed the next major topic, dominated by the present problems of interference on International Channels I16 and (to a lesser extent) I17. This interference is only apparent in the European sectors (making use of GOES-4 as a replacement for Meteosat) but raises both general and particular problems. The particular problems include support for ASAP (currently assigned to I16) and ASDAR (I17). The interim solution in the case of ASAP is to assign I12 for use with GOES-4 in the Atlantic sector. This should support the majority of ASAP voyages, particularly in connection with OWSE-NA. However, the USA will not be able to support I12 in the immediate future so that any ASAP needing to use GOES-E, GOES-W or GMS must continue to use international channel I16. It was also decided that operational ASDAR should use I18 with the few remaining prototype ASDAR (on PAN AM, Quantas and South African aircraft) remaining on the interference prone I17. Not all satellite operators will be able to support both channels in the immediate future, although potential loss of data will be minimised by the configuration which seems possible. Both GMS and GOES-W should be able to support both channels (giving full ASDAR coverage over the Pacific). GOES-E will be able to support channel 17 (giving support to the remaining prototypes over much of the Atlantic) and Meteosat/GOES-4 would support channel 18 at least (supporting new ASDAR over much of the Atlantic).

3.2 The general problem of interference is potentially serious as the Data Collection System is classed in the ITU Radio Regulations as "Secondary Use" of the 401 to 403 MHz band. The primary user is "METEOROLOGICAL AIDS" (e.g. radio-sonde) whereas secondary use includes also fixed and mobile (non aeronautical) services not controlled by the meteorological community. The "secondary" classification of DCS prohibits any absolute right to use the band and inhibits the correction or suppression of interference. The sharing of secondary status with other users is potentially a major problem considering the rapid growth in those other uses. Therefore the CGMS agreed to ask responsible bodies (such as the CBS of WMO) if the DCS should not be uprated to achieve primary status in co-existence with METEOROLOGICAL AIDS. Any conflicts would then be kept within the meteorological community and amenable to solution.

3.3 A more positive aspect of the DCS was introduced by Japan with a paper describing rain radars to be installed on two research vessels, reporting through the regional DCS of GMS. The ships will be deployed as required and transmit echo intensities and accumulated hourly rain intensities to the central ground station and from there to the JMA for use. The system will transmit at 1200 bits per second (cf. the standard DCP rate of 100 bits per second). The USA indicated that they are prepared to consider data transmission at 300 or 1200 bits per second provided that the interested user group paid development costs for both the DCP and the (central) de-modulators.

3.4 A discussion of DCS procedures illustrated some features of the USA system which might be worth considering for Meteosat, including

- at least 25 user stations equipped for direct reception of DCP data;

- NESDIS takes responsibility, and monitors, data flow only until it leaves their establishment;

- NESDIS provides a test mode (rapid response/retransmission) for use when setting up a DCP;

- NESDIS routinely checks "suspect" channels about 100 times a day.

3.5 A new draft of the IDCS user guide provided by EUMETSAT was accepted, subject to a few up-dates, and will be distributed in due course.

3.6 Representatives from NASA and Westinghouse gave a briefing on the SARSAT (Search and Rescue) capability mounted as an experiment on GOES-7. This is seen as complimentary to the SARSAT on NOAA polar satellites and the compatible COSPAS system of the USSR.

The NOAA SARSAT can receive distress beacons, which can be doppler processed to determine locations, but only when in line of sight of the satellites, causing delays of up to 4 hours in the tropics. GOES SARSAT cannot use doppler but can quickly identify the beacon and can therefore use flight plans or other information to make a preliminary estimate of location. The experiment will be used to define an operational system. The existing SARSAT frequency, around 406 MHz, can use DCS antennas on meteorological satellites and the system is therefore cheap to install. NESDIS reports that the operating costs are low since no additional NESDIS staff are needed. This might be considered as a possible option for Meteosat Second Generation, in view of the traditional concern of meteorological services for safety of shipping and aircraft.

4. DISSEMINATION

4.1 The USA described the so-called "GVAR" data format to be used for the transmission of data from GOES-Next from about 1990. This change has two implications. The receiving station in Lannion will have to be modified again by that date. Secondly, consideration should be given to the possibility of using GVAR, or a derivative, for transmission from Meteosat Second Generation in order to enhance inter-satellite compatibilities.

4.2 Japan reported that their changeover from HR-FAX to digital "Stretched VISSR" format would be completed by the end of 1988, but not all users would be able to implement new systems by that time, mainly for cost reasons. This may be regarded as a warning of the difficulties in moving from WEFAX to a digital equivalent.

4.3 There are several proposals, dating from previous meetings, for modifications to the current WEFAX format. The USA now supports a proposal from Japan to include a standard encoded digital header in all WEFAX frames. The USA also proposed the inclusion of a grey scale wedge and a grey scale enhancement curve. All operators are asked to form an opinion on this, the USA will propose a new standard format incorporating these suggestions (perhaps as options).

4.4 Concerning digital WEFAX, there was general agreement that the "smaller user" should continue to be supported and that a considerable changeover period should be contemplated. Perhaps the most relevant point of this discussion was that the changeover strategy should be agreed before deciding that a new system is needed. It might prove impossible to agree on a transition which can be supported by thousands of users worldwide. However, the CGMS agreed that a target antenna size of around 2 metres was appropriate. The USA are already preparing a Request for Proposals to ensure that the GOES-NEXT satellites are compatible with digital WEFAX. Operators are asked to exchange technical information and it was agreed that no changes would be decided prior to further discussion by the CGMS.

4.5 The USA provided outline specifications for their NOAA-PORT data distribution system, which is defined in two phases. The first phase would exclude image data but include DCS and other meteorological information and would operate at a data rate of 9600 band expandable to 56 K baud. Phase II would include all satellite data with provision for 2.1 M baud for this purpose (equivalent to the new GOES-NEXT rate from one satellite) plus additional capacity for other data. Phase I is anticipated for mid 1989, Phase II for gradual implementation from around 1992. Requests for proposals for the provision and operation of this concept will be issued shortly. The requirement is to deliver the data to around 60 government establishments within mainland USA. Other sites (e.g. commercial, academic) can be added by negotiation with the contractor concerning the data communication costs.

