CGMS XXIV

REPORT OF THE TWENTY-FOURTH MEETING OF THE CO-ORDINATION GROUP FOR METEOROLOGICAL SATELLITES

22 - 26 April 1996

Lauenen, Switzerland

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TABLE OF CONTENTS

TWENTY-FOURTH MEETING OF THE CGMS

FINAL REPORT OF THE PLENARY SESSION

A. PRELIMINARIES

A.1 Introduction

CGMS-XXIV was convened by WMO at 9:00 a.m. on 22 April 1996 in Lauenen, Switzerland. Dr Tom Spence, Director of the Global Climate Observing System (GCOS) welcomed the delegations from EUMETSAT, Japan, the People's Republic of China (PRC), the Russian Federation, and the United States. On behalf of the Secretary-General of WMO, Dr Tom Spence expressed his pleasure to be able to host this twenty-fourth Session of the Co-ordination Group for Meteorological Satellites. Recalling the wish of CGMS to find a venue in Switzerland that would be conducive to detailed discussion uninterrupted by external pressures he expressed his confidence that Lauenen will be well suited to these needs and will allow well focused and constructive debates.

He recalled that the WMO Executive Council had identified two satellite groups with which WMO should interact: CGMS and CEOS. WMO is most proud of its full membership status in CGMS since almost its inception. CGMS is a group that has proven itself repeatedly and its willingness to listen to and respond to WMO needs and requirements is most gratifying. In a recent ad hoc meeting of CEOS for an Integrated Global Observing Strategy (IGOS), CGMS was quoted as a role model for successful co-operation between users and providers. Of course, CGMS focuses on the field of meteorology but its success should be proof to the rest of the space agencies that such a noble enterprise can work most beneficially to all.

He assured the participants that topics such as contingency planning, protection of radio frequency and the future transition from analogue to digital services were considered by WMO Members as most important and encouraged CGMS to bear in mind the users and their needs. He wished to applaud the efforts of CGMS to provide continuity of data and services. The most recently completed co-operation between EUMETSAT and the United States of America in sharing a METEOSAT satellite over the East coast of the United States was most appreciated.

In conclusion he recalled that WMO was pleased to be able to host the twenty-fourth Session of CGMS, wished the participants every success and thanked them in advance for their time and effort.

A.2 Election of Chairman

Upon a proposal of the USA, supported by EUMETSAT, Dr Donald Hinsman was unanimously elected Chairman of CGMS XXIV.

A.3 Adoption of Agenda and Work plan of W/G Sessions

The Agenda (See Annex 1) was adopted. It was agreed that Working Groups I and III, dealing with telecommunications and wind vectors respectively, would work in parallel on Wednesday morning, while Working Group I dealing with satellite products would meet on Tuesday afternoon

The Secretariat provided a list of working papers submitted to CGMS XXIV, as well as a provisional order of business which was used as a basis for the subsequent discussions.

A.4 Arrangements for the Drafting Committee

The Drafting Committee was appointed, comprising Ms. Veronica Fratta, Mr. Gordon Bridge, Mr. Koichi Kimura, Dr. Alexander Uspensky, Mr. Jianping Xu, and Dr Donald Hinsman. All CGMS Members were invited to provide inputs to the final report through this drafting committee.

A.5 Review of Action Items from Previous Meetings

The Secretariat reminded the participants of the outstanding actions from previous meetings, taking into account the input provided in EUM-WP-01, JAPAN-WP-01 and WMO-WP-02. All these actions were then reviewed as follows:

(i) Permanent actions

1. *The Secretariat to review the tables of current and planned polar and geostationary satellites, and to distribute this updated information, via the WWW Operational Newsletter, via Electronic Bulletin Board, or other means as appropriate.*

   This information, updated by the Secretariat in June 1995, was published in the Final Report of CGMS-XXIII. Other distribution means are being considered. A further update is submitted to CGMS-XXIV for review.

2. *All satellite operators to circulate regular satellite operational reports.*

   This is routinely done.

3. *All satellite operators to provide NOAA/NESDIS with information on unexplained anomalies for study, and NOAA to provide solar event information to the satellite operators on request and a status report on the correlation study at each meeting.*

   No anomaly reported in that period.

4. *USA to issue quarterly to all other admitting authorities the consolidated DCP assignments.*

   This is routinely done.

5. *All satellite operators to regularly provide WMO with information on the number of*

Met satellite reception stations in their areas of responsibility.

6. *All CGMS Members to inform users to register user stations within their area of responsibility.*

7. *CGMS members generating CMW check that the following monthly statistics are sent and received on a quarterly basis: number of co-locations, temporal and spatial co-location thresholds, and radiosonde inclusion/exclusion criteria.*

(ii) Outstanding actions from previous meetings

ACTION 21.17 *All CGMS Members are requested to indicate planned introduction dates of LRIT*

Open. EUMETSAT will implement the LRIT with the first METEOSAT Second Generation satellite, by 2000, as described in EUM-WP-10. Japan will implement LRIT in parallel to WEFAX on MTSAT, by 1999, as described in JAPAN-WP-05.

ACTION 21.24 *CGMS Members to consider the possible technical measures for the reorganization of the IDCS to include the PRC and any other changes necessary to meet currently foreseen uses of the IDCS.*

Closed. Such measures are proposed in EUM-WP-07, for discussion under Item F.1.

ACTION 22.05 *EUMETSAT to consider the possibility of moving a "spare" METEOSAT satellite, if necessary, in order to provide coverage over the Indian Ocean.*

Closed. CGMS noted the preoperational status of GOMS-N1 and the plans of the Russian Federation for GOMS-N2 and of China for FY-2. EUMETSAT and Roshydromet also mentioned their preliminary consideration of a mutual back-up arrangement for the long-term. These issues were addressed in greater detail under Item D.1.

ACTION 22.06 *NOAA and WMO to investigate the possibility of making Special Sensor Microwave Imager (SSM/I) data and products available on the GTS, so that they could be received by all NWP centres, tropical cyclone RSMCs and regional forecast offices.*

Closed. Letter response received by WMO from NOAA/NESDIS.

(iii) Actions from CGMS XXIII

ACTION 23-01 *USA/NOAA to distribute by 1 November 1995 the definition of the LRPT format.*

Closed. The Working Group I reviewed the issue, taking into account EUM-WP-11 which describes the planned implementation of LRPT by EUMETSAT on METOP, and proposed new actions.

ACTION 23-02 *CGMS Members are requested to notify the Secretariat of their agreement on the proposed LRPT format by CGMS XXIV.*

Closed. As for Action 23-01, the Working Group I reviewed the issue, taking into account EUM-WP-11 which describes the planned implementation of LRPT by EUMETSAT on METOP, and proposed new actions.

ACTION 23-03 *WMO to provide CGMS Members with a copy of the GCOS Space Plan version 1.0.*

Closed.

ACTION 23-04 *CGMS Members to review and comment on the GCOS Space Plan version 1.0, with respect to achievability and proposed priority of implementation into their own plans.*

Open. EUMETSAT indicated its appreciation of this expression of requirements and noted that the instruments identified by GCOS as potentially "compliant" or "fully compliant" had the highest priority in EUMETSAT plans. IASI, ASCAT, MHS are included in the proposed payload for METOP. JMA and the Japan Science and Technology Agency (STA) are preparing the Japanese contribution to GCOS. JMA is in the process of updating the application plan of data from Meteorological and Earth Observation Satellites The issue was further discussed under Item E.1.

ACTION 23-05 *CGMS to investigate the feasibility of meeting the draft requirement for the exchange of digital satellite image data over the GTS.*

Closed. This issue was identified for discussion under Item G.3.

ACTION 23-06 *Japan, P.R.C, and the Russian Federation to indicate, by 30 November 1995, possible contributions to the CGMS Directory covering applications conducted in their respective regions.*

Closed. PRC and Japan informed CGMS Secretariat of their proposed contributions. Russian Federation may provide an input at a later stage.

ACTION 23-07 *EUMETSAT to seek resources to initiate the project of a CGMS Directory of Applications, and inform CGMS Members by January 1996.*

Closed. EUM-WP-15 refers.

ACTION 23-08 *CGMS members to provide WMO with names to be included in a list-server of points of contacts for the preparation of a CGMS Directory. WMO to establish such a list-server.*

Closed. WMO-WP-04 refers.

ACTION 23-09 *All CGMS Satellite operators to contribute to the WMO database of satellite user stations in providing information on geographical locations of the users of their respective satellites.*

Closed. WMO received input from Japan, EUMETSAT and the USA.

ACTION 23-10 *All CGMS satellite operators to check the registration status of receiving stations of their users.*

Closed. This refers to Permanent Action 6.

ACTION 23-11 *The CGMS Secretariat, with the assistance of CGMS Members, to prepare for the WMO-CGMS home page of the WMO Bulletin Board, an information note about future satellite programmes and missions, and the specific frequency bands requiring protection.*

Closed. A WMO-CGMS home page is now established but lacks frequency related information. Furthermore, a report on frequency protection was provided to the CEOS Plenary in October 1995.

ACTION 23-12 *Russia to provide CGMS Members with details of IDCP channel frequencies as soon as possible.*

Closed. This will nevertheless be carried forward as a new action from CGMS-XXIV.

ACTION 23-13 *The USA to provide CGMS Members with information on the number of APT reception stations world-wide by 1 September 1995.*

Open. The USA is revalidating its database and will provide additional information once completed.

ACTION 23-14 *The Secretariat to establish a period in the next twelve months for the end-to-end monitoring of certain DCP, in consultation with CGMS Members supporting the IDCS, and report to CGMS XXIV.*

Closed. This period was fixed to the last two weeks of April 1996.

ACTION 23-15 *The WMO to address any resulting problems relating to the onward relay of DCP messages via the GTS and report to CGMS XXIV.*

Open, pending the outcome of Action 23-14.

ACTION 23-16 *The Secretariat to update Annex 3 of the IDCS Users Guide, indicating the admitting authority address of the PRC.*

Closed. An updated version of page 3 of Annex 2 of the IDCS Users' Guide is provided in attachment to EUM-WP-07.

ACTION 23-17 *All CGMS Members to study the possibilities for using spread spectrum techniques and higher bit rates for future DCS.*

Closed. EUM-WP-18 refers.

ACTION 23-18 *The USA to provide CGMS with results of studies of DCS spread spectrum techniques and the use of higher bit rates by 1 July 1995.*

Closed. Detailed information was sent to EUMETSAT. Further distribution of the most relevant results is envisaged by NOAA.

ACTION 23-19 *CGMS Members to identify to WMO, by 1 July 1995, points of contacts who would assist with the design of, provision of material for, and dealing with enquiries resulting from, the CGMS home page.*

Closed. WMO-WP-05 refers.

ACTION 23-20 *EUMETSAT to report on visible calibration campaign at CGMS XXIV.*

Closed. EUM-WP-20 refers.

ACTION 23-21 *CGMS Members to nominate points of contacts to coordinate the preparation of a procedure for cross-calibration of satellites.*

Closed. T.Harada, P.Menzel and J. Schmetz were nominated.

ACTION 23-22 *EUMETSAT to update CGMS XXIV on the progress of the pilot SAFs.*

Closed. EUM-WP-05 refers.

ACTION 23-23 *USA (NOAA) to coordinate with the WMO to install or link TOVS operational processing change notifications to the CGMS Home Page and report at CGMS XXIV.*

Closed. NOAA/NESDIS is in the process of mirroring their home pages onto the WMO home page.

ACTION 23-24 *NOAA and EUMETSAT to each nominate one contact to review the ITWG report, consider any appropriate response, draft such response for Member review by 30 September and provide feedback to ITWG by 30 November 1995.*

Closed. This issue is addressed in USA-WP-14, to be discussed by

Working Group II under Item II/3.

ACTION 23-25 *CGMS to forward CGMS CAL/VAL working papers to CEOS CAL/VAL working group and maintain close communication on these issues.*

Closed. The Chairman of CEOS CAL-VAL was informed of relevant CGMS working papers.

ACTION 23-26 *People's Republic of China to report at CGMS XXIV on progress regarding its calibration sites.*

Closed. PRC-WP-05 refers.

ACTION 23-27 *The rapporteur of the Winds Workshop to discuss and recommend standardized reporting method on winds quality, in coordination with the International Winds Workshop, and propose a new method at CGMS XXIV.*

Closed. A new reporting format is presented in Sections III and IV of USA-WP-13, for review by Working Group III.

ACTION 23-28 *EUMETSAT will provide over an Electronic Bulletin Board a copy of the winds statistics section of the CGMS Consolidated Report.*

Closed. This may, nevertheless, need an update regarding the new reporting format.

ACTION 23-29 *CGMS winds operators to explore the establishment of standard guidelines for quality marking and report on their progress at CGMS XXIV. CGMS winds operators to propose a special session on this topic at the next International Winds Workshop.*

Open. Recommendations are expected from Working Group III.

ACTION 23-30 *EUMETSAT to report at CGMS XXIV on any differences between MPEF and MIEC wind processing.*

Closed. EUM-WP-26 refers.

B. REPORT ON THE STATUS OF CURRENT SATELLITE SYSTEMS

B.1 Polar Orbiting Meteorological Satellite Systems

In RUS-WP-01 Roshydromet presented a status report on its current polar orbiting METEOR satellites. The METEOR-3 N°7 (launched in 1994) failed in 1995 while METEOR-2 N°21 (launched in 1993) and METEOR-3 N°5 (launched in 1991) continue to be operational, providing visible imagery.

The United States presented USA WP-01 on the status of its polar-orbiting satellite systems. Currently the United States has five polar satellites in orbit. NOAA-14 and NOAA-12 continue to be the primary afternoon and morning operational satellites, respectively. NOAA-10 and NOAA-11 are in standby status. NOAA-9 continues to supply data from the SBUV and Search and Rescue instruments. This working paper may be referenced for the status of all instruments on all five NOAA satellites.

B.2 Geostationary Meteorological Satellite Systems

EUM-WP-02 reported on the status of all Meteosat satellites and missions. CGMS noted that under the Meteosat Transition Programme (MTP) control and operation of the satellites, the extraction of meteorological products and the image archive and retrieval service had been transferred from ESA/ESOC to EUMETSAT by the end of November 1995. The meeting was informed that Meteosat-7, the last in the current series of Meteosat satellites would be launched in July 1997 and is expected to operate until Meteosat Second Generation will assume the primary missions from geostationary orbit.

Japan reported on the status of GMS-5 and -4 in JAPAN-WP-02 and JAPAN-WP-04. GMS-5 was put into operation on 13 June 1995, and its three major missions, i.e. VISSR (Visible and Infrared Spin-Scan Radiometer) observations, dissemination of cloud images and collection of meteorological data have been normally performed. The planned cancellation of VISSR operations from July to September 1995 was mainly due to the replacement of ground systems. GMS-4 was stationed at 140°E above the equator as the operational satellite until 13 June 1995, and is currently kept at 120°E as the back-up satellite. Japan further explained in JAPAN-WP-03 the operation of Infrared Calibration Shutter of GMS-5. A disfunction of the calibration mechanism was discovered, which required changing the operation mode from 9 August 1995. JMA is now developing a statistical method for infrared calibration.

Russia informed CGMS in RUS-WP-02 of the status of GOMS-N1 satellite. At this time, all on board systems have been checked but the integrated tests of the GOMS system are not yet completed. The satellite at present is kept at 76°E (after a successful eclipse manoeuvre performed on 25 March 1996). GOMS-N1 operates in experimental mode and supports nominal heliogeophysical measurements (hourly) and regular imaging mode in IR channel (19 images per day). IR imagery is considered to be normal and adequate for distribution. The tests on image dissemination (WEFAX format, 1691 MHz) are coming to their end. The dissemination schedule will be available to the date of GOMS nominal operations. An interference was registered on the DCP mission retransmission system channel 401-403 MHz from an external radio source which is now localised. Work is going on to eliminate this source of interference.

The United States presented USA-WP-02 on the current status of its geostationary satellite systems and reported that it is now in a fully operational two GOES configuration. GOES-9, launched May 23, 1995, became the GOES West operational satellite at 135° west on January 11, 1996, while GOES-8 continues to perform as the GOES-East operational satellite at 75° west. Prior to GOES-9 becoming operational, NOAA conducted an Extended Research Checkout to collect rapid-interval imagery over the United States for future meteorological investigations. GOES-7, the last in the spin-stabilized series, was placed in standby mode on January 11, 1996, and is planned to be located near 100° west. Calibration for both GOES-8 and -9 spacecraft instruments has been characterized as excellent. The United States reported that it does not plan to routinely interrogate GOES-7 unless required to provide backup for GOES-8 or -9.