4.6 Japan described an experiment with similar objectives to MDD but with a different technical solution involving the multiplexing WWW data with WEFAX transmissions.

5. CALIBRATION

ESOC presented recent developments in Meteosat calibration procedures. The USA described the calibration of GOES I-M (GOES-NEXT) which is technically superior to that feasible on spin-scan satellites. Each instrument (imager and sounder) will have a black body external to the main telescope, so the entire instrument can be calibrated. However, there are major concerns about the instrument temperature variations which will necessitate frequent calibration even during one image cycle.

6. METEOROLOGICAL PRODUCTS

6.1 Progress on satellite winds was reported. The USA have established a scientific research panel on winds to determine future work areas. Japan has increased both the frequency (now 4 runs a day) and quantity of winds following the introduction of a new computer system. Their presentation included a historical tabulation of data quality which will be adopted by other operators. The WMO presented a paper calling for more wind data particularly in the tropics in support of both WWW and other WMO programmes such as WCRP. Various actions were suggested (such as the development of water-vapour winds, more frequent observations, etc.) and operators were urged to make available the necessary marginal resources needed to improve the utilisation of the existing satellites.

The USA indicated some concern about achieving the standards of image navigation and registration required for satellite winds on the 3 axis GOES-NEXT design. Temperature fluctuations and the movement of two instrument mirrors cause modelling problems which are not yet completely solved and it is not unlikely that wind extraction will prove impossible around the satellite midnight.

6.2 Other satellite products were described, including a new GMS product used internally and known as Satellite Cloud Information Charts (SCIC). These provide (for example) information or cloud cover, cloud top temperature, mean albedo etc. on a 0.25 degree grid.

7. ARCHIVING

Japan now uses a proprietry computer compatible tape cartridge system using VHS style cassettes storing 280 Mbytes in digital form. Technical details will be made available. The USA now use the Wisconsin "Suomi-Sony" system but this will have to be replaced for GOES-NEXT. ESOC reported on an evaluation of video disc systems, which have very attractive lifetimes and low volume but which cost two or three times as much as conventional tapes (not including the cost of storage).

8. MISCELLANEOUS

The meeting, as usual, provided a wealth of background information during verbal presentations and in papers. The next meeting of the group is tentatively scheduled for the first week of October 1988, in Darmstadt.

Seventeenth Meeting of the Coordination of Geostationary Meteorological Satellites (CGMS)

1. INTRODUCTION

The seventeenth meeting of the Coordination of Geostationary Meteorological Satellites (CGMS XVII) was held in the headquarters of EUMETSAT, from the 3rd to the 7th October 1988 with participants from ESA, EUMETSAT, Japan, India, USA, USSR, WMO and with the People's Republic of China (PRC) attending with observer status. EUMETSAT acts as the Secretariat to this group.

The Director of EUMETSAT was chairman for this meeting. The WMO delegation included Dr Mohr as Vice President of the CBS.

2. GENERAL

Initial discussions included presentations on the status of current and future geostationary meteorological satellite systems and on polar orbiting satellites of interest to CGMS members, a new agenda item for CGMS. Updated satellite status information will be distributed as a separate paper in due course.

A revised draft of the CGMS Consolidated Report was reviewed which, once updated to include information from CGMS XVII, will be distributed to CGMS and STG members in due course.

Within the concept of regional "help your neighbour" schemes, the Group discussed various bi-lateral schemes. EUMETSAT presented its proposals for the relay of INSAT image data via METEOSAT and the upgrading of the Lannion activities to relay more GOES products. India informed the meeting that its authorities were considering the request made by ESA to ISRO for the relay of INSAT image data. The USA informed the meeting there were no technical reasons why GMS and GOES-West data could not be relayed through GOES-East. EUMETSAT agreed to study the possibilities for the relay of a subset of image data from these two satellites via METEOSAT and make a specific request to the USA.

The USA also presented further information on Weatherwatch International, a rapidly expanding NOAA NESDIS information exchange service, centered on the use of an Electronic Bulletin Board (EBB). EUMETSAT is considering setting up a similar EBB for the supply of satellite information to the large number of users in Europe. Satellite operators in other main centres of user activity around the world have been requested to consider setting up similar information exchange systems.

3. OWSE-AFRICA

The WMO provided further information on the planning for the OWSE-Africa, due to commence in the early part of 1989. A planning conference is scheduled for November 1988 in Nairobi. The main emphasis during the initial phases of the OWSE would be on the collection of observational data from a number of sites in several African countries and the insertion of these data onto the GTS. All of the data would be transmitted through METEOSAT using DCP regional channels.

A detailed evaluation programme will be organised to determine the effectiveness of this equipment, its cost and the impact on National Weather Service activities.

The initial phase of the OWSE-AF is expected to continue until the end of 1991. The data relay activities of OWSE-AF will be expanded in 1989/90 to accommodate MDD.

4. CEOS ACTIVITIES

For the first time at these meetings CGMS were introduced to the activities and objectives of the Committee on Earth Observation Satellites (CEOS). CGMS took note of the coordination activities relating to data standards, formats and archiving, performed by the various CEOS working groups and considered that the presence at CGMS of the USSR and People's Republic of China might be the appropriate mechanism to involve additional partners in CEOS activities.

CEOS was reminded of the importance of data standards already achieved within bodies such as the WMO and CGMS.

5. DATA COLLECTION AND RELAY

CGMS members noted that there was still interference on International DCP channel I16 and (to a lesser extent) I17, mainly in the European sector. It was further noted that pre-operational and operational ASDAR would use I17 for the time being. Not all satellite operators are yet able to support further IDCS channels however by mid 1989 the situation should be much improved.

The USA announced that it was considering the possibility of charging for the use of its domestic data collection system.

CGMS expressed concern over the potential risk of interference to DCS frequencies by vertical profilers, which were gradually coming into use in various parts of the world. The USA informed the meeting that it was intending to deploy around 50 profilers, however, some test results were available on the extent of interference to the DCS frequency band.

Japan informed the meeting of the successful outcome of its test of the relay of data from rain radars installed on two research vessels, reporting through its regional DCS.

CGMS learned that the Operational ASDAR programme has entered the initial stages of implementation. IDCS certification was completed in July/August 1988. An installation kit has been installed on a DC-10. The first production unit has been assembled and has entered the company testing programme required as a basis for CAA certification. CAA certification is expected to be completed in December 1988. The unit will then enter a three month flight trial to demonstrate the operation of the software and the generation of meteorological messages.

A representative from NOAA gave a briefing on the SARSAT (Search and Rescue) capability mounted as an experiment on GOES-7. CGMS noted that the GOES-SARSAT was not yet part of the COSPAS/SARSAT project but could be regarded as complementary to the system currently implemented on NOAA polar satellites and the compatible COSPAS system of the USSR, which, to date, had saved some 1149 lives.

CGMS recalled that whilst GOES SARSAT could not use doppler techniques for the location of distress beacons it could quickly identify the beacon and could therefore use, e.g. flight pans or ship travel logs to make a preliminary estimate of location. Several CGMS members expressed interest in placing such a system on future geostationary meteorological satellites however in several cases the source of funding had still to be determined. CGMS requested the Secretariat to keep members informed on the status of this programme.

4. DISSEMINATION

EUMETSAT presented its proposals for the compression and encryption of METEOSAT data. The CGMS were informed that the higher volume of data to be received from the MOP satellites would require compression if all available data in full resolution is to be distributed to users within a half hour time period. CGMS were reminded that there was no intention to encrypt WWW data. The EUMETSAT Council had requested that studies be carried out on the technical aspects of encryption, key management, etc which could be applied to certain products which might have commercial value since national meteorological services in Europe were becoming increasingly aware of the potential for competition.

The USA described the GOES Variable (GVAR) data format to be used for the transmission of data from about 1990 when the first of a new series of five GOES spacecraft would be launched. GOES-I promised to be an evolutionary follow-on to the current series of GOES. Separate imager and sounder instruments necessitated the adoption of a new processed data format. The GVAR format, while similar in basic structure to Mode AAA, would allow the full capabilities of the new instruments to be utilised. Full details can be found in technical memoranda NESDIS 21 - "GVAR Users Compendium, Volume 1", and NESDIS 33 "An Introduction to the GOES-I Imager and Sounder Instrument and the GVAR Retransmission Format", copies of which are held by the Secretariat. For the METEOSAT system this change has two implications. The receiving station in Lannion will have to be modified again by mid 1991, the expected date when one of these new GOES satellites will be located over the Atlantic.

A proposal regarding digital headers for WEFAX data will be examined by EUMETSAT.

Concerning digital WEFAX, EUMETSAT presented its ideas on a new standard for digital WEFAX. It was foreseen that any new concept would have to make use of existing international standards in telecommunications and data processing methods. Furthermore the antenna size of the user station should be similar to that of an SDUS, i.e. around 2 meters. New transmission techniques (e.g. packetised) would be studied to allow flexibility in handling data from different sources. CGMS members expressed a growing interest in digital WEFAX and agreed that a special working group be convened by the USA to discuss the development of a common specification and a subsequent implementation plan.

5. CALIBRATION

CGMS were informed of recent developments in METEOSAT IR and WV calibration procedures and a method for the normalisation of GOES visible sensors (eight channels). Members noted that calibration related data was now available from the ISCCP project. In particular, the ISCCP Satellite Calibration Centre at CMS Lannion calculates normalised coefficients for the geostationary satellites as compared with NOAA polar orbiting satellites.

6. METEOROLOGICAL PRODUCTS

Progress on the production of satellite winds was reported by EUMETSAT, India, Japan and the USA. Japan informed the meeting that from January 1989, the coverage zone for wind derivation at 06 UT and 18 UT would be expanded to the full earth disk instead of just the northern half of the earth disk.

Members discussed the times of images used for wind extraction and noted considerable variation in practices. WMO reminded the meeting that the SATOB code and its bulletin header could accommodate the situation whereby the synoptic observation time might be different from the actual observation time. Both times were recorded in the total message and were thus available to the user community.

CGMS recommended that the time of observation should in future be the time of the middle image of the triplet used for wind extraction.

Noting the growing flexibility in the use of non synoptic satellite wind data in data assimilation schemes, CGMS requested that satellite operators time their wind extraction runs so that cloud motion vectors could be used in numerical model data assimilation schemes.

India indicated that it would consider shifting its wind image times to allow more time for the wind vectors to arrive at the main numerical forecast centres. This would, furthermore, permit the extraction of additional winds. In addition India informed the meeting that it was investigating the possibility of increasing the area of extraction of satellite winds.

The CGMS were pleased to note in the report made by the USA that the quality of INSAT winds had improved significantly over recent months.

CGMS considered that since the problem of wind bias affected all satellite operators a workshop should be convened to discuss the matter further with both research and operational meteorologists. A suitable forum for this workshop might be the ECMWF workshop on use of satellite data, being planned in 1989. The Secretariat agreed to investigate with ECMWF if it might be possible to expand the programme of the above workshop to include cloud motion vector problems in general and proposals for additional products for use in numerical forecasting.

CGMS noted several new products derived from satellite imagery. In particular were two from Japan. The first, called satellite derived index of precipitation intensity, would be extracted on an hourly basis from March 1989. The second, called cloud amount anomaly chart, would be used to monitor climate variations. The latter product has been disseminated in quasi-real-time via domestic land-line since July 1988 and is used for long-range forecasting.

The USA informed CGMS on the status of VAS products. The production of meteorological products from VAS radiances and multi-spectral images had been demonstrated using the NESDIS VAS Data Utilisation Centre (VDUS). VAS derived winds had proven to be a useful data source for tropical regions and VAS derived images of precipitable water and stability had proven useful for the recognition of mesoscale meteorological features, thus contributing to improved severe weather forecasts.

CGMS requested that further information be provided on these new products and, noting the progress made with VAS products, agreed that in future meetings there would be an agenda item dealing with sounding products.