C. REPORT ON FUTURE SATELLITE SYSTEMS

C.1 Future Polar Orbiting Meteorological Satellite Systems

Document EUM-WP-03 reported on the progress to date with the development of the EUMETSAT Polar System (EPS) based on the use of METOP satellites. The EPS is the European contribution to a joint USA/EUMETSAT satellite programme designed to provide continuous and timely availability of meteorological data from sun-synchronous polar orbiting satellites. The EPS will provide observations from the morning orbit whilst the USA will continue coverage from the afternoon orbits. By the beginning of 1996 EUMETSAT and ESA had finalised the definition of a METOP payload comprising:

- Advanced Very High Resolution Radiometer (AVHRR)
- Advanced Microwave Sounding Unit-A (AMSU-A)
- Microwave Humidity Sounder (MHS)
- High resolution Infra-Red Sounder (HIRS)
- Infra-red Atmospheric Interferometric Sounder (IASI)
- GPS Sounder (GPS-S)
- Scatterometer (ASCAT)
- Ozone Monitoring Instrument (GOME)
- Data Collection System-Argos (DCS-Argos)
- Space Environment Monitor (SEM)
- Search and Rescue service (S&R)

EUMETSAT will be responsible for the implementation of the overall EPS Programme, including the provision of launchers, the definition and procurement of the Ground Segment and the Operation and the definition of the Mission/System requirements. ESA and EUMETSAT will jointly be responsible for the METOP procurement contract. EUMETSAT will then procure METOP-2 and -3. Following approval of the EPS programme by the EUMETSAT Council expected in 1996, programme activities would be expected to begin in 1997. This means that the launch of METOP-1 can be scheduled for early 2002, with METOP-2 launched in 2006. Assuming a nominal 5 year lifetime for the satellites, METOP-3 would be launched in 2010 at the earliest, with operations hopefully continuing until 2015.

CGMS was informed by China in PRC-WP-01 that FY-1C will be launched in 1998. Compared to FY-1A and FY-1B, FY-1C will have some major changes:

- Orbit altitude will be changed from 901 km to 870 km;

- The number of channels of the scan radiometer will be increased from 5 to 10;

- Delayed Picture Transmission will acquire global image data with 4 km resolution at 4 channels

China will inform CGMS when the data format and exact frequency of CHRPT will have been decided.

In RUS-WP-03 a short description of future Russian polar orbiting satellites is given. In 1998 and 2000 the new METEOR-3M N°1 and METEOR-3M N°2 satellites are planned to be launched on sun-synchronous orbit. On board these satellites the modified imagers (in visible and IR), as well as microwave sounding devices will be installed. In accordance with the agreement between NASA and the Russian Space Agency the installation of American instruments SAGE III (on board METEOR-3M N°1) and TOMS (on board METEOR-3M N°2) is also planned. The future Russian environmental satellite RESOURCE-01 N°4 will be launched in 1997 and will be equipped with some instruments for meteorological missions. A plan exists to design and launch before the end of the century the specialised environmental satellite RESOURCE-ARCTICA for monitoring ice conditions in the northern areas of Russia. The main part of the payload will be a Synthetic Aperture Radar (SAR).

The United States reported in USA-WP-03 that NOAA is in the process of procuring NOAA-K,L,M,N,N'. The instrumentation for NOAA-K,L,M,N,N' will include the new Advanced Microwave Sounding Unit (AMSU) and an additional channel (1.6 μm) will be added to the AVHRR. Due to the successful performance of NOAA-14 and -12, the launch of NOAA-K is planned for early 1997. NOAA-K could be placed in either an a.m. or p.m. orbit in the event of a failure of either NOAA-14 or NOAA-12. NOAA-M is planned to be the last morning orbit satellite of the NOAA series, since EUMETSAT will be assuming responsibility for the morning orbit mission beginning with METOP-1. It was also noted that EUMETSAT will provide an MHS instrument on NOAA-N and -N'.

The United States also reported in USA-WP-04 on the current plans for the convergence of the Defense Department and NOAA polar orbiting satellite programs. An Integrated Program Office was established in 1995. "Early convergence" of the DMSP and NOAA POES operations will occur in 1998 by consolidating DMSP and POES operations at the NOAA Satellite Operations Control Center in Suitland, Maryland. NOAA is coordinating international inputs to the requirements for the future polar missions. NOAA and EUMETSAT expect to continue their cooperation in the NPOESS era with the Joint Polar System (JPS).

C.2 Future Geostationary Meteorological Satellite Systems

EUM-WP-04 reported on the status of the development of the Meteosat Second Generation (MSG) space and ground segments. The launch contract foresees a launch of MSG-1 on an Ariane-5 in mid-2000 and contains options for the launches of MSG-2 and -3, currently foreseen in 2002 and 2007 respectively. The overall concept of the MSG ground segment has been presented to EUMETSAT delegations for approval. Definition of system architecture and technical specification of the main elements is in progress. Some ground segment development contracts are expected to be awarded during 1997.

Following the introduction of the Satellite Applications Facilities (SAF) as distributed elements of the future MSG and EPS EUMETSAT Ground Systems, a pilot phase will be carried out in order to demonstrate the validity of the concept. EUMETSAT-WP-05 provided the current status of ongoing activities for the development of pilot SAF which can be summarised as follows: The primary objective of the SAF is to ensure the optimum use of meteorological satellites by generating and distributing products through the available expertise and resources of the National Meteorological Services (NMS).

A preliminary list of thematic areas to be addressed by SAF has been established as follows:

- Ozone measurement and monitoring;
- Clouds and precipitation;
- Air mass analysis and severe storm;
- Ice and snow monitoring;
- Ocean analysis;
- Land Surface analysis;
- Use of satellite data in Numerical Weather Prediction;
- Climate monitoring;
- Cross calibration;
- Synoptic applications.

The EUMETSAT Council has, so far, recommended the establishment of three pilot SAF dedicated to:

- Support to Nowcasting and Very Short Range monitoring;
- Ocean and Sea Ice;
- Ozone monitoring, or Climate and Ozone monitoring.

For each of the three pilot SAF, the EUMETSAT Member States have been invited to provide proposals for implementation. The idea is to have each SAF placed under the responsibility of a hosting institute in charge of co-ordinating a consortium of National Meteorological Services and/or associated institutes willing to participate in the SAF activities. The first pilot SAF, to be hosted by the Spanish National Meteorological Service, will be dedicated to "Support to Nowcasting and Very Short Term Forecasting", and will focus specifically on the following areas:

- cloud products, with emphasis on severe storms, and clouds and fog within the atmospheric boundary layer;

- air mass products, with emphasis on those from MSG; precipitable water and stability analysis, and winds from high resolution visible images.

The other pilot SAF dedicated to Ocean and Sea Ice, Ozone Monitoring or Climate and Ozone monitoring are currently the subject of proposals to be presented to the EUMETSAT Council in June 1996.

Japan informed CGMS in JAPAN-WP-05 on the progress of procurement and production of the Multi-functional Transport Satellite (MTSAT) as a successor to GMS-5. It explained that the High Resolution Imager Data (HiRID: in place of S-VISSR) of MTSAT have the same format as S-VISSR since GMS-5 will be maintained in geostationary orbit as a back-up satellite. The additional data and bits will be put into unused area in the current GMS-5 Stretched-VISSR format. The WEFAX and the LRIT signal will be disseminated on different time schedules, but using the same frequency.

CGMS was informed by China in PRC-WP-02 that the second FY-2 satellite will be launched at the end of 1996 or a little later if there are no unexpected events. All the specifications of the second FY-2 satellite are the same as the first one which were described in the previous PRC working papers.

The Russian Federation reported in RUS-WP-04 on the plans concerning future geostationary meteorological satellites. At present, work is underway for manufacturing GOMS-N2. Its development takes into account the elimination of GOMS-N1 malfunctions. GOMS-N2 is planned to be integrated and prepared for shipment to Baikonur in 1997 with possible launching at the beginning of 1998. The expected lifetime of GOMS-N2 is about three years. The prospects of development of the next geostationary satellites of the GOMS series are now under discussion. It can be expected that the manufacturing of GOMS-N3 will begin in 1997. With appropriate financing the manufacturing can be finished in 2000.

The United States described in USA-WP-05 its future GOES plans. GOES-K is the third of the GOES-I through -M series and is scheduled for completion at the end of 1996 with a planned launch date of April 1997. The GOES-K instrumentation is the same as GOES-8 and GOES-9. It was reported that GOES-M will be completed before GOES-L because of a special requirement to accommodate a new solar X-ray imager (SXI). Plans are to launch GOES-M in the 2002 time frame to gather as much data as possible during the solar maximum period, expected to peak around 2000. GOES-L will be the fifth satellite to be manufactured, with a launch planning date near 2002, if needed. GOES-L will have the same instrumentation as GOES-K, without SXI. One important change will be in the imager channels. One channel at 12.0 μm will be replaced with one at 13.3 μm in order to better establish the level of cloud tops for wind observations. In addition, the horizontal resolution of the water vapor channel at 6.7 μm will be improved from 8 km to 4 km. The next generation of GOES satellites will be the N,O,P,Q series and will include the GOES I-M series of imager and sounder instruments utilizing a 3-axis stabilized platform. Studies are under way to examine the practicality of an interferometer sounder, as well as a faster imager with more spectral channels, for the next generation series beginning with GOES-R.

D. OPERATIONAL CONTINUITY AND RELIABILITY

D.1 Global planning, including orbital positions

The CGMS noted that the five geostationary positions were currently filled since the launch of GOMS-N1 and renewed its thanks to the Russian Federation for this important step, although bearing in mind that GOMS-N1 was still in a pre-operational status and that no images or products had been regularly disseminated so far. The WMO reported that the meteorological community was deeply concerned that the availability of images and products from the geostationary orbit was still affected by a gap over the Indian Ocean area, as recalled by the CBS Working Group on Satellites. It was stressed that the operational coverage of the Indian Ocean is recognized as an essential requirement of the world meteorological community. In particular, it is expected to be an essential input for global numerical weather forecasting and for the operation of World Meteorological Centers in general, through the generation of wind vectors over this area of the globe. The data collection mission aboard GOMS is an important part of the IDCS. In addition, the Tropical Cyclone Committee of RA-I recalled the importance of real-time availability of satellite imagery over the Indian Ocean for the monitoring of tropical cyclones.

The CGMS, bearing in mind these essential requirements and aware of the major step already achieved in launching GOMS-N1, strongly encouraged the Russian Federation to pursue its efforts to bring GOMS-N1 to an operational status, to operationally disseminate images and products, to operate the data collection mission using channel 401-403 MHz, and to ensure the launch of GOMS-N2 around 76°E in order to provide continuity of the GOMS system.

D.2 Inter-regional contingency measures

CGMS recalled the contingency strategy adopted at CGMS XXIII in response to the need expressed by the forty-fourth Executive Council of WMO to increase the reliability of the space-based global observation system. Experience shows that such contingency plans are necessary to minimize the impact of possible failures in part of the system. EUMETSAT reported that the long-term back-up agreement between the USA and Europe had just entered into force and now provided a clear contingency plan for the western longitudes. CGMS identified a similar need for contingency planning for the eastern longitudes and noted that the current plans of the Russian Federation, of the PRC, of Japan and of EUMETSAT should allow this issue to be addressed in an efficient way.

CGMS was informed that EUMETSAT and Roshydromet had initiated preliminary discussions on future bilateral back-up arrangements. CGMS also noted that the PRC experimental satellite FY-2, at 105° East, will be located at an intermediate position between GOMS-ELECTRO and GMS, and that it could be considered as a potential back-up satellite in the event that contingency measures were required in this area.

CGMS encouraged the relevant satellite operators to further consider the implementation of the CGMS contingency strategy in this part of the world through bilateral arrangements.

D.3 Long-term global contingency planning

No issue raised under this specific item.

E. METEOROLOGICAL SATELLITES AS PART OF WMO PROGRAMMES

E.1 World Weather Watch

In WMO-WP-10, WMO informed CGMS of the latest status of data requirements including those of WMO as well as CEOS Affiliates. This item was discussed at the CBS WGSAT-II where a procedure for improving and updating the requirements was refined and endorsed.

The four components of the review procedure, a Rolling Requirements Review, was explained through the use of a figure. It was noted that the "user requirements" must not take into account the available technology (i.e., they should be technology-free), and that the users will conduct the review not only of the user requirements but also of the system capability. This new procedure will be tested during the next six months and be forwarded to CBS-XI for endorsement. EUMETSAT expressed a desire to avoid duplication among the different efforts being conducted in other bodies such as GCOS and stressed the importance of close collaboration with them. WMO explained that it is collaborating with others and mentioned that although the requirements do not have to be common, there will be a degree of commonality among them. WMO also indicated that IGBP and IOC were initially in agreement with the procedures discussed at the CBS WGSAT-II.

It was suggested to establish and regularly update a document summarising the instruments existing or planned on CGMS Members' missions. Such a document would provide more details than the tables of satellites currently attached to the CGMS reports. This should rely on, but not duplicate, the information elaborated by CEOS.

<u>Action 24.01</u>	**CGMS Secretariat to develop a document summarising the instruments on CGMS Members' missions and to submit the sketch of such a document for review by CGMS XXV.**
<u>Action 24.02</u>	**WMO to provide CGMS Members with a preliminary report on the critical review from the CBS Working Group on Satellites by 1 November 1996.**
<u>Action 24.03</u>	**CGMS Members to comment on the preliminary report on the critical review from the CBS Working Group on Satellites prior to CGMS XXV.**

WMO reported in <u>WMO-WP-14</u> the latest status in WMO's development of a project for low-cost low-resolution satellite receiving project. It indicated that there was an untied contribution from the Government of Switzerland toward this programme. The Working Paper also showed the countries that will receive satellite receiving equipment as well as the status of its implementation. CGMS took note of Switzerland's contribution to this project.

WMO also reported that it is going to initiate a new project to encourage the development of a Low-Cost Advanced Processing System (LCAPS) by first specifying the characteristics for applications and presentation. This activity was initiated at the CBS WGSAT-II meeting.

In <u>WMO-WP-21</u>, the Director of the Joint Planning Office for GCOS informed CGMS of recent GCOS activities, particularly with regard to space-based observations. The Director briefly described the elements of its Initial Operating System as well as the seven GCOS missions which was a concept developed to provide a context for space instrument analysis. To assist further in the review of the on going missions and plans of space agencies, WMO Document GCOS-16, a "Guide to Satellite Instruments for Climate" was prepared and is available for CGMS Members.

The Director reiterated the already agreed upon three tier system of instruments: operational meteorology, earth system monitoring and research/experimental. GCOS needs will focus primarily in the area of earth system monitoring but depend upon the continuity of data sets from operational meteorology as well as those of earth system monitoring. GCOS will also have needs for individual missions of the research/experimental type. Thus GCOS needs will span the three tier system of instruments as described in the CEOS Affiliates' Dossier.

E.2 Other Programs

No issue raised under this item.

F. COORDINATION OF INTERNATIONAL DATA COLLECTION & DISTRIBUTION

F.1 Status and Problems of IDCS

In its EUM-WP-07 EUMETSAT informed CGMS about a minor reorganisation of IDCS admitting authority coding in order to allow the future operation of IDCP by the People's Republic of China. The proposal was unanimously adopted by the meeting. CGMS also noted that the relevant page of Annex 2 of the IDCS User Guide (advanced copy distributed at the meeting) would be amended accordingly at the next revision.

EUM-WP-08 reported on the status of the Meteosat international DCP channels (IDCS). CGMS noted that during 1995 around 450 International DCPs were registered worldwide for use with the IDCS, using 9 of the 33 available channels. International Channels 6, 7, 12, 13, 14, 15, 16, 18 and 20 were regularly in use. At the end of January 1996 140 International DCPs were regularly reporting through the Meteosat IDCS. CGMS also noted that following the agreement of CGMS in 1995 International Channels 29, 30, 31, 32 and 33 were being used by EUMETSAT to accommodate networks of agro-meteorological and hydro-meteorological DCPs of WMO programmes. During 1995 some radio interference had been experienced on International Channel 16 within the Meteosat telecommunication field of view. Diskettes containing the latest consolidated listings of all IDCS allocations, in ASCII text format, were distributed at the meeting. CGMS Members were invited to check the contents and report any omissions or corrections to the CGMS Secretariat in due course. EUMETSAT informed CGMS of its plan to implement a new facility for the localisation of DCP interference sources.

Action 24.04 **EUMETSAT to report at CGMS XXV about its experience on detection and localisation of interference sources in the 401-403 MHz band.**

Japan described the status and problems of IDCS in JAPAN-WP-06 and JAPAN-WP-07. The 237 DCPs (298 addresses) are registered to GMS IDCS as of 31 December 1995. IDCS did not experience serious problems in the GMS area.

The United States reported in USA-WP-06 on a new international data collection system channel monitoring system. The prototype system automatically scans the IDCS channels and measures potential interference. The system utilizes a PC and commercial software and a frequency agile demodulator. The system confirms continuous interference on IDCS channel 1 from GOES East and some interference on channels 32 and 33 that could result in degraded data. The United States intends to enhance and expand the system to cover both GOES East and West.

F.2 Ships, including ASAP

Japan described the status of ship IDCPs including ASAP in JAPAN-WP-08. The 156 ship IDCPs (217 addresses) including ASAP are registered to the GMS IDCS as of 31 December 1995. Japan emphasised that the new IDCP to be used in the GMS area need to be registered with the JMA before operation, and this was noted by CGMS Members.

WMO-WP-19 gave a status on the present status of ASAP implementation. As of December 1995, 14 ASAP systems were operated by eight countries in the Atlantic, Pacific and Atlantic Oceans. WMO also mentioned that ASAP operations began in the USA and Sweden/Iceland in 1995, and that ASAP operations on research vessels are being done by Germany and the USA.

F.3 ASDAR

The status of the ASDAR in the GMS system was provided in JAPAN-WP-09. JMA newly registered 19 ASDAR DCPs in GMS IDCS in October 1995. The discrepancy between numbers of received and disseminated messages is mainly due to the reception of messages from outside the area of responsibility of data collection by GMS.

WMO-WP-20 described the present status of 23 ASDAR units as of March 1996. WMO reported that 17 units out of 23 are installed and providing operational data on British Airways, KLM, SAUDIA, South African Airways and two further units are expected to be operational shortly on Air Mauritius.

F.4 Dissemination of DCP Messages (GTS or other means)

In EUM-WP-09, EUMETSAT summarised the steps taken to establish a DCP certification facility, following the handover of all Meteosat operations from ESOC to EUMETSAT at the end of 1995. The certification contractor is currently in the process of establishing test facilities and preparing test procedures for this service. Certification of manufacturers equipment is expected to commence during May 1996. EUMETSAT is also studying the possibility of offering a reduced certification to DCP manufacturers who are already certified to supply GOES compatible DCP. Detailed information about GOES certification methods was requested by EUMETSAT.

Action 24.05 **USA to provide EUMETSAT with information on the certification procedure for DCP using the GOES DCS by 1 August 1996.**

EUMETSAT added that it was currently in the process of updating Annex 6 of the IDCS Users' Guide to reflect changes caused by the transfer of the type certification service from ESOC to EUMETSAT and also to clarify certain technical aspects of the certification specifications described. It was agreed that the CGMS Secretariat would consider whether there was a need to update and/or consolidate the technical contents of IDCS Users Guide, Annexes 3, 4, 6, 7 and 8, and propose any modification to CGMS for approval in due course.

Recalling Action 23.12 from the previous meeting, CGMS expressed high interest in IDCS capabilities supported by GOMS satellites and agreed on the following action:

Action 24-06 **The Russian Federation to provide CGMS Members with details of IDCP channel frequencies on GOMS by 1 September 1996.**

In JAPAN-WP-10 it was indicated that the Meteorological Satellite Centre (MSC) received messages from 363 DCPs via 8 international and 26 regional DCP channels of the GMS-5 DCP report transponder as of December 1995. The received messages were processed at MSC and transmitted to the headquarters of the Japan Meteorological Agency.

The United States introduced information document USA-WP-07 which tallies the yearly number of messages on the international channels for GOES east and GOES west.

G. COORDINATION OF DATA DISSEMINATION

G.1 Dissemination of images via Satellite

EUM-WP-10 presented the current status of preparations for the implementation of the Low Rate and High Rate Image Transmission (LRIT/HRIT) as a dissemination protocol via the Meteosat Second Generation (MSG) mission transponders. Details about the MSG LRIT/HRIT physical layer, data content and file structure, compression and encryption algorithms were presented. CGMS noted that, whilst much of the core definition of LRIT/HRIT was now completed, flexibility existed in the actual implementation. EUMETSAT added that with lossless compression techniques a compression factor close to 2.5 could be expected. For lossy compression techniques, compression factors up to 8 would be applied.

Action 24.07 **EUMETSAT to provide CGMS Members with the results of recent studies on the performance of lossless and lossy compression techniques by 1 August 1996.**

CGMS noted that manufacturing constraints tended to minimize the actual size of the antennas, below the specifications, anticipating the over-performance of satellite transponders. It was emphasized that in such cases the reliability of the receiving chain was questionable.

CGMS further noted that for reception of LRIT data an antenna size of 1.8 m would be recommended. For HRIT, an antenna of 2.5 to 3 m would be specified. Reception of data in Southern Africa and Antarctica would require correspondingly larger size antenna, because of the offset nature of the telecommunication coverage zone of MSG.

In its EUM-WP-11 EUMETSAT summarized the current planning of the data content and the aspects of the physical layer of the new Low Rate and High Rate Picture Transmission LRPT/HRPT which will form the baseline for the METOP Direct Broadcast Service. The document also listed the METOP payload instrumentation, source packet sizes, application process identifiers and their data rates. The implementation of such data into the defined Network and Data Link Layers of the LRPT/HRPT General Specification was also described. The Direct Broadcast System requirements were introduced and the intermediate results of concept studies focusing on the definition of the LRPT/HRPT physical layers (modulation and coding schemes, propagation effects) were presented. The resulting user station designs and the potential synergy created by the parallel development of geostationary satellite LRUS/HRUS (Low Rate and High Rate user Stations) was also briefly addressed.

EUMETSAT, underlining the lack of a definition of LRPT beyond the LRPT/HRPT General Specification NASA GSFC-S-480-77 stressed that CGMS should review this specification and agree without delay on a standard for LRPT in order to meet the deadlines for METOP-1. It was recognized that the implementation of LRPT by the individual operators should be similar, although not necessarily identical, but should rely on a common general specification. CGMS were informed by the USA that a questionnaire had been distributed to over 370 known users of APT. Following on analysis of the results of this questionnaire in May 1996, the USA would then determine its implementation strategy.

WMO expressed concern with the short period of notice left to users to adapt to the new digital transmission format. It urged CGMS to agree on a global general specification by the end of 1996 at the latest and to allow a smooth transition from current analog to digital transmissions.

EUMETSAT commented that in the 2002-2006 time frame the transition from analog to digital will be achieved by the parallel operation of the NOAA polar satellites, which will continue APT, and of METOP which will only support digital transmissions.

The Working Group on Telecommunications was tasked to:

- identify which elements of the proposed LRPT definition can be considered as agreed and which other elements need further discussions.

- identify the relevant information for distribution by WMO to the user community

- review the actions to be taken and propose a new action, replacing Action 23.02, leading to the agreement on a common definition of LRPT.

In Japan-WP-11 Japan informed CGMS on the policy established by JMA since 1 March 1996 for the distribution and utilisation of GMS cloud images made available on a real-time or non-real time basis. According to this new policy :

(i) users are allowed to publish GMS cloud images on the condition that they indicate that the images are originating from JMA's GMS;
(ii) any user willing to redistribute GMS cloud images to third parties via telecommunication lines or information network should apply to JMA for the permission of re-distribution and should notify the third parties the above-mentioned condition;
(iii) every user receiving GMS images, by means of either S-VISSR or WEFAX, should register with JMA as before.

The United States and China sought clarification on the purpose, background, and implementation of the new policy with respect to registration. JMA explained that the purpose of these provisions was to ensure that JMA is acknowledged as the originator of the data, and to allow monitoring and promoting the use of the data through an identification of the users, their locations and applications. CGMS took note of the new policy and understood JMA's wish to be recognized as the originator of GMS data. Specific questions were raised as to whether the policy applies to networks as well as direct rebroadcast. As regards the indication of origin of the data, it was suggested that JMA could identify its products by embedding appropriate information into the images themselves, thus meeting JMA's requirement without requiring additional specific processing by each distributor. These comments were noted by Japan, which explained that different means were available to indicate the origin, either by embedding information into the images themselves or by providing appropriate explanations or comments.

The United States noted that it would be officially responding to the notice of JMA's new policy regarding GMS cloud imagery dissemination. The U.S. indicated that it would not be in a position to enforce the registration requirement for GMS cloud imagery. The U.S. will, however, inform other users of JMA's registration requirement for use of cloud imagery products from GMS. The U.S. also indicated that it would appreciate receiving further clarification on JMA's new cloud imagery policy.

Japan then reported in Japan-WP-12 that JMA plans to disseminate meteorological data in Low Rate Information Transmission (LRIT) format with the entry into operation of MTSAT, to be launched in 1999. This will be based on the LRIT Global Specification, Revision 2.3, with a data rate provisionally fixed at 64 kbs. Japan also studied the possibility to include in the LRIT flow Grid Point Values (GPV) of numerical weather prediction in addition to the cloud imagery.

WMO discussed the conversion of analogue APT/WEFAX to digital LRIT/LRPT in WMO-WP-3. WMO recalled previous activities of CGMS in defining the new transmission formats as well as matters related to technical aspects of receiving stations. WMO noted that its Technical Document (SAT-13) described a standard small satellite ground station using an omni-directional antenna with a 180 degree beamwidth and gain of 3 dbi and requested that this requirement be taken into account when designing the satellite service for digital LRPT.

CGMS wished to encourage the availability of affordable user stations, for the widest possible use of meteorological data. In order to avoid that multiple development costs be borne by the users, EUMETSAT intends to support the development of a "black box" base band equipment which would be made available for integration into future user stations. The Working Group 1 was tasked to address such a concept .

CGMS was informed of WMO activities in contributing to the definition of layers six and seven of the ISO standard, i.e. "Presentation" and "Application" respectively, agreed that this activity was important and wished to be kept informed of future developments.

G.2 Dissemination of products via GTS or other means

No issue raised under this item.

G.3 Global exchange of satellite image data via satellite or via the GTS

In EUM-WP-12 EUMETSAT described the various exchanges of foreign satellite image data through the Meteosat system. CGMS noted that whilst the X-ADC mission had been completed following the successful introduction of GOES-8 coverage of the Americas and West Atlantic, plans for the relay of GOMS WEFAX data via Meteosat were progressing well. It was hoped that such a relay could be in place by the end of 1996. Additionally, EUMETSAT was holding discussions with JMA for the acquisition and rebroadcast of digital GMS image data. In conclusion, EUMETSAT added that it was planning to continue the relay of foreign satellites data through the ground segment of MSG.

These arrangements were welcomed by WMO as an excellent illustration of a global and coordinated approach to meeting users´needs.

In WMO-WP-17, the status in the development of a WMO requirement for the exchange of digital satellite image data over the GTS was presented. WMO recalled that dissemination of satellite image data over the GTS was discussed at the twenty-second session of CGMS in April 1994. CGMS acknowledged the need for a global exchange of certain image data and agreed that WMO should articulate its operational requirements for the global exchange for satellite image data, consider how best to achieve such exchange and make recommendations as appropriate to CGMS. In response to this CGMS request, a draft WMO Requirement for Digital Satellite Image Data Exchange over the GTS was developed and circulated in 1995 to all RSMCs, WMCs and other CBS Working Group Chairmen. Their responses, as well as those of CBS Working Group on Satellites members, were incorporated into a new Interim WMO Requirement for Digital Satellite Image Data and Extracted Product Exchange over the GTS.

As a preliminary reaction, before assessing the detailed content of this requirement, CGMS indicated that with the presently available technology such a requirement could best be satisfied through the data distribution system on board the meteorological satellites. CGMS further suggested that a requirement for data and products should not prejudge the means of distribution. For the future the most appropriate means to distribute these data should be seen in the light of the available technology, of the global communication infrastructure implemented and of the plan adopted by WMO for the development of the GTS. In this regard, CGMS was pleased that the various CBS working groups would discuss the requirement and that it would be discussed at the next session of CBS in October 1996. CGMS indicated that it would be pleased to receive and review the requirement once accepted by CBS. However, it agreed that the completeness of the information contained in the requirement should first be assessed.

CGMS decided to close Action 23.05 to be replaced by the following action:

Action 24.08	**CGMS Members to indicate by 1 October 1996 to WMO whether the interim requirement for the exchange of digital image data as expressed, once approved by CBS, would be sufficient for formal consideration and response.**

H. OTHER ITEMS OF INTEREST

H.1 Applications of Meteorological Satellite Data for Environment Monitoring

A report was provided in Japan-WP-13 on the detection of volcanic ash clouds using the infrared split window channel of GMS-5, showing the example of the explosive eruption of Mt Bezymianny in October 1995. The ash clouds were seen on Brightness Temperature Difference (BTD) images during the entire period of eruption, thus enabling to trace their displacement and change. This is an advantage of geostationary satellites which perform observations at short intervals. GMS-5 is expected to show its ability for detecting volcanic ash clouds for other future eruptions. CGMS noted this information with interest and recalled that a long-term objective should be to set up a global observation of these phenomena and a warning service important for aviation safety.

In PRC-WP-03, China informed that since April 1995 an anomaly vegetation index was operationally generated from AVHRR data and communicated on a monthly basis to the Chinese government every month to provide information about vegetation growth anomalies.

H.2 Search and Rescue (S&R)

EUM-WP-13 reported on the accommodation of Search and Rescue (S&R) on the MSG satellite series. CGMS were informed that it had been possible to design the on board communications subsystem to allow a dual use of the VHF and L-band antennae and the VHF receiver, to accommodate both the DCS mission and the S&R mission. The mission had been included in the baseline for MSG-1. The inclusion of S&R on MSG-2 and -3 is subject to approval by EUMETSAT Council.

Japan reported in Japan-WP-22 that the Ministry of Transportation completed in February 1996 a 406 MHz GEOSAR experiment using the S&R transponder aboard GMS-5. The results of the experiment are now under evaluation.

In RUS-WP-05, the Russian Federation reported on its plans to use geostationary satellites for future development of S&R. Initial tests were performed on board geostationary communication satellite "LUCH" but no result could be obtained due to a transponder failure. In view of the importance of S&R, it is expected to install aboard GOMS-ELECTRO N°2 such a system, which represents around 25 Kg including redundancy. It is anticipated that in future the geostationary segment will become the official component of the operational international system COSPAS/SARSAT .

In USA-WP-08 the United States presented the status of low-earth orbit and geostationary earth orbit satellite systems for Search and Rescue. The United States was pleased to note that EUMETSAT, Japan, and Russia have indicated their plans to include S&R monitoring on their geostationary satellite systems. This will provide almost complete global coverage of the 406 MHz S&R frequency.

WMO and the Chairman congratulated the operators for their activities, as described in these four reports, in support to Search and Rescue which was now approached through a global and co-ordinated effort.

H.3 Anomalies from Solar and Other Events

No issue raised on this item.

H.4 Information and Training

Document EUM-WP-14 summarised the implemented and planned EUMETSAT training activities in satellite meteorology for Member States and Developing Countries. The activities comprised the following:

Foundation courses, intended to both introduce the elements of satellite meteorology for newcomers to the subject and also to act as a revision for more experienced staff. The courses cover the basic physics of remote sensing, meteorological satellite operations and image interpretation. A large measure of practical work is included in each course with case studies based on regional weather patterns and forecasting problems.

More recently, use has been made of meteorologists from neighbouring Member States to assist with the presentation of material. Additionally, use of specially developed CAL display facilities has greatly improved the effectiveness of presentation. Some thought is now being given to further development and lengthening of course duration to meet more advanced and comprehensive training needs expressed by some EUMETSAT Member States.

EUMETSAT is additionally playing an active role in the planning activities for the EuroMet project which, with funding assistance from the European Commission, is aimed at producing Computer Aid Learning (CAL) modules in satellite meteorology for eventual distribution by the Internet.

In November 1994 EUMETSAT extended its training strategy for satellite meteorology to include developing countries with particular emphasis on WMO Regional Association I, Africa. This decision follows the recommendation from the WMO Commission for Basic Systems Working Group on Satellites (CBS WG SAT). The Regional Meteorological Training Centres (RMTC) in Nairobi and Niamey were identified for EUMETSAT support which will be aimed at fostering the development of trainers at these two centres.

More recently, EUMETSAT has been actively involved in the planning of Computer Aid Learning (CAL) project which is being funded by Germany. The project, known as ASMET (African Satellite Meteorology Education and Training) is the subject of a bi-lateral agreement between Germany and Kenya for the development of CAL for teaching satellite meteorology. The RSSATC personnel will be involved with the development of the CAL which is intended to be self-sustaining and eventually distributed to other trainers in the region. Representatives of the training institutes in Nairobi and Niamey were assisted in attending the EUMETSAT Satellite Data Users' Conference in Winchester, UK in September 1995. In addition to the benefit gained by these participants, they were able to make a positive contribution to the conference.

In EUM-WP-15 EUMETSAT summarised the activities proposed for the production of CGMS Directory of Meteorological Satellite Applications. CGMS were informed that the project has reached the stage where a contractor would soon be hired by EUMETSAT to collate material, edit it to a common format and prepare for publication. All CGMS Members were now being asked to endorse the approach presented in the document and to encourage potential contributions. The points of contact nominated by CGMS Members for this activity should take scientific responsibility for submissions. Submissions should be provided to EUMETSAT's contractor within the next 6 months so that a first edition of the Directory can be prepared in 1997.