7. ARCHIVING

Several CGMS members are now planning the upgrading of data archive and retrieval facilities and CGMS agreed that new storage technology was urgently required. Tape cartridge systems were currently the most promising storage medium and were being seriously considered by USA, ESA and the PRC. Japan already uses a tape cartridge system using VHS style cassettes storing 280 Mbytes of data in digital form. To date this cartridge system had been working satisfactorily. CGMS noted, however, that for users of GMS data outside Japan, the contents of a cartridge tape would be converted to 6250 bpi magnetic computer compatible tape.

8. TELECOMMUNICATIONS

Japan informed the meeting on early test results of a method for the dissemination of WWW data using the GMS WEFAX transmission system. The intention was to add the facility to receive this data (similar to METEOSAT MDD products) to an SDUS type receiving station. JMA were considering the implementation of this transmission scheme in the 1990/1991 time-frame. CGMS noted however that to date tests had been carried out using a large (12 meter) JMA satellite ground-station antenna.

9. A.O.B.

Noting the status of planning of a Chinese geostationary meteorological satellite, CGMS were very pleased to invite PRC to the next meeting of CGMS. At the time that financial commitment to the programme had been established CGMS agreed that PRC should become a full member of CGMS.

The next meeting of CGMS is tentatively scheduled for November 1989, to be hosted by the WMO in Geneva, Switzerland.

ANNEX 7

LIST OF PARTICIPANTS IN CGMS MEETINGS

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ANNEX 8

INDEX OF CGMS SUBJECTS

INDEX OF CGMS SUBJECTS

This index is designed to permit easy access to subjects addressed in CGMS Reports. References to subjects are only made when they are elaborated in the corresponding text; The mention of a subject in the text does not automatically qualify it for indexing.

The system of referencing is as follows:

The reference provides the meeting number (in bold print) followed as appropriate by a paragraph number, an Annex number or a combination of both, e.g.

VI, para C.2
VIII, Annex IV, App 3, Att 1
XV, Annex II, Min 4, Rec 1, para 2

In the above example App refers to an Appendix, Att refers to an Attachment, Min refers to a Minute and, Rec to a Recommendation.

Subjects are frequently addressed in several reports. In this case the meetings numbers are arranged generally in ascending (chronological) order and will appear as either:

XV, XVI, or **IX to XVII,**

In general, each subject is mentioned only once, with little or no cross reference.

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ANNEX 9

INTERNATIONAL COMPARISON OF SATELLITE WINDS

International Comparison of Satellite Winds

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1. INTRODUCTION

Four independent satellite Operating Agencies will be measuring winds by tracking clouds with geostationary satellites. These data will be widely used. Therefore, it is essential to monitor their homogeny and their accuracy. Two types of reports will be distributed semiannually to the meteorological community. The first, a comparison of co-located satellite winds from neighboring satellite systems; the second, a comparison of satellite winds with "ground truth" observations. These reports will display various characteristics of the satellite observations and provide a means for each user to monitor their quality.

Type 1 Reports will pertain to the comparison of co-located satellite winds from the overlap regions illustrated in Figure 1. Type 2 Reports will pertain to deviations between satellite and non-satellite wind observations wherever data are available from any part of the area viewed by each satellite.

When neighboring systems are operating normally, the difference between satellite winds will reflect a characteristic random "noise". Thus Type 1 Reports will provide the international community with information concerning the homogeny and compatibility of satellite winds. Type 2 Reports are expected to show about the same deviation between satellite and "ground truth" winds from one satellite system to another, thereby assuring users that accuracy is up to the expected standards.

Should a bias appear, it will be a signal to the appropriate operating agency to investigate the cause and a caution to the users to allow for this lack of homogeny in their analysis schemes. Analysis of the statistics by each operating agency will aid in quality control of their observations and provide clues to any problems that may arise.

Type 1 Reports, treating only simultaneous, co-located satellite winds, will be prepared and distributed by one designated operating agency from data provided by all four operating agencies. Type 2 Reports, comparing satellite winds with "ground truth" data, will be prepared by each operating agency independently. Only the results, that is, tables of differences, will be sent to the designated reporting operating agency for duplication and distribution together with Type 1 Reports. Following is the rationale for these two different procedures.

First, non-satellite observations of winds in the area viewed by each satellite should be more readily available to each satellite's operating agency in his own part of the world than they are to other operating agencies. For example, some aircraft reports may not be transmitted world-wide and sometimes significant level data from rawinsondes are not received at distant analysis centers. Each operating agency will be better able to collect "ground truth" data and control their quality.