Recalling the extensive use of Meteosat data in Africa, EUM-WP-16 reported on its activities in support of developing countries, in particular on the establishment of the EUMETSAT User Forum in Africa which had its first meeting in April 1995 in Niamey. It is planned to convene the "Second EUMETSAT User Forum in Africa" in December 1996 in Harare, Zimbabwe, with the co-sponsorship of WMO. The basic objectives of the Forum are the following:

- to provide up-to-date information on EUMETSAT systems, programmes and policy;
- to collect user requirements for products, data access and training;
- to exchange experience on regional applications and user equipment.

JAPAN-WP-14 explained that Meteorological Satellite Centre has been developing a computer aided learning system since 1994. The system runs on NEC's microprocessors (PC-98) and UNIX workstations with X-window. A MS-Windows version is being developed. The system has the following functions:

(1) to show GMS images (Visible, IR, WV), still and loop-animated;
(2) to show texts which explain features of images;
(3) to let an operator measure some elements on images such as cloud temperature, cloud movement velocity, and albedo;
(4) to superimpose other meteorological data, i.e. radar, i.e. intensity data and numerical weather prediction data.

Japan informed CGMS with Japan-WP-15 that the Australian Bureau of Meteorology (BoM) plans to hold the Asian Pacific Satellite Applications Training Seminar (APSATS) at BoM in November 1996 with the co-sponsorship of JMA and WMO. Lecturers will be dispatched to APSATS by JMA, which is expected to play a leading role in APSATS as the operator of GMS.

In WMO-WP-11,- 12 and -13, CGMS was informed of the latest status of the new WMO Strategy for Education and Training in Satellite Matters. CGMS was also informed of results from the Second Session of the CBS Working Group on Satellites where the strategy was refined to cover four important areas:

- continuing the present training programme with the strong participation by EUMETSAT in co-sponsoring two RMTCs in Africa,

- supporting the NOAA/NESDIS demonstration project at the Costa Rica and Barbados RMTCs,

- identifying a similar sponsor for an RMTC in WMO Regions II and V (Asia and the Pacific),

- reviewing the list of databases for trainers and books with a goal to improve their utility.

NOAA described a demonstration education and training project planned for the Costa Rica and Barbados RMTCs that is in the final planning stages. The project will be implemented by NESDIS' Office of Research and Applications and components of the Cooperative Institute for Research in the Atmosphere (CIRA) at Colorado State University and of the Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin. A Regional and Mesoscale Meteorology Advanced Meteorological Satellite Development Interpretation System (RAMSDIS) unit will be placed at Costa Rica and Barbados to enable GOES research and training. The two sites will receive digital GOES data through the Internet and will communicate with CIRA and CIMSS via a bulletin board system established by the Cooperative program for Operational Meteorology, Education, and Training (COMET). It is envisioned that personnel from Costa Rica and Barbados will come to the United States to receive training on the operation and maintenance of the system as well as familiarization with use of GOES data and, as necessary, U.S. experts will travel to Costa Rica and Barbados to provide on-site training.

H.5 Any other business

CGMS was informed of the latest status of the WMO database of satellite receiving stations in WMO-WP-1. It noted that the WMO database now contained over 8,000 receiving stations with over 5,000 stations identified by latitude/longitude. In WMO-WP-18, CGMS noted the number of satellites and receiving stations registered with the International Telecommunication Union (ITU). CGMS noted that some satellites as well as some of its member countries were not referred to in the ITU database. CGMS agreed to renew its effort to register both satellites and receiving stations with ITU.

PARALLEL WORKING-GROUP SESSIONS

REPORT FROM WORKING GROUP 1 : TELECOMMUNICATIONS

I/0 Introduction

The Working Group elected Mr Robert Wolf as its Chairman. Messrs Gordon Bridge and Carl Staton served as Rapporteurs.

I/1 Outcome of WRC (Geneva, 23/10-17/11/95) and SFCG (Bangalore, 6-15/12/95)

The Chairman introduced a summary of EUM WP-17, USA WP-9 and -10 and WMO WP-6 and -8, all of which addressed the above subject.

Recalling the results of the World Radio Conference of 1995 (WRC 95), CGMS was pleased to note that a proposal to allocate Mobile Satellite Services (MSS) on a primary basis over the whole of the 137 - 138 MHz band (parts of which are used for APT) had been withdrawn.

No new allocations for MSS were made in the band 400 - 406 MHz at WRC 95. However, vigilance will have to be maintained in case new proposals for primary allocation in this band come in the future. WRC has issued a resolution to study the technical feasibility of frequency sharing in this band.

Likewise, the proposed allocations within the band 1670 - 1710 MHz were not agreed during the conference. A resolution was issued to study the possibility to share part of the band (1680 - 1690 MHz) between MSS and Meteorological Satellite Services (MetSS). This issue will be discussed again at future WRC meetings. It was proposed, via a resolution, that future possible sharing of this band would be on the basis of definition of exclusion zones around MetSS stations operating within the band. Studies are being performed on possible sharing between MSS and Meteorological Aids Services (MetAS) in this band.

Proposed action I.1: *CGMS Members to inform the Secretariat about ground stations operating in the frequency band 1670 - 1690 MHz.*

CGMS were also informed about the preparations for WRC 97 (WMO WP-09 also refers).

The Chairman then reviewed steps being taken to protect frequencies used by passive sensors. This subject will feature prominently within the Agenda for WRC 97 and all users and potential users are already being made aware of potential conflicts with future systems, in particular, the TELEDESIC satellite network, which was projected to operate inter-satellite links in the 54- 58 GHz band and which could destroy any measurements made from satellites in large parts of the oxygen absorption band.

The Chairman then reported on the outcome of the Space Frequency Co-ordination Group (SFCG) meeting held in Bangalore, where the main topics of discussion were spectrum utilization and interference mitigation, ITU matters, data relay, earth exploration and meteorological satellites, orbital matters, space research, lunar and planetary exploration and software packages for frequency management. Many of these discussions also related to the outcome of WRC 95 and preparations for WRC 97. Of particular interest to CGMS was the discussions relating to the passive sensors (which can be found in some detail in EUM WP-17) and where reallocation of frequencies of the Inter-Satellite Service to bands above 65 GHz are proposed. SFCG also discussed the sharing of the 1670 - 1710 MHz band with MSS and potential interference caused by wind profiler radars. The group noted that an evolving list of passive and active sensor frequencies now existed. However, in order to better justify use of the frequencies, the Group noted that the CBS WG Sat had recommended that more background information on the various applications was necessary.

Members of the WG expressed their appreciation for the various activities carried out to date with the protection of frequencies, in particular the efforts of Chairman, USA and WMO. The WG noted that whilst the WMO only had observer status at WRC it had nevertheless been highly successful in making delegations aware of the use of MetSS and MetAS frequencies by the meteorological community globally. In response, Dr Hinsman thanked CGMS for their remarks and restated the importance of maintaining accurate databases of users and, in particular, he reminded all CGMS Members of the need to continue to register both existing and future ground stations. He also reminded all Members of the continuing need to register all user stations with the ITU, as stated in CGMS Permanent Action N°6.

In Russia WP-06, the WG took note of the frequencies being used by GOMS-N°1 and noted that severe interference had been experienced in the band 401- 403 MHz preventing operation of the GOMS DCS. Russia informed the group that the source of interference had been located and steps were being taken to eliminate the interference. EUMETSAT commented that similar interference had also been detected within the Meteosat DCS rendering some Regional channels unusable. Noting the importance of this mission to the meteorological community worldwide, the WG strongly supported any measures which could be taken by Russia to remove this particular source of interference.

I/2 Coordination of Frequency Allocations

In USA WP-11 the WG took note of steps taken by the NOAA Office of Radio Frequency Management to coordinate the use of frequencies available for meteorological use and to investigate through various studies the possibilities for sharing with other entities such as the MSS. CGMS were informed that significant (and most successful) use had been made of the WMO Internet mailing list established for this purpose in the period leading up to WRC-95, bringing a large number of interested group in contact with each other thus ensuring that proposals and positions could be clarified in advance of the meeting. The WG strongly endorsed the recommendation that CGMS should consider an organised effort with respect to developing countries to publicize the benefits of data provided by the various Met Satellite systems.

In WMO WP-07, WG Members were informed about questions relating to meteorological activities which were being addressed in the 1996-1997 ITU study period. A list of WRC 97 preparatory meetings was also presented in the document. WMO WP-09, presented the preliminary Agendas for the WRC 97 and 99 meetings.

Proposed action I.2: *All CGMS Members to place high priority on interacting with their national frequency regulators to keep them informed of their frequency needs.*

I/3 Telecommunication Techniques.

PRC presented PRC WP-04 which commented on the potential use of spread spectrum techniques for future DCS implementations. The PRC noted the benefits of this technique and encouraged further studies but indicated that the current design of FY-2 and its ground system would not allow for any such implementation. Both NOAA and EUMETSAT concurred with the PRC on the potential technical and program benefits and each also noted that they had no program requirements that would justify the costs to do further development on this technique at this time.

EUMETSAT presented EUM-WP-18 which noted the planned expansion of DCS services on the future MSG. The MSG will have the capability to cover over 400 DCP channels which would include the 200 regional channels assigned to GOES and GOMS, the 33 IDCS channels (plus 7 channels for future expansion) and 210 European regional channels. The USA reminded the WG that this coverage was also available on the new GOES I-M satellites and with implementation of MSG would provide an extended backup for both IDCS and regional DCS programs that is in conjunction with the broad "help your neighbour" policy agreed upon by the CGMS. Japan commented that this possible expansion of the IDCS could not be supported on MTSAT.

EUMETSAT also discussed the development and implementation of higher rate DCPS; specifically 300 bps and 1200 bps platforms. EUMETSAT noted that there would be immediate benefits from an increase in the transmit rate of DCPs and there could be a need for such an increase in the IDCS. It was discussed and agreed by the Working Group that there were immediate benefits to be gained by the development and implementation of 300 bps DCPs while there was not an immediate need for 1200 bps. NOAA noted that it is currently developing a design and certification for 300 bps DCPs. As a result of this discussion, EUMETSAT recommended that the current NOAA development be utilized as the basis for a CGMS standard for 300 bps DCPs. The WG agreed to this recommendation and NOAA agreed to provide all pertinent information on the specifications and the certification procedures to CGMS members for their review.

Proposed action I.3: *NOAA to provide to all CGMS members by 1 September 1996 its design specifications and certification procedures for 300 bps DCP.*

Proposed action I.4: *CGMS members to review and provide comments to NOAA regarding NOAA's 300 bps DCP design and certification procedures by 1 February 1997.*

Proposed action I.5: *NOAA to present at CGMS XXV, a proposed design and certification plan for 300 bps DCPs for acceptance as a "standard" by CGMS members at CGMS XXV.*

Also included within this agenda item were several discussion items assigned to WG 1 by the plenary of CGMS XXIV. These are summarized below.

- **To discuss the benefits of integrating GPS and other GNSS receivers into DCPs**

The WG discussed the integration of GPS and other GNSS receivers into DCPs and noted the benefit to be gained by really stabilizing the clock on the DCP. This would allow the minimizing of the guard band times that are now required in DCP scheduling and result in an increase in the number of DCPs that could be placed on a DCS channel. This would also benefit regional DCP programmes. WG I also noted, however, that this does not present a immediate benefit to the IDCS in so far as the IDCS is not near its current capacity; and that the retrofitting of these receivers into existing DCPs would be expensive. The group supported any improvements in stabilizing the timing of DCPs and noted that the most cost effective opportunity to integrate a GPS receiver would be when new designs for DCPs were developed.

Proposed action I.6: *CGMS Members to recommend to DCP manufacturers the inclusion of GPS or other GNSS clock modules in future design of DCP.*

Proposed action I.7: *CGMS Members to encourage the use of GPS and other GNSS clock controlled DCP for future DCS applications.*

- **To recommend what, if any, aspects of the LRPT format could be disseminated to the user community**

EUMETSAT recalled the presentation of its WP 11 which detailed their current plans for LRPT on METOP I. This was based on an initial study by the USA (NASA). EUMETSAT indicated that although this represented a complete LRPT format, concurrence on this proposed format with NOAA was essential before information was released to the user community. EUMETSAT emphasized that concurrence was needed only for the global structure to insure universal access and that the format allows for operator specific features to be implemented. NOAA noted that it sent a questionnaire regarding the LRPT to over 370 users in March 1996 and it is awaiting responses to the survey (due May 3, 1996) to analyze the results. The WG agreed that specifications of the LRPT format not be released at this time. The WMO expressed concern that users would not have sufficient time to prepare for the implementation/conversion from APT to LRPT. WMO also noted that it was essential for the user community to have continuity between satellite systems broadcasting LRPT. The WG I discussed current planned launch schedules presented in Agenda Item B.1 and B.2 and noted that current schedules would project an overlap period of at least 4 years (2001 to 2005) of APT on NOAA and Russian satellites and LRPT systems on METOP. The PRC reminded the group that FY-1C would not have an APT broadcast function. From this discussion, the WG I noted that the best information available to the users today is the current planned launch and implementation schedules. The satellite operating members of WG I asked WMO to prepare a short publication that denotes the time table for continuance of APT and the implementation of LRPT. This should include information on China's and Russia's satellites. The WMO agreed with this recommendation and also encouraged all satellite operators to achieve agreement on a global LRPT format as a matter of urgency.

Proposed action I.8: *WMO to prepare a timetable of planned satellite launches indicating the proposed implementation of LRPT and its expected overlap with APT systems.*

Proposed action I.9: *CGMS Members to review the draft prepared by the WMO prior to distribution to WMO Members.*

Proposed action I.10: *NOAA to provide CGMS with the results of the analysis of the questionnaire and details of a global LRPT specification by the end of 1996.*

- **To resolve questions regarding the potential differences in LRIT band width and data rates.**

The WG I discussed the question raised by China which noted that data rates other than 64Kbps were presented in different working papers. EUMETSAT recalled for the working group that the data rates are effected by specifics in the satellite subsystems and transponders and that each operator would need to take full advantage of the band width available from their systems. There was discussion by all members on this issue with concerns expressed that such differences would not represent a truly global standard and would compromise the WEFAX replacement (LRIT) standard that CGMS had already agreed upon. The Group noted that Japan and EUMETSAT are finalizing their LRIT specifications and would distribute them to all CGMS Members in order that as much standardization over and above the global LRIT specification could be achieved.

Proposed action I.11: *EUMETSAT and Japan to provide CGMS with details of their LRIT formats as soon as possible.*

- **To discuss WMO concerns on the cost implications of a LRIT/LRPT "black box" for low resolution receiving stations.**

EUMETSAT had presented a design for a "black box" that would be integrated into receiving systems and provide an interface for the LRPT and LRIT formats. EUMETSAT noted that in order to minimize the cost of these black boxes, it would continue to fund the design and testing of this interface and make this design available to industry in order that development costs would not be duplicated during the various initial engineering design stages. The WMO expressed its appreciation to EUMETSAT for this initiative.

I/4 Electronic Bulletin Boards (EBB)

In EUM WP-19, the Group was informed about EUMETSAT plans for an external information system which will be installed by September 1996. The functionality of the systems was described in the paper. The Group noted with interest that a EUMETSAT Home Page was in preparation and which would be linked to those of the WMO and other operators. It was suggested that satellite operators should link their home pages to that of EUMETSAT thus allowing possibilities for enhanced intercommunication and electronic exchange of documentation between all parties in the future.

WG Members were made aware of the WMO List Servers in WMO WP-4 and were requested to regularly keep WMO informed of any changes to the lists and to bring to the attention of WMO any requirements for additional lists.

Details of the WMO Home Page were described in WMO-WP-05. Examples of some of the contents were presented and Members were, in particular, invited to take note of the current contents of the CGMS Home Page. Members of the WG were invited to suggest additional topics for the Page. WMO added that whilst it had very limited resources which could be used to create additional home pages on behalf of other Members, it was a relatively simple task to import prepared material.

Proposed action I.12: *CGMS Members to announce their individual implementation of Home Pages, to submit new information for the CGMS Home Page and provide Universal Resources Locator (URL) to allow links between the various Home Pages.*

The WG members recalled the reported successes at the recent WRC and SFCG in protecting many meteorological frequency bands. The WMO observed that many of the country representatives were not aware of the extent of the meteorological uses of these frequencies and the WMO was, therefore, coordinating the development of a WMO publication "Handbook of Frequencies used for Meteorological Applications" which would describe the various uses of the frequency bands now used for meteorological applications and satellite operations. The WG members acknowledged the benefits of this publications and recommended that all (or the significant highlights) of this publication be accessible via the CGMS Home Page.

Proposed action I.13: *WMO to consider inclusion of the "Handbook of Frequencies used for Meteorological Applications" in the CGMS Home Page.*

REPORT FROM WORKING GROUP II : SATELLITE PRODUCTS

II/0 Introduction

The Working Group on Satellite Products (WG II) was chaired by Dr Paul Menzel of NOAA and Dr Johannes Schmetz of EUMETSAT assisted as Rapporteur.