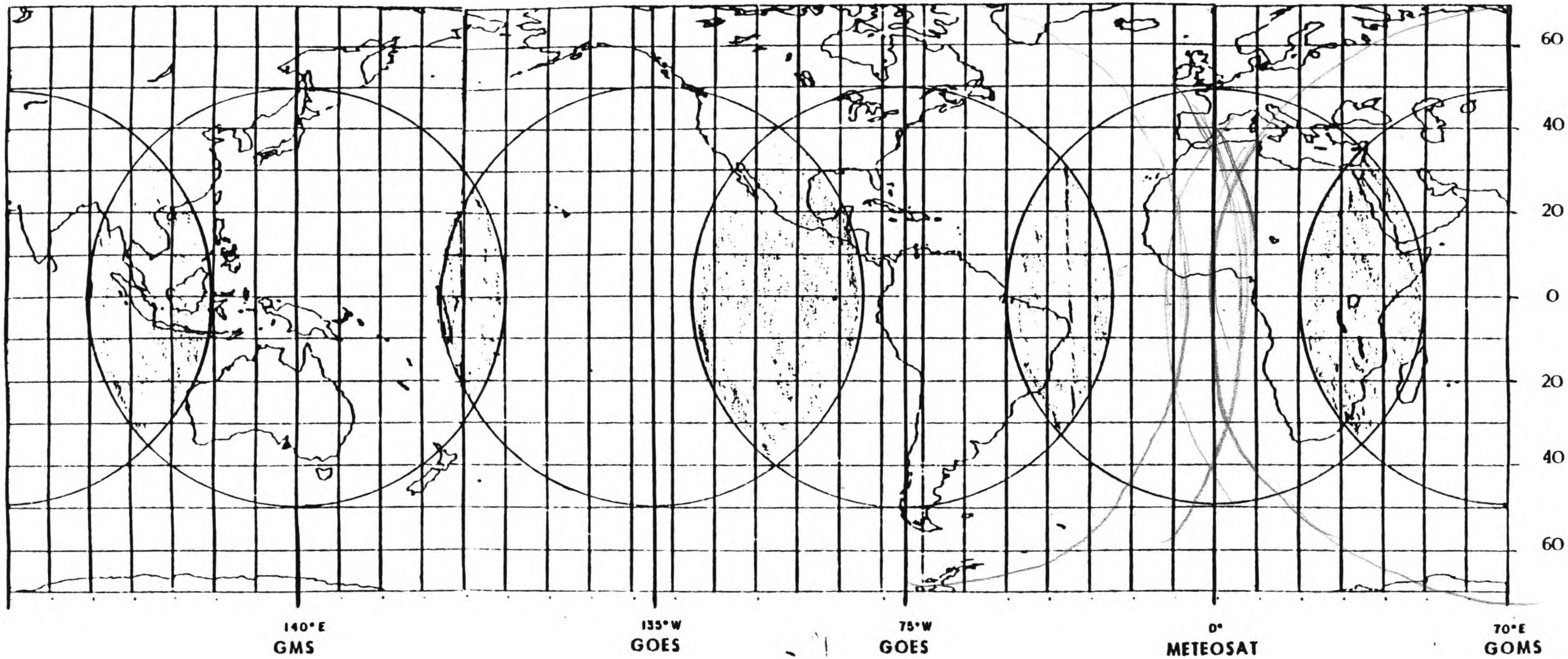

FIGURE 1 : COMMON FIELDS OF VIEW OF NEIGHBORING GEOSTATIONARY SATELLITES
HATCHED AREAS : OVERLAP FROM BOTH SATELLITES

Second, comparison of satellite winds with "ground truth" is of immediate interest to each operating agency in order to monitor the performance of its system. Each operating agency will want to examine those results quickly. Their value would be compromised if each operating agency awaited preparation and distribution from another operating agency.

And third, satellite winds used for Type 1 Reports will not, in general, be the same winds used for Type 2 Reports; therefore, no efficiency would accrue from a single operating agency producing both reports. In general, the two types of report will be prepared from different data because relatively few "ground truth" observations will be available in the limited fields of view common to neighboring spacecraft. Were Type 2 comparisons confined to those areas, an adequate sample could not be obtained in a reasonable time period.

2. TYPE 1 REPORTS

Type 1 Reports will consist of a set of tables which summarise the differences of wind observations between system "i" and system "j". In addition, explanatory comments about the data or the tables will be added as appropriate. For example see Appendix 1.

2.1 Comparison Periods

Wind-derivation system will be operated by Japan, USA and ESA early in 1978. Therefore a pre-FGGE test comparison is proposed for the period 10 - 24 July 1978.

Two full comparison periods for FGGE should be during the Intensive Observation Periods : 15 January to 13 February 1979 and 10 May to 8 June 1979.

Thereafter, semi-annual comparison periods each year beginning in 1980 will be : 15 - 30 January and 15 - 30 July.

2.2 Data Exchange and Schedules

Satellite-derived wind observations will be written on magnetic tape by each operating agency and airmailed to the designated operating agency as follows :

2.2.1 Data

Each magnetic tape will include all winds derived from the common fields of view out to a distance of 60° great circle arc (gca) from the spacecraft sub-satellite point (ssp). Each operating agency, for their own convenience, may assemble winds from their entire field of view for an extended period on an archive tape. Consequently it may be convenient for some operating agencies to exchange tapes which contain more data than specified. This will be permitted with the restriction that only one magnetic tape per comparison period may be sent to the reporting operating agency.

2.2.2 Format

The tape format will be that of the International Level II (FGGE) data as described in "Formats for the International Exchange of Level II Data Sets during the FGGE". This will be Annex I of the following WMO Report to be published early in 1978.

WMO Publication n° 469, 1977
WORLD WEATHER WATCH INTERNATIONAL GLOBAL DATA
PROCESSING PLAN TO SUPPORT THE FIRST GLOBAL GARP EXPERIMENT.

2.2.3 Data schedule

Magnetic tapes are to be airmailed no later than seven days after the last day of the comparison period. In the event an operating agency cannot meet this schedule due to system failure or other such emergency, it will be responsible for notifying the designated reporting operating agency. If the reporting operating agency has not received all three magnetic tapes within four weeks after the close of a comparison period, the report will be prepared with the data on hand.

2.2.4 Report schedule

Type 1 Reports will be prepared, duplicated and distributed by the reporting operating agency within two months after receipt of magnetic tapes from all other operating agencies.

2.3 Data Selection

Satellite winds will be used for Type 1 Reports if they are of high quality* and satisfy the following conditions :

- time : data will be compared when their times of observation differ by no more than 3 hours;
- location: wind observations from system "i" and from system "j" will be considered to be a candidate pair if their locations differ by no more than, 2° latitude and 2° longitude in the zone 25°N to 25°S, or 2° latitude and 3° longitude in the region poleward of 25°. All possible i-j pairs will be considered. That is, if an i-observation falls within the specified distance of three different j-observations, three i-j pairs are thus formed.

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* The tape format provides for two different designators of "confidence"; one pertaining to the height (pressure) of the vector and the other representing a "total" confidence level. Only "high confidence" data will be used for Type 1 and Type 2 Reports, viz. code figures "08" and "09" in both designators.

- height : observation will be compared only if they fall within a given range of pressures, where the ranges are :

  surface to 700 mb
  699 mb to 400 mb
  less than 400 mb .

  For example, an "i" observation at 650 mb will be compared with a "j" observation at 450 mb but not with a "j" observation at 750 mb.

2.4 Preparation and Statistics

2.4.1 Computation of difference and means

The following listed differences will be computed. Computation of speed differences will be carried out to the nearest 0.1 m/s and then rounded to the nearest integral unit for compiling into tables. Direction differences will be computed and summarised in whole degrees.

$\Delta V = |V_i - V_j|$: magnitude of vector difference, m/s

$\Delta s = s_i - s_j$: difference of speed, m/s

$\Delta d = d_i - d_j$: difference of direction, degrees

$\Delta u = u_i - u_j$: difference of u component, positive eastward, m/s

$\Delta v = v_i - v_j$: difference of v component, positive northward, m/s.

All differences, with the exception of vector magnitude, will include the sign.

In addition to the set of five differences, the mean pressure of each pair will be computed for subsequent classification of each set.

2.4.2 Classifying the differences

All vectors within 50° great circle angle will be used in the comparison, but each pair of vectors will be placed in one of three pressure (height) categories, according to their mean pressure (height) :

P1 = surface to 700 mb

P2 = 699 mb to 400 mb

P3 = pressures less than 400 mb.

As a consequence of sorting the data into three pressure classes, each set of five differences (per vector pair) will fall into one of three categories. Tables will be prepared for each of these three categories separately. In the event less than 30 pairs fall into any one category, tables will not be included in the final report and comment to that effect will appear in the introduction.

2.4.3 Compilation of tables

Tables of percentage frequencies will be assembled in the format illustrated in Appendix I. They will be designated with a combination number and letter. Letters will identify the overlap region involved as follows :

A : common field of view of GOES East (USA) and METEOSAT (ESA)

B : common field of view of METEOSAT (ESA) and GOMS (USSR)

C : common field of view of GOMS (USSR) and GMS (Japan)

D : common field of view of GMS (Japan) and GOES West (USA)

E : common field of view of GOES West and GOES East (USA).

Each tabular entry will represent a frequency rounded to the nearest integral percentage, thus the sum of individual entries may differ slightly from 100%. The headings of each table will show the following information :

- table number, parameter, sense of subtraction, date. For example, "Table 10 C Vector Magn. GOMS - GMS June 78";
- the pressure (height) categories;
- the type of percentage, i.e. individual or cumulative.

Notice that table 1, vector magnitude, includes both individual and cumulative frequencies. This is convenient because all values are positive. The other parameters, having both positive and negative signs, will be summarised in separate tables, one for individual frequencies, another for cumulative frequencies. All tables will be single-spaced and arranged in a manner most suitable for photo-reduction and duplication. Following are the tables numbers and their designation :

Table n°	Parameter summarised	Type of frequency
1.A,B--E	Vector magnitude difference	Individual and cumulative
2.A,B--E	Speed difference	Individual
3.A,B--E	Speed difference	Cumulative
4.A,B--E	Direction difference	Individual
5.A,B--E	Direction difference	Cumulative
6.A,B--E	u-component difference	Individual
7.A,B--E	u-component difference	Cumulative
8.A,B--E	v-component difference	Individual
9.A,B--E	v-component difference	Cumulative

Class intervals into which the various difference frequencies will be compiled are as follows :

- Tables 1, 3, 7, 9 : class intervals of 2 m/s, i.e. :

  0 and 1 m/s
  2 and 3 m/s
  ----
  24 and 25 m/s.

  Frequencies of differences greater than 25 m/s will be summed and shown as a single entry.

- Tables 2, 6, 8 : class intervals of 2 m/s except for the class centered on zero which will be +1,0 and -1 m/s:

  +21 and +20 m/s

  +5 and +4 m/s
  +3 and +2 m/s
  +1,0 and -1 m/s
  -2 and -3 m/s
  -4 and -5 m/s

  -20 and -21 m/s

  Frequencies of differences whose magnitudes are greater than 21 mps (either plus or minus) will be summed and shown as two entries, one for plus and the other for minus.

- Table 4 : class intervals each 20°, with the central interval +10° to -10°.

  +90° to 71°

  +50° to 31°
  +30° to +11°
  +10° to -10°
  -11° to -30°
  -31° to -50°

  -71° to -90°.

  Frequencies of differences exceeding 90° will be summed into two single classes, one for all differences greater in magnitude than +90°, the second for differences greater in magnitude than -90°.

- Table 5 : class intervals each 20°, except the first interval which will be 0° to 10°, followed by 11° to 30°, etc. Frequency of differences greater in magnitude than 90° will be summed and shown as a single entry.

In addition to the tabular entries, the following results will be shown in the appropriate columns of each table :

- the number of pairs used for compiling that frequency distribution;
- the mean of the difference computed with regard to sign, to the nearest 0.1 m/s or nearest degree;
- the mean of the differences computed without regard to sign, to the nearest 0.1 m/s or whole degree;
- the Root Mean Square (RMS) of the differences, to the nearest 0.1 m/s or whole degree.

2.4.4 Concluding documents

Type 1 Reports could amount to a maximum of 270 columns assembled into 45 tables. It is unlikely, however, that this number will be produced because some categories may not contain an adequate sample (30 pairs). Little would be gained by combining categories but, if an adequate sample were obtained, information might be developed from these several categories.

The pressure categories are useful because of various characteristics of this type of wind measurement. Perhaps most important is the effect of wind speed. Low clouds generally are slow moving; thus, the direction differences may be large while speed differences remain small. Faster moving clouds at upper levels, on the other hand, tend to show small direction differences but larger speed differences. Hence, combining categories would make interpretation more uncertain.

3. TYPE 2 REPORTS

Type 2 Reports will reflect the differences between satellite-observed winds and independent observations called "ground truth". The table format and the rules governing their preparation will be, to the extent possible, the same as for Type 1 Reports as illustrated in Appendix 2. Each operating agency will prepare and send to the reporting operating agency for duplication and distribution a semi-annual Type 2 Report.

Although each operating agency will prepare the tables in a manner most convenient to its own procedures, a certain uniformity is necessary. For example, the method of selecting ground truth data must not vary from operating agency to operating agency and the distance and height categories must be uniform.