The WG II started with a review of the action items that arose from its previous meeting at CGMS XXIII. The requested report on progress on visible calibration campaigns was submitted by EUMETSAT. An update on the pilot SAFs was given in plenary. PRC provided an update on their ground calibration capabilities. The planning of periodic and on-going inter-calibration campaigns of all current leo and geo visible and infrared sensors continues with demonstration inter-calibrations of GOES and AVHRR/HIRS. The notification of operational TOVS processing changes has been facilitated with the CGMS home page. The CGMS response to the issues raised by the International TOVS Working Group (ITWG) has been drafted. The following paragraphs summarize the resolution of these action items and indicate areas of further work.

II/1 Image Processing Techniques

No papers were presented.

II/2 Satellite Data Calibration

Seven papers were presented on this subject, indicating the continued importance of radiometric calibration for quantitative application of the satellite data. As the CEOS Working Group on Calibration and Validation (Cal/Val) is coordinating and pursuing activities in the area of satellite calibration and inter-calibration, the WG II recommended that close communications between the two groups be continued.

Proposed action II.1: *CGMS continue to forward calibration papers to CEOS Cal/Val Working Group and seek report on recent CEOS activities.*

EUMETSAT presented four papers on calibration. EUM-WP-20 reported on the results of the airborne calibration campaign for the visible channels on Meteosat-5; absolute accuracy of the calibration is within 5%. EUM-WP-21 provided an update on the water vapor calibration achieved by radiative transfer calculations making use of radiosonde data in clear skies; tighter quality control of the radiosondes improved the stability of the vicarious calibration (absolute radiance values were lowered by 8%). EUM-WP-22 outlined a new approach of using synthetic radiances for inter-calibration of similar spectral measurements from different sensors; simulation results showed 1% accuracy. EUM-WP-23 described the sensitivity of the vicarious calibration of the infrared window channel on Meteosat with respect to water vapor absorption. The vicarious calibration is based on radiative transfer calculations, making use of short term forecasts of atmospheric temperature and humidity and sea surface temperatures, collocated with clear sky radiances. Cloud screening at night was shown to be causing problems; the new method introduced in this paper uses daytime observations only and eliminates the artificial day to night differences.

JAPAN-WP-16 reported that the inflight infrared calibration with internal blackbody is performing well, but that pre-launch estimates used to establish the fixed conversion tables (released October 1993) need adjustment; this will be done May 1996. The silicon detectors are proving to be very stable for the visible channels; corrections for destriping have been necessary only once to date

PRC-WP-05 described two calibration sites in the Peoples Republic of China; a stone (gobi) desert in Dun Huang has been characterized with ground measurements including spectral bi-directional reflectance functions and a large high altitude salt water lake called Qing Hai Lake is instrumented for surface temperature measurements. PRC plans to test calibration procedures with AVHRR data in preparation for FY-2 calibrations. WG II encouraged utilization of these sites for calibration of solar and thermal infrared channels of all appropriate leo and geo satellites.

USA-WP-15 presented comparison of GOES-7 (spinner) and GOES-9 (three axis stable) infrared calibrations; results within 0.5 C are maintained through the diurnal heating by 50 C of the GOES-9 telescope. An equally good comparison of GOES-9 with HIRS on NOAA-12 was also presented.

WG II expressed keen interest in developing an overall strategy for inter-calibration making use of recent progress reported here.

II/3 Vertical Sounding

RUS-WP-07 informed the WG II on the status of the operational software for TOVS data processing; applications toward assimilation of humidity and cloud liquid water are planned and impact studies of temperature and moisture retrievals in regional models will be pursued. Recent numerical experiments have shown the benefit of improved cloud screening.

USA-WP-12 presented five month evaluations of the temperature and moisture retrievals from the GOES-8 sounder with respect to radiosondes and model first guess. GOES temperature retrievals improved upon the guess by about 0.1 C in bias and RMS with respect to radiosondes over the data rich Continental United States; GOES-8 precipitable water vapor layer retrievals improved the guess by 0.5 to 1.0 mm in bias and 0.3 mm in RMS. It is expected that the impact over data sparse regions will be greater. Model impact studies of GOES-8/9 retrievals over the eastern Pacific Ocean and the Gulf of Mexico are planned for Summer 1996.

WG II discussed the issues raised by the International TOVS Working Group (ITWG) at CGMS XXIII in considerable detail. An initial response was drafted in USA-WP-14; a complete response will be coordinated by 31 July 1996 and forwarded to the rapporteur for ITWG. Some responses to the ITWG concerns are attached in section II/8. CGMS will be responding to the ITWG through its rapporteur at their next conference (scheduled for February 1997 in Igls, Austria). The value of this direct dialogue with the international community of sounding experts is appreciated by CGMS.

It was also indicated by the Russian delegation that there is the potential for an opportunity to launch a geostationary sounder on GOMS N°3. WG II expressed interest in the possibility of evolving the global geostationary sounding capability toward higher spectral resolution instruments and encouraged further scientific dialogue.

II/4 Other Parameter Extraction

RUS-WP-08 presented the possibility for the retrieval of sea surface temperatures and cloud heights from GOMS infrared data. Operational procedures are being developed. A need for infrared calibration has been identified; an inter-calibration campaign with HIRS is being discussed.

JAPAN-WP-17 reported on GMS-5 SST estimates and compares them with buoys; the mean difference (SST minus buoy) is found to be -0.4 C indicating the excellent performance of the on-board calibration. WG II congratulated the JMA on their good work.

II/5 New Products and their use in Numerical Weather Prediction

EUM-WP-24 showed that the upper atmospheric circulation determines the upper tropospheric humidity and cloud field. This has been demonstrated by relating monthly mean fields of UTH and divergence derived from water vapor winds. Usefulness of these data in climate research was noted.

JAPAN-WP-18 and -19 reported on the new UTH and precipitable water vapor amount (PWA) products derived from GMS-5. GMS-5 UTH shows comparable performance with those derived from Meteosat and GOES. JMA plans to improve the split window retrieval of PWA with tighter screening of clouds.

II/6 Coordination of Code Forms for Satellite Data

WMO-WP-16 described a problem in the identification of satellite and processing centers when transmitting satellite data with standard WMO codes. It proposed modifications to the WMO formats to ensure correct identification of both satellite and processing center. It was noted that EUMETSAT is not listed in Common Code Table C1 identifying the originating/generating center.

Proposed action II.2: *CGMS members to forward comments to WMO on this document, by 31 July 1996.*

II/7 Coordination of Data Formats for the Archive and Retrieval of Satellite Data

RUS-WP-09 presented the current version of the format for digital meteorological satellite image archiving and distribution. WG II felt that comment from a broader audience was necessary.

Proposed action II.3: *CGMS Secretariat to submit the paper RUS-WP-09 to the CBS WG on Data Management for comment.*

WG II noted that Mr Xu Jianmin, in his capacity as rapporteur on archiving to the CBS Working Group on Satellites, is seeking up to date information on archiving from satellite operators for WMO Report SAT-14.

Proposed action II.4: *CGMS members to provide Mr Xu Jianmin with current information on their archiving by 30 June 1996.*

II/8 Responses to ITWG

With regard the NOAA notification of TOVS operational processing changes, it is noted that the CGMS home page and the ITWG list server have facilitated communication; in addition NESDIS is maintaining existing notification procedures.

Access to the level 1b TOVS data for climate studies remains an important issue. There are no new avenues to access the retrospective data bases on the immediate horizon. At NOAA, the National Climate Data Center (NCDC) continues striving for improved access to past data and NESDIS is introducing the NOAA Satellite Active Archive for easier access to future data.

Cal/Val efforts continue to receive high priority with CGMS as noted by the increasing number of papers on this subject. NOAA is formulating a plan for cal/val of NOAA-K; ITWG can be briefed on this activity at their next meeting.

The opportunity to re-introduce the 8.2 μm channel on HIRS has apparently passed; all instruments are already in construction. The importance of this channel for future sensors has been noted.

To enhance successful assimilation of satellite sounding data (whether radiances or retrievals), WG II strongly supports enhanced collaboration between NWP centres and product generation centres. This remains a high priority activity in their estimation.

International distribution of global ATOVS data and products through GTS at resolutions consistent with the WMO requirements is receiving considerable attention. NESDIS is investigating possible avenues for distribution of these products. Plans include (a) distribution of retrievals in SATEM code on the GTS at 500 km resolution, and (b) distribution to global NWP centres in Europe of full resolution (60 km) retrievals and clear radiances in BUFR code. NESDIS has expressed a willingness to investigate distribution of products at an intermediate resolution where existing telecommunications capacity does not enable distribution of full resolution products. WG II encouraged NESDIS to pursue these investigations in collaboration with the user community.

More generally it was recognized that distribution of increasing volumes of satellite products will require considerably increased telecommunications capacity. Long term approaches and CGMS guidance will be necessary.

With regard to advances in infrared sounders, WG II applauds the progress made on the IASI, AIRS, and ITS instruments and notes the international contributions to each development program. The economic and scientific benefits of moving toward common instruments were also noted. It is understood that the WMO requirements for data quality are uniformly being pursued by the satellite operators as much as possible.

Finally, the key role of Direct Broadcast of sounder and imager data on the polar orbiting environmental remote sensing systems is recognized by the WG II. Therefore, it strongly supports continuation of this policy by the satellite operators.

REPORT FROM WORKING GROUP III: CLOUD MOTION WINDS

III/0 Introduction

The working group on Cloud Motion Winds was chaired by Dr. John R. Eyre, representing WMO. Dr. Robert Husband of EUMETSAT was the Rapporteur. The working group started by reviewing the status of actions arising from CGMS XXIII.

Action 23 WG IV.1: CGMS members to develop a new standardised reporting method on winds quality, in co-ordination with the International Workshop on Winds, and propose a new method at CGMS XXIV. Co-ordination via Electronic Bulletin Board is requested by WMO.

Status: Ongoing - the proposed standardised reporting method is presented in the paper USA-WP-13. Consideration of the proposal will take place at the third meeting of the International Workshop on Winds, in June 1996.

Action 23 WG IV.2: EUMETSAT will provide over the Electronic Bulletin Board an electronic copy of the wind statistics section of the CGMS consolidated report.

Status: Closed - an electronic copy has been provided. This may, nevertheless, require an update regarding the new reporting format.

Action 23 WG IV.3: CGMS wind operators to explore the establishment of guidelines for quality marking and report on their progress at CGMS XXIV. CGMS wind operators to propose a special session on this topic at the next International Workshop on Winds.

Status: Ongoing - this issue will be addressed in more detail at the third meeting of the International Workshop on Winds.

Following the review of actions, the working group received a report from the new rapporteur of the International Workshop on Winds to the CGMS, Dr. Johannes Schmetz, concerning the current status of activities. The progress since the last meeting of CGMS was highlighted and included:

- work on new reporting methods for comparisons between cloud motion winds and radiosonde data;
- new operational wind products produced from GMS-5, GOES-8 & -9;
- transfer of operations from ESA to EUMETSAT and the first use of quality marks for CMW extraction;
- experimental production of high resolution visible winds by ESOC/MIEC and their positive contribution to forecast accuracy.

It was noted that the next International Workshop on Winds will be held from 10 - 12 June 1996 at Ascona in Switzerland.

The working group also considered and refined a list of issues for consideration at the third meeting of the International Workshop on Winds. This list is attached as Annex I of this report.

The working group recommended that the fourth meeting of the International Workshop on Winds should be held in the Autumn of 1997. WMO expressed a strong willingness to host this meeting. The working group welcomed this offer and, noting the suitability of the venue for the current meeting of CGMS at Lauenen, felt sure that a similar appropriate location would be proposed which would be conducive to detailed discussion, uninterrupted by external pressures, whilst also providing opportunities for informal interactions during the non-traditional working hours.

III/1 Winds Verification Statistics

EUM WP-25 provided a comparison of MPEF and MIEC statistics for November 1995, and initial MPEF statistics for December 1995 and January 1996. After some problems in November, it was noted that water vapour winds had improved significantly during December, leading to a performance that was better than had previously been experienced with the MIEC system at ESOC. Infra-red high and low level cloud motion winds for December 1995 were close to MIEC performance, and high level winds in January 1996 exceeded the quality previously experienced from the MIEC system.

JAPAN WP-20 reported on the current status of the GMS-5 cloud motion wind activities and described the results of the new height assignment method using cloud top height involving semi-transparent cirrus correction.

During the discussion a need was identified for comparing the various methods for the derivation of wind speeds from pixel displacements.

Proposed action III.1: *CGMS wind operators to exchange details of the algorithm(s) used for the derivation of wind speed from pixel displacements.*

USA WP-13 provided information in two main areas: the recent developments in the US system and a proposed format for the presentation of statistics. Concerning the recent developments, significant progress was reported in the increased coverage of the CMW product and the automation of the quality control activity. Operational production of winds from both GOES-8 and -9 was started in early 1996.

In sections III and IV of the paper, an example of the proposed new reporting scheme for CMW verification statistics was presented for further consideration by the third meeting of the International Workshop on Winds.

In the discussion on the use of radiosonde data it was noted that there was a need for further detail on the vertical treatment of such data.

Proposed action III.2: *CGMS wind operators to provide details of the vertical treatment of radiosonde data at the third meeting of the International Workshop on Winds, in June 1996.*

III/2 Procedures for the Exchange of Inter-comparison Data

The formats to be used for inter-comparison data were discussed. This topic was covered within the framework of the discussions on paper USA WP-13. The procedures to be used will be further discussed at the next meeting of the International Workshop on Winds.

III/3 Derivation of Wind Vectors

EUM WP-26 described the differences between the MPEF and the predecessor MIEC system. Notable differences were identified in the areas of quality control, and the increased flexibility made possible by the more modern MPEF architecture.

EUM WP-27 described how low level wind fields over the Atlantic were derived from clouds in the Meteosat high resolution visible images. These winds were produced experimentally over a period of more than a year. The impact of these experimental winds was tested with a data assimilation experiment at ECMWF, and positive improvements were found.

JAPAN WP-21 described the approach used for the derivation of Water Vapour Motion winds from GMS-5 data. A comparison with radiosonde data was also provided.

PRC WP-06 presented a method for the calculation of Cloud Motion Wind Vectors utilising GMS-5 data. A significant feature of the approach was the minimisation of the computational requirements, and its consequent compatibility with a PC-based implementation.

RUS WP-10 described the current state of development of the GOMS IR data processing scheme for wind velocity and direction detemination. A quasi-operational IR wind extraction system is planned to be implemented by the end of 1996.

ANNEX I:

Inputs to the 3rd Meeting of the International Workshop on Winds

The CGMS Working Group on Cloud Motion Winds recommends that the third meeting of the International Workshop on Winds considers:

1) Requesting wind operators to assess the appropriate use of wind forecast data in the production of winds;

2) Developing methods to assign "quality flags" to individual winds;

3) Requesting wind operators to improve coverage of the wind product whilst preserving an acceptable quality of the product;

4) Exploring applications of wind products in addition to those of NWP centres;

5) Investigating, and proposing, the generation of wind products with improved temporal and spatial resolution;

6) Proposing an appropriate reporting format for the comparison of Cloud Motion Winds with radiosonde data;

7) Investigating, and proposing, a common approach to the establishment and regular maintenance of a directory of accurate sources of radiosonde data;

8) Investigating whether a consensus can be developed between NWP centres concerning the pre-processing and quality control of winds that is recommended to take place at wind producing centres;

9) Compiling a report on the accuracies assigned to winds during the assimilation process at all NWP centres;

10) Encouraging NWP centres to investigate improved techniques for the assimilation of wind information and, in particular, clear air WV winds;

11) Encouraging climatological studies which utilise satellite winds and UTH;

12) Preparing recommendations concerning the re-processing of satellite winds for use in future re-analysis projects;

13) Producing a summary of the product development plans of all wind operators;

14) The scope of future International Workshops on Winds (whether to increase consideration of scatterometer data; whether to include consideration of passive microwave surface wind data, wind lidar data, etc).

FINAL PLENARY SESSION: SENIOR OFFICIALS MEETING

J.1 APPOINTMENT OF CHAIRMAN

The CGMS XXIV Senior Officials meeting was convened at 9 a.m. on 26 April 1996, with Dr Donald Hinsman elected as Chairman.

J.2 REPORTS FROM THE WORKING GROUPS

The reports from the three Working Groups were presented by their Chairmen: Mr. R. Wolf (WG I on Telecommunications), Dr P. Menzel (WG II on Satellite Products), and Dr J.R. Eyre (WG III on Satellite-tracked Winds).

The Senior Officials took note of the reports and thanked the participants and Chairmen for their active and fruitful discussions. They endorsed the proposed actions and recommendations formulated with minor modifications.

In particular, CGMS thanked the **Working Group I on Telecommunications** for its comprehensive review of many outstanding issues and was pleased to note the good progress being made with regard to the protection of frequencies used by the MetSS and the ongoing studies on possibilities for sharing with MSS. CGMS noted that the protection of frequencies used by passive sensors had received considerable attention over the last twelve months. Furthermore, preparations for WRC 97 were well in hand where several topics relating to MetSS would be discussed. CGMS were particularly pleased to note the Russian activities to try and remove interference in the 401-403 MHz band.