3.1 Comparison Periods

Data for each Type 2 Report will span about one month as follows :

July 1978
15 January to 13 February 1979 and following years
10 May to 8 June 1979
July 1980 and following years.

Minor variations will be permitted, but every effort must be exerted to collect an adequate sample size and to meet the scheduled mailing dates.

3.2 Schedule

Tables for Type 2 Reports will be airmailed by each of the three operating agencies to the reporting operating agency no later than the following dates :

1 September 1978 and following years
15 March 1979 and following years.

Each operating agency will be responsible for notifying the reporting operating agency if the Type 2 Report is late or missing. The operating agency designated to be the reporter will duplicate tables for all overlapping areas and distribute them together with the corresponding Type 1 Report.

3.3 Selection of Ground Truth Data

Any non-satellite wind observation which the operating agency deems accurate will be a potential ground truth datum. To be used, ground truth and satellite pairs must meet the following conditions :

- time : satellite wind and its companion ground truth observation must differ by no more than 3 hours;

- location: satellite wind and its companion ground truth observation must be within the distance of 2° latitude and 2° longitude in the zone 25°N to 25°S, or 2° latitude and 3° longitude poleward of 25° latitude. All pairs will be considered. That is, if three satellite observations fall within the specified distance of a single ground truth measurement, three pairs will be considered;

- height : in general, the height of satellite winds and the height of the ground truth must fall within the same 500 meters (approximate) layer. Vertical interpolation of rawinsondes will be used, with certain restrictions. Because satellite winds are often measured in regions of significant vertical shear, interpolation of rawinsonde observations must be performed only between significant levels. Non-linear shear is common; therefore, interpolation between standard levels is unsatisfactory. Hence :

  . wind observed at standard rawinsonde levels will be used only where the satellite wind is within ±50 mb for satellite winds at pressures from surface to 700 mb and within +35 mb at pressures lower than 700 mb

  . winds interpolated from rawinsondes will be used as ground truth only where significant level data are available.

These height criteria, somewhat more stringent than those specified for Type 1 Reports, are justified by the following. There is a tendency for simultaneous satellite measurements to track the same cloud system. Nevertheless, different heights might be assigned because of two independent methods of assigning height. The larger differences allowed for satellite versus satellite comparisons is therefore likely to produce legitimate comparisons. On the other hand, ground truth observations are made with completely independent tracers. We must thus assume that each satellite vector is assigned to the correct height and place small limits on allowable height differences in order to derive representative deviation statistics.

3.4 Preparation of the Statistics

3.4.1 Computation of differences and associated speed and height

The following listed differences will be computed. Speed differences will be computed to the nearest 0.1 m/s and rounded to whole m/s for summarisation. Direction differences will be treated in whole degrees.

$\Delta V = |V_i - V_t|$: magnitude of vector difference, m/s

$\Delta s = s_i - s_t$: speed difference, m/s

$\Delta d = d_i - d_t$: direction difference, degrees

$\Delta u = u_i - u_t$: u-component difference, positive eastward, m/s

$\Delta v = v_i - v_t$: v-component difference, positive northward, m/s

where subscript "i" refers to satellite measurement and subscript "t" refers to the ground truth measurement. Each set of differences will be associated with the pressure (height) for subsequent classification and with the speed of the satellite wind observation.

3.4.2 Classifying the differences

One distance category (within 50° great circle angle of the sub-satellite point) and 3 pressure categories will be used :

Pressure : P1 = surface to 700 mb
P2 = 699 to 400 mb
P3 = pressures less than 400 mb.

In the event less than 30 pairs fall into any category, tables will be omitted and so indicated by the operating agency.

3.4.3 Compilation of tables

Table n°	Parameter summarised	Type of frequency
1.	Vector magnitude	Individual and cumulative
2.	Speed difference	Individual
3.	Speed difference	Cumulative
4.	Direction difference	Individual
5.	Direction difference	Cumulative
6.	u-component difference	Individual
7.	u-component difference	Cumulative
8.	v-component difference	Individual
9.	v-component difference	Cumulative

Class intervals into which the frequencies will be compiled are:

- Tables 1, 3, 7, 9 : class intervals of 2 m/s, i.e. :

  0 and 1 m/s
  2 and 3 m/s
  ----
  24 and 25 m/s.

  Frequencies of differences greater than 25 m/s will be summed and shown as a single entry.

- Tables 2, 6, 8 : class intervals of 2 m/s except the class centered on zero which will be +1, 0 and -1 m/s:

  +21 and +20 m/s

  +5 and +4 m/s
  +3 and +2 m/s
  +1, 0 and -1 m/s
  -2 and -3 m/s
  -4 and -5 m/s

  -20 and +21 m/s.

  Frequencies of differences greater in magnitude than 21 m/s will be summed by sign and shown as two entries, one for positive and one for negative differences.

- Table 4 : class intervals each 20°, with the central interval +10° -10°.

  +90° to +71°

  +50° to +31°
  +30° to +11°
  +10° to -10°
  -11° to -30°
  -31° to -50°

  -71° to -90°

  Frequencies of differences greater in magnitude than 90° will be summed by sign in two categories, positive and negative.

- Table 5 : class intervals each 20°, except the first interval which will be 0° to 10° followed by 11° to 30°, etc. Frequency of differences greater than 90° will be summed and shown as a single entry.

Tables will be single spaced and arranged in a manner that will be convenient for reproduction on a minimum number of pages.

In addition to the columns of frequencies, the following results will be shown under the appropriate columns :

- the number of pairs involved in that frequency distribution,

- the mean difference, computed without regard to sign, to the nearest 0.1 m/s or full degree,

- the root mean square, to the nearest 0.1 m/s or full degree,

- the mean speed of the satellite winds, to the nearest 0.1 m/s.

3.4.4 Concluding comments

Type 2 Reports from each operating agency could consist of 54 columns assembled into 9 tables. This maximum will probably not be produced because some operating agency may not derive winds in some of the categories. As with Type 1 Reports, it is desirable to provide for all 3 categories in the event an adequate sample is obtained.