CGMS also noted that several matters raised during the Plenary session had been discussed by the Working Group, in particular the use of GPS or other GNSS receivers within DCPs, the provision of LRIT format information to the user community and measures being taken to reduce the cost of LRIT/LRPT user stations. Further steps have been taken towards a global standardization of the LRPT format.

Finally, CGMS appreciated the progress made by the WMO and CGMS Members to develop the use of electronic information exchange systems, in particular the development of CGMS Home Page and list servers.

The Senior Officials thanked the **Working Group II on Satellite Products** for its report and noted that all the items raised by CGMS XXIII in that area had been addressed. The requested report on the progress of visible calibration campaigns was submitted by EUMETSAT. An update on the development of pilot SAF was already given in plenary. PRC provided an update on their two ground calibration sites. The planning of periodic and on-going inter-calibration campaigns of all LEO and GEO visible and infrared sensors continues, with demonstrations of inter-calibration of GOES and AVHRR/HIRS. The notification of operational TOVS processing changes has been facilitated with the CGMS home page.

Various issues raised by ITWG were also addressed by the Working Group and brought to the attention of the Senior Officials :

- Confirming the importance of radiometric calibration for quantitative application of satellite data, the Senior Officials recommended to maintain links with the CEOS CAL/VAL Working Group and wished that cross-calibration activities be further developed. They agreed that an overall strategy be defined for inter-calibration, taking advantage of the recent progress.

- With respect to sounding data, the suggestion was endorsed to further consider the concept of higher spectral resolution instruments for global geostationary sounding. It was furthermore recognized that distribution of increasing volumes of satellite products, for example the imminent distribution of ATOVS products, will require increased telecommunications capacity and that a long term strategy should be established. In recognizing the need for elaboration on a long term strategy, the Senior Officials requested WMO and the CGMS WG on Telecommunications to study further this area and report to CGMS XXV. The importance of Direct Broadcast was reaffirmed. The Senior Officials also acknowledged the value of the dialogue with international community of experts gathered in ITWG and agreed that CGMS, as a Permanent Action, shall review the issues raised by ITWG and respond through its Rapporteur.

- CGMS, noting the very successful results emerging from ITWG activities, in particular the development and consequent use of the TOVS package by the World Meteorological community and the work in progress with the development of a similar ATOVS package, felt it appropriate to apply this example in a more general way to all new instruments planned on operational meteorological satellites. CGMS therefore urged all satellite operators to consider the implementation of this strategy within their relevant satellite programmes.

The Senior Officials agreed to review the proposed modification of WMO codes for satellite data transmission over the GTS, and tasked the Secretariat to submit the Digital Imagery Data Uniform Format defined by Russia to the CBS WG on Data Management.

The Senior Officials noted with appreciation the progress of activities reported by the **Working Group III on Cloud Motion Winds**. It was agreed that CGMS wind operators should inform each other of the algorithms used for the derivation of wind speed from pixel displacement and for the vertical treatment of radiosondes. The Senior Officials endorsed the list of items proposed for consideration by the third Meeting of the International Winds Workshop, in June 1996. The Senior Officials furthermore considered that there was a need to address the new wind measurement techniques expected to be used operationally in the short-term, such as the scatterometer. Working Group III was tasked to identify and propose a forum suitable to address these issues.

The Senior Officials congratulated the three Working Groups for their comprehensive reports and for their achievements since the preceding CGMS.

J.3 NOMINATION OF REPRESENTATIVES AT WMO AND OTHER MEETINGS

The Senior Officials agreed that :

- Dr P. Menzel	will represent CGMS at the next meeting of the ITWG,
- Dr T. Mohr	will represent CGMS at the WMO EC in May 1996,
- Mr W.J. Hussey	will represent CGMS at the WMO CBS/WG-Sat,
- Dr J. Schmetz	will be Rapporteur at the Winds Workshop,
- Mr R. Wolf	will represent CGMS at the SFCG and WRC,
- The Secretariat	will represent CGMS at CEOS plenary.

Furthermore, the points of contacts of CGMS Members for the plenary, for frequency matters, for winds and for the Home Page were reviewed. The updated lists are given in the annexes.

J.4 ANY OTHER BUSINESS

In the light of the discussions of the preceding days, CGMS was pleased to record that significant progress was ongoing towards a globally co-ordinated meteorological satellite system in terms of global coverage, contingency planning and standardization of formats. It was also pointed out that CGMS was providing a unique and highly valuable framework for exchanging expertise and working out harmonized approaches in matters as essential as telecommunications, cross calibration and product processing.

WMO also thanked CGMS Operators for the strong and determined involvement shown in user support activities, including user training and support to user system development.

All participants thanked WMO for hosting this meeting and providing the excellent arrangements which facilitated fruitful discussions.

J.5 APPROVAL OF DRAFT FINAL REPORT

The plenary session, with all Senior Officials present, reviewed the draft Final Report of the meeting. Noting a few modifications and the new actions resulting from the Working Groups, the Senior Officials approved the report. The Secretariat agreed to include all the amendments into a revised version which would be distributed to CGMS Members for final comment prior to publication.

J.6 SUMMARY LIST OF ACTIONS

The Senior Officials reviewed, and agreed upon, the following list of actions.

(i) Permanent actions

1. The Secretariat to review the tables of current and planned polar and geostationary satellites, and to distribute this updated information, via the WWW Operational Newsletter, via Electronic Bulletin Board, or other means as appropriate.

2. All satellite operators to circulate regular satellite operational reports.

3. All satellite operators to provide NOAA/NESDIS with information on unexplained anomalies for study, and NOAA to provide solar event information to the satellite operators on request and a status report on the correlation study at each meeting.

4. USA to issue quarterly to all other admitting authorities the consolidated DCP assignments.

5. All satellite operators to regularly provide WMO with information on the number of Met satellite reception stations in their areas of responsibility.

6. All CGMS Members to inform users to register, with the ITU, user stations and main ground stations within their area of responsibility.

7. CGMS members generating CMW to check that the following monthly statistics are sent and received on a quarterly basis: number of co-locations, temporal and spatial co-location thresholds, and radiosonde inclusion/exclusion criteria.

8. All CGMS Members to place high priority on interacting with their national frequency regulators to keep them informed of their frequency needs.

9. CGMS to address at its subsequent meetings the issues raised in the ITWG Reports, and respond through the CGMS representative with ITWG.

(ii) Outstanding actions from previous meetings

ACTION 21.17 All CGMS Members are requested to indicate planned introduction dates of LRIT by CGMS XXV.

ACTION 23-04 CGMS Members to review and comment on the GCOS Space Plan version 1.0, with respect to achievability and proposed priority of implementation into their own plans, by CGMS XXV.

ACTION 23-13 The USA to provide CGMS Members with information on the number of APT reception stations world-wide, by 1 August 1996.

ACTION 23-15 The WMO to address any resulting problems relating to the onward relay of DCP messages via the GTS and report to CGMS XXV.

ACTION 23-29 CGMS winds operators to explore the establishment of standard guidelines for quality marking and report on their progress at CGMS XXV.

(iii) Actions from CGMS-XXIV

ACTION 24.01 CGMS Secretariat to develop a document summarizing the instruments on CGMS Members' missions and to submit the sketch of such a document for review by CGMS XXV.

ACTION 24.02	WMO to provide CGMS Members with a preliminary report on the critical review from the CBS Working Group on Satellites by 1 November 1996.
ACTION 24.03	CGMS Members to comment on the preliminary report on the critical review from the CBS Working Group on Satellites prior to CGMS XXV.
ACTION 24.04	EUMETSAT to report at CGMS XXV about its experience on detection and localisation of interference sources in the 401-403 MHz band.
ACTION 24.05	USA to provide EUMETSAT with information on the certification procedure for DCP using the GOES DCS, by 1 August 1996.
ACTION 24-06	The Russian Federation to provide CGMS Members with details of IDCP channel frequencies on GOMS, by 1 September 1996.
ACTION 24.07	EUMETSAT to provide CGMS Members with the results of recent studies on the performance of lossless and lossy compression techniques, by 1 August 1996.
ACTION 24.08	CGMS Members to indicate by 1 October 1996 to WMO whether the interim requirement for the exchange of digital image data as expressed, once approved by CBS, would be sufficient for formal consideration and response.
ACTION 24.09	CGMS Members to inform the Secretariat about ground stations operating in the frequency band 1670 - 1690 MHz, by 1 September 1996.
ACTION 24.10	The Russian Federation to report at CGMS XXV on its efforts to remove interference affecting the 401-403 MHz frequency band used for DCP.
ACTION 24.11	NOAA to provide to all CGMS members its design specifications and certification procedures for 300 bps DCP, by 1 September 1996.
ACTION 24.12	CGMS members to review and provide comments to NOAA regarding NOAA's 300 bps DCP design and certification procedures, by 1 February 1997.
ACTION 24.13	NOAA to present at CGMS XXV, a proposed design and certification plan for 300 bps DCPs for acceptance as a "standard" by CGMS members at CGMS XXV.
ACTION 24.14	CGMS Members to recommend to DCP manufacturers the inclusion of GPS or other GNSS clock modules in future design of DCP, by CGMS XXV.

ACTION 24.15	CGMS Members to encourage the use of GPS and other GNSS clock controlled DCP for future DCS applications, by CGMS XXV.
ACTION 24.16	WMO to prepare a timetable of planned satellite launches indicating the proposed implementation of LRPT and its expected overlap with APT systems, by 1 August 1996.
ACTION 24.17	CGMS Members to review by 1 September 1996, prior to distribution to WMO Members, the draft timetable prepared by the WMO indicating the proposed implementation of LRPT.
ACTION 24.18	NOAA to provide CGMS with the results of the analysis of the questionnaire and details of a global LRPT specification, by 1 September 1996.
ACTION 24.19	EUMETSAT and Japan to provide CGMS with details of their LRIT formats as appropriate during 1996 and 1997.
ACTION 24.20	CGMS Members to announce their individual implementation of Home Pages, submit new information for the CGMS Home Page and provide Universal Resources Locator (URL) to allow links between the various Home Pages, by 1 July 1996.
ACTION 24.21	WMO to consider inclusion of the "Handbook of Frequencies used for Meteorological Applications" in the CGMS Home Page and report at CGMS XXV.
ACTION 24.22	CGMS Secretariat to continue to forward calibration-related papers to CEOS Cal/Val Working Group and seek report on recent CEOS activities, by CGMS XXV.
ACTION 24.23	CGMS points of contact on calibration, Dr Menzel, Dr Schmetz and Dr Harada, to prepare a draft strategy for inter-calibration and report to CGMS XXV.
ACTION 24.24	CGMS Members to report at CGMS XXV on their plans to implement data processing packages supporting future instrumentation on the model of the ATOVS software package.
ACTION 24.25	CGMS members to forward comments to WMO, by 31 July 1996, on the proposed modification of WMO codes regarding identification of satellites and processing centres.
ACTION 24.26	CGMS secretariat to submit to the CBS WG on Data Management for comment, the digital imagery Data Uniform Format (DUF) for image archiving and distribution developed by RPA "Planeta" as described in CGMS XXIV RUS-WP-09, by 1 June 1996.
ACTION 24.27	CGMS members to provide Dr Xu Jianmin, PRC, with current

	information on their archiving systems by 30 June 1996.
ACTION 24.28	WMO, through the Chairman of CBS Working Group on Satellites, to contact by 1 June 1996 the Chairpersons of CBS Working Groups on Telecommunications and on Data Management concerning the distribution of satellite data and products, to review the progress of these Working Groups on evolving an appropriate strategy and to inform CGMS XXV.
ACTION 24.29	The CGMS Working Group on Telecommunications to prepare a satellite-based strategy for distribution of satellite products, with input from ITWG and WMO CBS WG Sat, for presentation at CGMS XXV.
ACTION 24.30	CGMS wind operators to exchange details of the algorithms used for the derivation of wind speed from pixel displacement, by 1 June 1996.
ACTION 24.31	CGMS wind operators to provide details of the algorithms used for the vertical treatment of radiosondes at the third meeting of the International Workshop on Winds, in June 1996.
ACTION 24.32	CGMS Members, through their relevant points of contacts, to submit to EUMETSAT their input to the CGMS Directory of Meteorological Satellite Applications, by 1 November 1996.
ACTION 24.33	EUMETSAT to proceed with the preparation of a first edition of the CGMS Directory of Meteorological Satellite Applications and report to CGMS XXV.

J.7 DATE AND PLACE OF NEXT MEETINGS

CGMS was very pleased to accept the offer by the Russian Federation to host CGMS XXV in May 1997, in a location to be announced shortly.

CGMS was also very pleased to note a preliminary proposal from Japan to host CGMS XXVI, and strongly encouraged Japan to consider it further.

AGENDA OF CGMS XXIV
Lauenen, Switzerland, 22-26 April 1996

A. PRELIMINARIES

A.1 Introduction
A.2 Election of Chairman
A.3 Adoption of agenda and work plan of Working Group Sessions
A.4 Arrangements for the Drafting Committee
A.5 Review of Action Items

B. REPORT ON THE STATUS OF CURRENT SATELLITE SYSTEMS

B.1 Polar Orbiting Meteorological Satellite Systems
B.2 Geostationary Meteorological Satellite Systems

C. REPORT ON FUTURE SATELLITE SYSTEMS

C.1 Future Polar Orbiting Meteorological Satellite Systems
C.2 Future Geostationary Meteorological Satellite Systems

D. OPERATIONAL CONTINUITY AND RELIABILITY

D.1 Global planning, including orbital positions
D.2 Inter-regional contingency measures
D.3 Long-term global contingency planning

E. METEOROLOGICAL SATELLITES AS PART OF WMO PROGRAMMES

E.1 World Weather Watch
E.2 Other Programs

F. COORDINATION OF INTERNATIONAL DATA COLLECTION & DISTRIBUTION

F.1 Status and Problems of IDCS
F.2 Ships, including ASAP
F.3 ASDAR
F.4 Dissemination of DCP messages (GTS or other means)

G. COORDINATION OF DATA DISSEMINATION

G.1 Dissemination of images via Satellite
G.2 Dissemination of products via GTS or other means
G.3 Global exchange of satellite image data via satellite or via the GTS

H. OTHER ITEMS OF INTEREST

H.1 Applications of Meteorological Satellite Data for Environment Monitoring
H.2 Search and Rescue (S&R)
H.3 Anomalies from Solar and Other Events
H.4 Information and Training
H.5 Any other business

--------- PARALLEL WORKING GROUP SESSIONS -----------

WORKING GROUP I : TELECOMMUNICATIONS

I/1 Outcome of WRC and SFCG
I/2 Coordination of Frequency Allocations
I/3 Telecommunication techniques
I/4 Electronic Bulletin Boards (EBB)
I/5 Preparation of WG Report

WORKING GROUP II : SATELLITE PRODUCTS

II/1 Image processing techniques
II/2 Satellite Data Calibration
II/3 Vertical sounding
II/4 Other Parameter Extraction
II/5 New Products & their use in Numerical Weather Prediction
II/6 Coordination of Code forms for satellite Data
II/7 Coordination of Data Formats for the Archive and Retrieval of Satellite Data
II/8 Preparation of WG Report

WORKING GROUP III : CLOUD MOTION WINDS

III/1 Wind verification statistics
III/2 Procedures for the exchange of inter-comparison data
III/3 Derivation of Wind vectors
III/4 Preparation of WG report

------ FINAL SESSION: SENIOR OFFICIALS MEETING ------

J.1 Appointment of Chairman of final session
J.2 Reports from the Working Groups
J.3 Nomination of CGMS Representatives at WMO and other meetings
J.4 Any Other Business
J.5 Summary List of Actions from CGMS XXIV
J.6 Approval of Draft Final Report
J.7 Date and Place of Next Meetings