Examples of Tables for Type 1 Reports

The three tables in this appendix do not contain actual data. Instead they represent typical differences that NESS experience has suggested might be obtained when two independent satellite systems are compared. While the table format should be followed, details such as spacing of the columns, number of tables per page, etc, are left to the reporting operating agency.

TABLE 1 E. VECTOR MAGNITUDE GOES E - GOES W JUNE 1978

	SFC-700 MB		699-400 MB		LESS 400 MB	
	INDIV.	CUM.	INDIV.	CUM.	INDIV.	CUM.
0 1	11	11	1	1	5	5
2 3	37	48	30	31	28	33
4 5	25	73	31	62	27	60
6 7	23	96	15	77	18	78
8 9	0	96	15	92	8	86
10 11	2	98	2	94	9	95
12 13	0	98	2	96	0	95
14 15	1	99	0	96	0	95
16 17	1	100	2	98	4	99
18 19			1	99	0	99
20 21			0	99	0	99
22 23			0	99	0	99
24 25			1	100	0	99
GTR 25					1	100

	SFC-700 MB	699-400 MB	LESS 400 MB
NUMBER	866	97	259
ALG. MEAN	4.1	5.7	5.8
ABS. MEAN	4.1	5.7	5.8
RMS	4.9	6.7	7.1

TABLE 2 E. SPEED DIFFERENCE GOES E - GOES W JUNE 1978

	SFC-700 MB INDIV.	699-400 MB INDIV.	LESS 400 MB INDIV.
GTR 21	0	0	0
20 21	0	0	0
18 19	0	0	0
16 17	0	2	1
14 15	0	0	0
12 13	1	0	0
10 11	0	1	5
8 9	0	7	8
6 7	11	6	7
4 5	10	16	19
2 3	17	19	16
1,0 -1	12	3	5
-2 -3	21	11	14
-4 -5	15	15	10
-6 -7	11	10	8
-8 -9	0	6	1
-10 -11	0	1	4
-12 -13	0	2	0
-14 -15	2	0	0
-16 -17	0	0	1
-18 -19	0	1	0
-20 -21	0	0	1
LESS -21	0	0	0

NUMBER	866	97	259
ALG. MEAN	0	0	0.9
ABS. MEAN	3.8	5.3	5.3
RMS	4.7	6.2	6.4

TABLE 3 E. SPEED DIFFERENCE **GOES E - GOES W** **JUNE 1978**

	SFC-700 MB CUM.	699-400 MB CUM.	LESS 400 MB CUM.
0 1	12	3	5
2 3	50	33	35
4 5	75	64	64
6 7	97	80	79
8 9	97	93	88
10 11	97	95	97
12 13	98	95	97
14 15	100	97	97
16 17		99	99
18 19		100	99
20 21			100
GTR 21			

NUMBER	866	97	259
ALG. MEAN	0	0	0.9
ABS. MEAN	3.8	5.3	5.3
RMS	4.7	6.2	6.4

Examples of Tables for Type 2 Reports

The three tables in this appendix do not contain actual data. While NESS has derived many such comparisons between satellite winds and rawinsonde observations, they have not been classified into the three different categories required for Type 2 Reports. The tables do, however, represent typical deviations suggested by NESS experience. Table formats should follow these examples but details of their arrangement are left to the preparers of Type 2 Reports.

TABLE 1 VECTOR MAGNITUDE GOES E JUNE 1978

	SFC-700 MB INDIV.	SFC-700 MB CUM.	699-400 MB INDIV.	699-400 MB CUM.	LESS 400 MB INDIV.	LESS 400 MB CUM.
0 1	22	22	10	10	16	16
2 3	14	36	10	20	14	30
4 5	37	73	25	45	35	65
6 7	17	90	15	60	10	75
8 9	0	90	15	75	13	88
10 11	3	93	5	80	1	89
12 13	3	96	0	80	6	95
14 15	2	98	8	88	2	97
16 17	2	100	5	93	1	98
18 19			2	95	1	99
20 21			1	96	0	99
22 23			3	99	0	99
24 25			0	99	0	99
GTR 25			1	100	1	100

	SFC-700 MB	699-400 MB	LESS 400 MB
NUMBER	73	82	107
ALG. MEAN	4.5	7.7	6.5
ABS. MEAN	4.5	7.7	6.5
RMS	5.8	7.7	7.1
MEAN SPEED	7.6	11.5	23.5

TABLE 2 SPEED **GOES E.** **JUNE 1978**

	SFC-700 MB INDIV.	699-400 MB INDIV.	LESS 400 MB INDIV.
GTR 21			
20 21	0	2	0
18 19	0	1	0
16 17	0	4	0
14 15	0	5	1
12 13	1	0	2
10 11	1	0	0
8 9	0	8	7
6 7	7	10	8
4 5	25	14	13
2 3	5	7	8
1,0 -1	28	12	17
-2 -3	7	4	9
-4 -5	15	10	22
-6 -7	7	8	3
-8 -9	0	8	7
-10 -11	3	0	1
-12 -13	1	0	0
-14 -15	0	4	1
-16 -17	0	1	1
-18 -19	0	2	0
-20 -21	0	0	0
LESS -21	0	0	0
NUMBER	73	82	107
ALG. MEAN	0.2	1.3	0.2
ABS. MEAN	3.8	7.0	4.8
RMS	4.7	8.7	5.8
MEAN SPEED	7.6	11.5	23.5

TABLE 3 SPEED GOES E JUNE 1978

	SFC-700 MB CUM.	699-400 MB CUM.	LESS 400 MB CUM.
0 1	28	12	17
2 3	40	23	34
4 5	80	47	69
6 7	94	65	80
8 9	94	81	94
10 11	98	81	95
12 13	100	81	97
14 15		90	99
16 17		95	100
18 19		98	
20 21		100	
GTR 21			

NUMBER	73	82	107
ALG. MEAN	0.2	1.3	0.2
ABS. MEAN	3.8	7.0	4.8
RMS	4.7	8.7	5.8
MEAN SPEED	7.6	11.5	23.5

Annex 10

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DISTRIBUTION LIST FOR DOCUMENTS

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Annex 11

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