WORKING PAPERS SUBMITTED TO CGMS-XXIV

EUMETSAT

EUM-WP-01	Review of Action Items	A.5
EUM-WP-02	Status of the Meteosat System	B.2
EUM-WP-03	Status of Preparation of the EUMETSAT Polar System	C.1
EUM-WP-04	Status of Preparation of MSG	C.2
EUM-WP-05	Development of Pilot Satellite Applications Facilities (SAF)	C.2
EUM-WP-07	Reorganisation of IDCS Admitting Authority Coding to Include the Operation of IDCP by the PRC	F.1
EUM-WP-08	Status of the IDCS	F.1
EUM-WP-09	EUMETSAT DCP Certification Facility	F.4
EUM-WP-10	Planned MSG Mission Specific Implementation of LRIT/HRIT	G.1
EUM-WP-11	LRPT/HRPT Implementation Plan on the EUMETSAT Polar System	G.1
EUM-WP-12	EUMETSAT Contribution to the Global Exchange of Satellite Data	G.3
EUM-WP-13	Planning of a Search and Rescue Mission Aboard MSG	H.2
EUM-WP-14	EUMETSAT Training Activities	H.4
EUM-WP-15	The CGMS Directory of Meteorological Satellite Applications	H.4
EUM-WP-16	EUMETSAT User Fora in Developing Countries	H.4
EUM-WP-17	Report from the World Radio Conference 95 and the 15th Meeting of the Space Frequency Coordination Group	I.1
EUM-WP-18	Planned Usage of MSG DCP Transponder - Thoughts on Future Regional/International High-Rate DCPs	I.3
EUM-WP-19	EUMETSAT External Information System	I.4
EUM-WP-20	Visible Channel Calibration of Meteosat-5	II.2
EUM-WP-21	The Calibration of the Meteosat Water Vapour Channel	II.2
EUM-WP-22	Synthetic Radiances for Satellite Sensors with Applications to Satellite Cross-Calibration	II.2
EUM-WP-23	Analysis of the Vicarious Operational Calibration of the Meteosat Infrared-Window Channel	II.2
EUM-WP-24	Satellite Observation of Upper Tropospheric Humidity, Clouds and Wind Field Divergence	II.5
EUM-WP-25	Wind Verification Statistics	III.1
EUM-WP-26	The Operational Cloud Motion Winds from the Meteorological Products Extraction Facility in the MTP Ground Segment	III.3
EUM-WP-27	Low-Level Cloud Motion Winds from Meteosat High-Resolution Visible Imagery	III.3

JAPAN

JAPAN-WP-01	Review of Action Items from Previous CGMS Meetings	A.5
JAPAN-WP-02	Status of Geostationary Meteorological Satellite-5 (GMS-5)	B.2
JAPAN-WP-03	Operation of Infrared Calibration Shutter on Board GMS-5	B.2
JAPAN-WP-04	Report on Status of Satellite Systems: Present Status of the Geostationary Meterological Satellites	B.2
JAPAN-WP-05	Future Geostationary Meteorological Satellite Systems	C.2

JAPAN-WP-06	Status and problems of IDCS	F.1
JAPAN-WP-07	Interference monitoring of IDCS channels	F.1
JAPAN-WP-08	Status of ship IDCPs including ASAP	F.2
JAPAN-WP-09	Status of ASDAR	F.3
JAPAN-WP-10	Dissemination of DCP Messages	F.4
JAPAN-WP-11	Policy on the utilisation of the GMS cloud images	G.1
JAPAN-WP-12	Dissemination of meteorological data by LRIT	G.1
JAPAN-WP-13	Detection of Volcanic Ash Clouds by GMS-5	H.1
JAPAN-WP-14	Developing of CAL System in MSC	H.4
JAPAN-WP-15	Information and training Plan of the Asia-Pacific Satellite Applications Training Seminar (APSATS)	H.4
JAPAN-WP-16	GMS-5 Calibration Status	II.2
JAPAN-WP-17	Sea Surface Temperatures	II.4
JAPAN-WP-18	Upper Tropospheric Air Humidity	II.5
JAPAN-WP-19	Precipitation Water Amount	II.6
JAPAN-WP-20	Current Status of the GMS Cloud Motion Wind	III.1
JAPAN-WP-21	Derivation of Water Vapour Motion Winds	III.3
JAPAN-WP-22	GMS-5 GEOSAR Experiment in Japan	H.2

PEOPLE'S REPUBLIC OF CHINA

PRC-WP-01	The Status of FY-1 Program	C.1
PRC-WP-02	The Status of FY-2 Program	C.2
PRC-WP-03	The Application of AVHRR Data in Vegetation Monitoring	H.1
PRC-WP-04	The Possibilities for Using Spread Spectrum Techniques and Higher Bit Rate for Future DCS	I.3
PRC-WP-05	The Characteristics of Chinese Remote Sensing Radiometric Calibration Sites	II.2
PRC-WP-06	Calculation of Cloud Motion Wind with GMS-5 Images in China	III.3

RUSSIAN FEDERATION

RUS-WP-01	Current Polar Orbiting Meteorological Satellite Systems (Meteor)	B.1
RUS-WP-02	Geostationary Operational Meteorological Satellite GOMS/ELECTRO	B.2
RUS-WP-03	Report on the Status of Future Polar Orbiting Meteorological Satellite Systems	C.1
RUS-WP-04	Geostationary Operational Meteorological Satellite GOMS N2	C.2
RUS-WP-05	Search and Rescue (GOMS)	H.2
RUS-WP-06	Satellite Network	I.1
RUS-WP-07	TOVS data processing and enhancement of the operational software efficiency	II.3
RUS-WP-08	The Current Stage of Development of GOMS IR Data Processing Scheme for Sea-surface Temperature and Cloud Cover Parameters Retrieval	II.4
RUS-WP-09	Digital Imagery Data Uniform Format (DUF)	II.7
RUS-WP-10	The Current Stage of Development of GOMS IR Data Processing Scheme for Wind Velocity and Direction Determination	III.3

USA

USA-WP-01	Polar Orbiting Meteorological Satellite Systems	B.1
USA-WP-02	Report on the Status of Current NOAA Geostationary Meteorological Satellites	B.2

USA-WP-03	Future Polar Orbiting Meteorological Satellite Systems	C.1
USA-WP-04	Polar Satellite Convergence Status	C.1
USA-WP-05	Report on the Status of Future NOAA Geostationary Meteorological Satellites	C.2
USA-WP-06	Status and Problems of IDCS	F.1
USA-WP-07	Dissemination of DCP Messages (GTS or other means)	F.4
USA-WP-08	Further Development of Low-Earth Orbit and Geostationary Earth Orbit Satellite Systems for Search and Rescue	H.2
USA-WP-09	Summary of the 1995 Space Frequency Coordination Meeting	I.1
USA-WP-10	The 1995 World Radiocommunications Conference (WRC-95)	I.1
USA-WP-11	Coordination of Frequency Allocations	I.2
USA-WP-12	GOES-8 Temperature and Moisture Soundings	II.3
USA-WP-13	GOES-8 Winds Performance	III.1
USA-WP-14	CGMS Responses to ITWG	J.3
USA-WP-15	Comparison of the Spin-Scan and Three-Axis-Stable Geostationary Satellite Infrared Calibration	II.2

WMO

WMO-WP-01	WMO Databases	H.5
WMO-WP-02	Review of Action Items from Previous CGMS Meetings	A.5
WMO-WP-03	APT and WEFAX Conversions	E.1
WMO-WP-04	List-Servers	I.4
WMO-WP-05	CGMS Home Page	I.4
WMO-WP-06	Radio Frequency Allocation	I.1
WMO-WP-07	Co-ordination with ITU-Radiocommunication Sector Activities	I.2
WMO-WP-08	Outcome of the World Radiocommunication Conference 95	I.1
WMO-WP-09	WRC 97 and 99 and Relevant Conference Preparatory Meetings	I.2
WMO-WP-10	Report, WMO and CEOS Affiliates' Satellite Data Requirements and Databases	E.1
WMO-WP-11	WMO Strategy for Education and Training	H.4
WMO-WP-12	List of WMO Experts in Satellite Applications and List of Satellite Books/Material for a RMTC	H.4
WMO-WP-13	Report, Training Event in Costa Rica	H.4
WMO-WP-14	Low Cost Low Resolution Satellite Receiving Project	E.1
WMO-WP-15	Review of Satellite Related WMO Publications	H.5
WMO-WP-16	Modification to WMO Formats for the Identification of Satellite and Processing Centre for the Transmission of Satellite Data	II.6
WMO-WP-17	Digital Satellite Image Data and Extracted Product Exchange over the GTS	G.3
WMO-WP-18	Registration of Satellite and Receiving Stations with ITU	H.5
WMO-WP-19	ASAP	F.2
WMO-WP-20	ASDAR	F.3
WMO-WP-21	Report on GCOS Activities	E.1

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Annex 4

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Annex 5

CGMS MEMBERS' SATELLITES IN GEOSTATIONARY ORBIT

Status as of May 1996

Operator	Satellite	Launched	Location	Status
EUMETSAT	**Meteosat 5**	**03/1991**	**0°**	**Operational**
	Meteosat 6	11/1993	0°	Stand-by
	Meteosat 7	---	0°	Projected launch 07/1997
	MSG 1	---	0°	Projected launch 2000
	MSG 2	---	0°	Projected launch 2002
	MSG 3	---	0°	Projected launch 2006
INDIA	INSAT I-d	06/1990	83° E	Domestic operational use
	INSAT II-a	07/1992	74° E	Domestic partly operat. use
	INSAT II-b	07/1993	93.5° E	Domestic operational use
	INSAT II-e	---	TBD	Projected launch 1997/98
JAPAN	GMS-4	09/1989	120° E	Back-up
	GMS-5	**03/1995**	**140° E**	**Operational**
	MTSAT-1	---	140° E	Projected launch in 1999
USA	**GOES - 8**	**04/1994**	**75°W**	**Operational**
	GOES - 9	**05/1995**	**135° W**	**Operational**
	GOES - K	---		Projected launch 04/97
	GOES - L	---		Projected launch in 2002
	GOES - M	---		Projected launch in 2002
RUSSIA	GOMS-N1	11/94	76° E	Pre-operational
	GOMS-N2	---	76° E	Projected launch in 1998
	GOMS-N3	---	76° E	Projected launch in 2001
CHINA	FY-2	---	105° E	Projected launch in 1997

CGMS MEMBERS' SATELLITES IN POLAR ORBIT

Status as of May 1996

Operator	Satellite	Launched	Orbit	Status
EUMET-SAT	Metop-1	---	AM 827 km	Projected launch in 2002
	Metop-2	---	AM 827 km	Projected launch in 2006
	Metop-3	---	AM 827 km	Projected launch in 2010
USA	NOAA-9	12/1984	PM 850 km	Partly operational
	NOAA-12	**05/1991**	**AM 850 km**	**Operational**
	NOAA-14	**12/1994**	**PM 850 km**	**Operational**
	NOAA-K	---	AM 850 km	Projected launch early 1997
	NOAA-L	---	PM 850 km	Projected launch 12/1997
	NOAA-M	---	AM 850 km	Projected launch 09/1999
	NOAA-N	---	PM 850 km	Projected launch 12/2000
	NOAA-N'	---	PM 850 km	Projected launch 12/2003
	NPOESS-1	---	824 km	Launch date TBD
	NPOESS-2	---	824 km	Launch date TBD
CHINA	FY-1 C	---	870 km	Projected launch in 1998
	FY-1 D	---	870 km	Launch date TBD
RUSSIA	**Meteor 2-21**	**08/1993**	**950 km**	**Operational**
	Meteor 3-5	**08/1991**	**1200 km**	**Operational**
	Resurs-01-4	----	835 km	Projected launch in 1997 (partly meteorological mission)
	Meteor 3M-1	----	925 km	Projected launch in 1998
	Meteor 3M-2	----	925 km	Projected launch in 2000

Appendix A:

SELECTED PAPERS SUBMITTED TO CGMS XXIV

CGMS-XXIV EUM-WP-10
Prepared by EUMETSAT
Agenda Item: G.1

PLANNED MSG MISSION SPECIFIC IMPLEMENTATION OF LRIT/HRIT

This paper presents the current status of preparations for the implementation of the Low Rate and High Rate Image Transmission (LRIT/HRIT) as a dissemination protocol via the Meteosat Second Generation (MSG) mission transponders. Details about the MSG LRIT/HRIT physical layer, data content and file structure, compression and encryption algorithms are given as far as possible at this early stage of the project.

PLANNED MSG MISSION SPECIFIC IMPLEMENTATION OF LRIT/HRIT

1 INTRODUCTION

The LRIT/HRIT Global Specification has been agreed by CGMS members in 1993. It bases on the CCSDS standards on Advanced Orbiting Systems. The architecture follows the concept of communication between open systems as specified in ISO standard 7498. Meteorological satellite operators have indicated plans to define a mission specific implementation for all aspects which go beyond the contents of the Global Specification.

It should be mentioned that the DWD (German National Meteorological Service) has implemented the first LRIT service (called FAX-E) within Europe via a 64 kbps VSAT link with a hub at the headquarters in Offenbach replacing an analog fax broadcast of a costly high power longwave transmitter. The realisation was achieved within a tight project schedule which included the development of user stations based on PCs or UNIX work stations at attractive costs.

2 MSG LRIT/HRIT MISSION SPECIFIC IMPLEMENTATION

The following chapters give an overview on the implementation of the LRIT/HRIT formats within the EUMETSAT METEOSAT Second Generation programme. The information is given to allow other satellite operators planning to implement LRIT or HRIT on their systems to consider similar implementation to obtain a maximum of compatibility between LRIT/HRIT services of the various operators. It is understood that full compatibility on the lower levels of data formats will be difficult or not possible due to the variations in spacecraft instrumentation and the design of sub-systems.

2.1 Physical Layer

The following table presents the baseline of the physical MSG link characteristics:

Parameter name	LRIT	HRIT
Length of coded VCDU	1020 octets	
Centre Frequency	1691.0 MHz	1695.15 MHz
Bandwidth	0.660 MHz	1.960 MHz
Polarisation	linear horizontal	
Packetized data rate	128 kbps	1 Mbps
Total coded data rate	294 kbps	2.3 Mbps
Modulation	PCM/NRZ/BPSK	PCM/NRZ/QPSK
Pulse shaping	raised cosine filter roll-off factor 1.0	raised cosine filter roll-off factor ≤ 0.7
Coding	concatenated coding Reed-Solomon (255,223) + convolutional coding (½ rate, k=7)	
Probability of frame loss	5 x 10E-5	
Required Eb/No (coded data)	2.8 dB	
Coding Gain	9.4 dB	
Achieved margins in case of nominal S/C and user station	worst case 0 dB nominal case 3 dB	

Table 2-1 Physical link parameters

The MSG LRIT/HRIT dissemination links are designed to allow the data reception with the given probability of frame loss within the following areas with nominal user stations as defined in table 2-2:

- all of the EUMETSAT member states
- all of Africa and the island of Reunion
- North-Eastern part of South America
- locations at which the elevation to the satellite is greater than or equal to 10 degrees

	LRUS		HRUS	
	worst case	nominal case	worst case	nominal case
G/T [TBC]	5.0 dB/°K	6.0 dB/°K	12.0 dB/°K	14.0 dB/°K
demodulation losses	1.0 dB	0.6 dB	1.0 dB	0.8 dB

Table 2-2 Required MSG User Station Performances

2.2 MSG LRIT/HRIT Presentation and Session Layers

2.2.1 LRIT/HRIT Data Content

The LRIT/HRIT contains the following data and products:

	LRIT	HRIT
level 1.5 data (geo-located and radiometrically processed SEVIRI images plus supplementary and quality data)	sub-set	yes
level 2.0 and 3.0 products (MPEF products, re-transmission of GTS data)	yes	yes [TBC]
DCP re-transmission data	yes	yes [TBC]
foreign satellite data	sub-set	yes
encryption control information	yes	yes
service messages (e.g. test messages (compression/encryption), admin messages, algorithm updates, etc.)	sub-set	yes

Table 2-3 LRIT/HRIT data stream contents

The LRIT sub-sets of image data are fully configurable in spatial or temporal resolution. The LRIT/HRIT formats are self-describing and allow a modification to the configuration of the dissemination service during the whole life-time of the MSG mission.

HRIT data will always contain full resolution data. The level 1.5 data disseminated via LRIT will be truncated to 8 bit resolution. Histogram equalization may be applied and the relevant equalization table would be made available as mission specific secondary header.

2.2.2 Compression

The limited channel capacity requires the use of data compression in order to maximise the amount of information to be transmitted. The current baseline foresees the ISO standard 10918 - Digital compression and coding of continuous-tone still images, known as JPEG.

A study is currently underway to provide synthetic SEVIRI data and to optimize the performance of the quantisation and coding tables wrt the dynamic behaviour of the various SEVIRI spectral channels. The tables will be made available via mission specific secondary headers. Therefore, all compressed LRIT/HRIT files will be completely self-describing.

On average, 85% of the LRIT/HRIT capacity will be used by MSG level 1.5 SEVIRI image data. The remaining 15% will be distributed to other data and products listed in the above table.

Table 2-4 summarizes the applicability of compression to the various data wrt the dissemination via the LRIT or the HRIT channel. It is expected that the compression factor for SEVIRI HRV will be approximately 5.

	LRIT compression type	HRIT compression type
level 1.5 image data- SEVIRI HRV	lossy	lossy
level 1.5 image data - all other SEVIRI channels	lossy	lossless
level 2.0 and 3.0 products (MPEF products, re-transmission of GTS data)	none	none
DCP reports + bulletins	none	none
foreign satellite data	lossy	[TBD]
encryption control information	none	none
service messages (test/admin messages and other support data)	none	none

Table 2-4 Compression method vs. dissemination product

2.2.3 Encryption

In accordance with EUMETSAT data policy the access to the dissemination links will be controlled through the employment of the encryption schemes. The encryption scheme will base on the standardized DES3 algorithm (triple Data Encryption Standard) according to ANSI X3.92. The DES algorithm is a well known and standardized public algorithm. Its 'triple' implementation provides sufficient protection against unauthorised access wrt the sensitivity of meteorological data. Sufficient hardware and software are available at low cost.

2.2.4 MSG Dissemination Timeliness

The MSG LRIT/HRIT dissemination scheme will mainly be governed by the timeliness requirements for the various products as depicted in table 2-5 . The timeliness will be achieved by the implementation of a scheme regulating the data flow in accordance to a mission specific priorities.

The time interval between two successive starts of a radiometer scan is called 'repeat cycle'. The repeat cycles are no longer bound to absolute time references as in defined in the current operational MOP/MTP concept.

	Max. delivery time		Max. repeat cycle	
	LRIT	HRIT	LRIT	HRIT
level 1.5 data	15 minutes	5 minutes	30 minutes	15 minutes
level 2.0 and 3.0 products - MPEF products - re-transmission of GTS data	60 minutes	60 minutes	N/A	N/A
alert DCPs	3 minutes	3 minutes [TBC]	N/A	N/A
regional/international DCPs	10 minutes	10 minutes [TBC]	N/A	N/A
foreign satellite data [TBC] - GOES-E, GOMS - GOES-W, GMS - polar orbiter (European area) - polar orbiter (other selected areas)	 3 hours 3 hours [TBD] [TBD]	 3 hours 3 hours [TBD] [TBD]	 [TBD] [TBD] [TBD] [TBD]	 3 hours 6 hours [TBD] [TBD]
encryption control information	N/A	N/A	12 hours	12 hours
service messages (test/admin messages and other support data)	N/A	N/A	6 hours/ if required/ on demand	6 hours/ if required/ on demand

Table 2-5 LRIT/HRIT Timeliness Requirements

The delivery time is specified as the max. time difference between the entry into the ground segment and the dissemination reaching the end-user in the disseminated form, i.e. before decryption and decompression.

2.3 Structure and Sequencing of LRIT/HRIT Files

As the LRIT/HRIT dissemination being a file transfer protocol, the file size has to be known before the dissemination can start. Due to compression of image data, these files are of variable length. Consequently, the dissemination service has to split a complete Earth's scan data into 'image segment files' (horizontal slices of the full Earth disk) to guarantee the timeliness and re-synchronisation requirements.

Figure 2-1 illustrates the implementation of image segment files for the 11 spectral channels of 3 km resolution. A file size of 64 lines has been chosen. 58 of such image segment files will disseminated. The minimum compressed data block size which allows re-synchronisation in the case of non-recoverable transmission errors is 64 x 64 pixel. The level 1.5 image data of the 1 km resolution HRV spectral channel will be a rectangular of 5568 x 11136 pixel and will be segmented accordingly.

Additional mission specific file types (repeat cycle header and trailer) are under definition to especially provide all supplementary information for the image data repeat cycles. It is foreseen that the image segment files are embedded between the repeat cycle header and trailer files (see table 2-6). All non-image data will be kept self-describing. The dissemination scheme will artificially restrict the number of open files to limit the required user station resources to a reasonable size.

<table>
<tr><td>image repeat cycle header (MSG mission specific file type)</td><td colspan="2">- repeat cycle start time
- repeat cycle number
- scan size information</td></tr>
<tr><td>image segment files (Global file type 0)</td><td colspan="2">- data of all spectral channels in compressed and encrypted form</td></tr>
<tr><td rowspan="5">image repeat cycle trailer (MSG mission specific file type)</td><td>repeat cycle processing statistics</td><td>- repeat cycle end time
- early repeat cycle end flag
- Processing info record
- S/W configuration info record
For every SEVIRI channel:
- channel processing info record</td></tr>
<tr><td>repeat cycle data statistics</td><td>For every SEVIRI channel:
- missing lines record
- corrupted lines record
- modified lines record</td></tr>
<tr><td>image platform data block</td><td>information about
- orbit, attitude & spin information
- S/C configuration and operations
- celestial events
- denoted anomalies</td></tr>
<tr><td>radiometric quality records</td><td>For every SEVIRI channel:
- level 1.0 radiometric quality
- level 1.5 radiometric quality
- level 1.0 -level 1.5 radiometric quality
- S/C calibration
For foreign satellite data: [TBD]</td></tr>
<tr><td>geometric quality records</td><td>For every SEVIRI channel:
- absolute geometric quality record
- relative repeat cycle-to-repeat cycle geometric quality record
- relative image internal geometric quality record
- channel registration record</td></tr>
</table>

Table 2-6 MSG image data sequencing

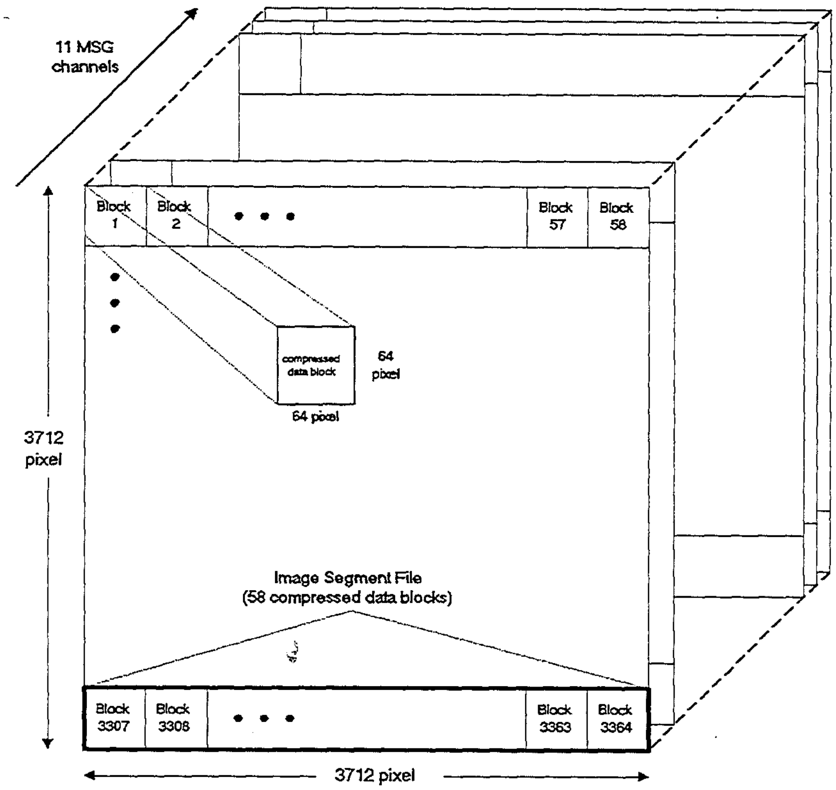

Figure 2-1 Example of an MSG Image Data LRIT/HRIT file structure

3 CONCLUSION

This paper has presented initial ideas about the MSG LRIT/HRIT mission specific implementation. It was shown that an image segmentation will be required, if compression of LRIT/HRIT image data is considered together with stringent timeliness requirements.

The current phasing of MSG ground segment preparatory activities foresee to have a detailed MSG Mission Specific LRIT/HRIT implementation ready by the end of 1996.

CGMS members will be regularly updated on the progress of the implementation.

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LRPT/HRPT IMPLEMENTATION PLANS ON THE EUMETSAT POLAR SYSTEM (EPS)

This paper summarizes the current planning of the data content and the aspects of the physical layer of the new Low Rate and High Rate Picture Transmission LRPT/HRPT which will form the baseline for the METOP DBS (direct broadcast service). The application data contained w.r.t. the planned assembly of the METOP payload instrumentation and their data rates is listed. This includes the implementation of such data into the defined Network and Data Link Layers of the LRPT/HRPT General Specification [1] without repeating its contents.

The DBS system requirements are introduced and the intermediate results of concept studies focusing on the definition of the LRPT/HRPT physical layers (modulation and coding schemes, propagation effects) will be presented. The derived user station designs and the potential synergy effect from the parallel development of the geostationary LRUS/HRUS (Low Rate and High Rate User Stations) will briefly be discussed.

LRPT/HRPT IMPLEMENTATION PLANS ON THE EUMETSAT POLAR SYSTEM (EPS)

1 INTRODUCTION

A move from the analog WEFAX formats to low rate image transmission (LRIT) for geostationary meteorological satellites has been adopted by CGMS member in mid-1993. In addition, it was agreed that the HRIT format shall replace any current digital high rate dissemination. The new formats base on the OSI reference model (ISO standard 7498) as implemented by the CCSDS standards of Advanced Orbiting Systems (AOS).

A similar CGMS activity was started to replace the current APT and HRPT formats of the NOAA/TIROS-N links on VHF and L-band channels respectively which are successfully used in nearly unchanged form for more than 20 years. These either analog or fixed frame formats have been earmarked to change to the more flexible 'packetised telemetry' type of format with the introduction of the next generation of polar orbiting spacecraft. Especially the move from APT to the digital LRPT will provide the users with a number of advantages. Modern compression and coding techniques allow for a link with improved quality and an increase of the number of available spectral channels together with higher spatial resolution. Concept studies concerning the physical layer are still under way, but the principle format description on higher layers [1] can already be frozen.

The LRPT/HRPT formats will be introduced starting with the operations EPS on-board the European METOP-1 platform (projected launch in 2001). It is expected that U.S. NPOESS (National Polar-Orbiting Environmental Satellite System) will utilize the new LRPT/HRPT formats after commencement of its operation in 2006 which would allow for a transition period of a few years from the current generation.

In order to maintain the tight implementation schedule for EPS it will be necessary to finalize the LRPT and HRPT formats as a matter of urgency. The following chapters provide the information on planned LRPT/HRPT implementation on EPS.

2 DATA CONTENT

Table 2-1 provides a brief description of all METOP instruments while table 2-2 lists sizing of source packets, their application process identifiers (APID), and the overall data rates as far as defined at this early design stage.

AVHRR/3, HIRS/3, AMSU A1/A2, SEM, DCS-2 and S&R are identical copies of the instruments flying on NOAA K, L, M, N, N'.

MHS, the EUMETSAT replacement of AMSU B, will fly on NOAA N, N'. The European instruments IASI, OMI, ASCAT and GPS will fly on METOP only. The provision of ASCAT is to be confirmed. The use of GPS as a meteorological sounder is under consideration as a new application.

INSTRUMENT	INSTRUMENT TYPE
AVHRR/3 Advanced Very High Resolution Radiometer	Imaging radiometer with six channels in the range 0.6-12 microns.
HIRS/3 High resolution Infra-red Radiation Sounder	Sounder with 19 infrared channels in the range 3.8-15 microns, and one visible channel.
AMSU-A 1/2 Advanced Microwave Sounding Unit-A	Microwave sounder with 15 channels in the range 23-90 GHz.
MHS Microwave Humidity Sounder	Microwave sounder with five channels at 89, 157 and around 183 GHz.
DCS/2 Data Collection System	UHF receiver and signal processor.
GPS Global Positioning System	L band receiver and signal processor.
IASI Infrared Atmospheric Sounding Interferometer	Infrared Michelson Interferometer covering the 3.6-15.5 microns range.
ASCAT Advanced Scatterometer	Pulsed doppler radar in C-band.
OMI Ozone Monitoring Instrument	Nadir-viewing ultraviolet and visible spectrometer.
S&R Search & Rescue	VHF/UHF transponder and signal processor.
SEM Space Environment Monitor	Multichannel charged-particle spectrometer.

Table 2-1 METOP Instrument Descriptions

Application Data Type	APID	packetised data rate (bps) HRPT	LRPT	Packet size (octets)	Rate (packets per sec.)
AVHRR/3 (HRPT data)	103	621984	-	12958	6
AVHRR/3 (compressed LRPT data)	64 ... 70	-	40000	variable	3
MHS	34	3900	3900	1300	3/8
DCS-2	35	2574	2574	2574	1/8
SEM	37	163.5	163.5	654	1/32
HIRS/3	38	2897.5	2897.5	2318	1/6.4
AMSU-A1	39	2094	2094	2094	1/8
AMSU-A2	40	1134	1134	1134	1/8
IASI	128 ... 191	1500000	-	[TBD]	[TBD]
ASCAT [TBC]	192 ... 255	43000	-	672 [TBC]	[TBD]
OMI	384 ... 447	240000	-	[TBD]	[TBD]
GPS meteorological sounding data	448 ... 479 480 ... 511	10000	-	266 [TBC] 1266 [TBC]	1 1/120
housekeeping data	1	4080	4080	510	1
GPS position data	2	500	500	44 [TBC]	1
administrative messages	3..6	2000	2000	8000 [TBC]	1/32 [TBC]
sub-total		2434327	59343		
reserved capacity		580316	2673		
total uncoded		3014643	62016		
Reed-Solomon coding/Transfer Frame overhead (≡16.1 %)		485357	9984		
total bit rate before Viterbi coding		3500000	72000		

Table 2-2 METOP LRPT/HRPT Source Packets

2.1 HRPT Data Content

The HRPT direct broadcast service will contain data from all instruments and services listed in tables 2-1 and 2-2.

2.2 LRPT Data Content

The sub-set of application data provided via LRPT contains:

1. imagery from selected channels of the AVHRR instrument:

   In order to provide a low rate data stream to the LRPT users, the AVHRR data will be truncated to 8 bits and then lossy compressed with a target compression ratio of 8. In contrast to the current APT which contains 2 spectral channels at a 4 km resolution, LRPT allows the dissemination of three out of six AVHRR/3 spectral channels with a spatial resolution identical to HRPT (1.1 km).

The current baseline for the AVHRR data compression algorithm is ISO standard 10918 - Digital compression and coding of continuous-tone still images, known as JPEG, which is currently the only agreed international image compression standard.

It is not expected that other algorithms will achieve a comparable status and popularity within the next few years. Therefore, application software and source code for user stations even if minor modifications may be required are available at very attractive prices. JPEG has already been adopted as the compression scheme for the Meteosat Second Generation (MSG) for the same reasoning.

The JPEG algorithm allows the use of different quantization and coding tables. As in the case of MSG, studies will be performed to consider the different spectral channel dynamic behaviour of the AVHRR/3 and to derive optimized quantization and coding tables. Administrative messages could be used for updates of these tables during the life-time of METOP.

2. infrared and microwave sounding data from the Meteorological Payload: AMSU-A1, AMSU-A2, MHS, HIRS/3
3. SEM data
4. spacecraft housekeeping data
5. GPS position data
6. administrative messages

3 CONCEPT STUDY RESULTS OF LRPT/HRPT PHYSICAL LAYER ASPECTS

3.1 System Requirements

The METOP data broadcast service shall allow the reception of almost real-time meteorological data (as defined in section 2) by users equipped with either type of user station:

- **LRPT** user stations which utilize the low-rate VHF link. This link shall support a bit rate of 72 kbps. The receiver antenna can be a circular polarized steerable yagi or an omnidirectional hemispherical antenna.

- **HRPT** user stations which utilize an L-band link at 1.7 GHz to receive the high-rate data at 3.5 Mbps. The sizing of the HRPT data rate includes margin for later growth. The required RF front-end is a parabolic antenna with a minimum G/T of 6 dB/°K with satellite tracking capabilities.

The METOP communication links have been studied w.r.t. the following additional requirements:

- Maximum bandwidth occupancy at 99% (BW_{max}):
  LRPT: 150 kHz
  HRPT: 4.5 MHz

- robustness of the modulation scheme to satellite non-linear amplifiers and high link power efficiency

- minimal spectral re-growth in the spacecraft HPA (compliance with out-of-band power requirements)

- low power flux density emissions to comply with radio regulations

- maximum doppler Δf_{max} = 37 kHz at 1.7 GHz
  Δf_{max} = 3 kHz at 137 MHz

- maximum doppler rate $[df/dt]_{max}$ = 330 Hz/s at 1.7 GHz
  $[df/dt]_{max}$ = 27 Hz/s at 137 MHz

- probability of frame loss (PFL) of 10^{-6} corresponding to a BER of 10^{-3} at the demodulator output (after Viterbi decoding)

- target availability: 99.8 %

3.2 Modelling of Communication link

Both, the LRPT and the HRPT communication link can be modelled as multi-path fading channels. These channels are doubly dispersive and exhibit a dispersion in both the time and frequency domain. The fading is caused by the combined effects of time variations in the propagation path and the movement of the spacecraft transmitter (doppler spread). Additional link impairments are specular reflections (applicable to omnidirectional antennas) and man-made impulsive noise.

The results of the performed propagation study show that ionospheric absorption losses in the VHF and the L-band are most of the times one order of magnitude smaller than the scintillation effect.

Ionospheric scintillation fading caused by irregularities in the F-layer is low in L-band, but is an important issue in the VHF propagation path. The scintillation depends on daily, monthly and solar cycle variations of the ionosphere total electron content. The effect predominates during night-time and the 'dark months'. In the worst case, user stations within ± 20° of the magnetic equator and high latitudes are affected. These two user station location areas will suffer from scintillation losses of more than 3-4 dB over 10% and will exceed 8 dB over 1% of all orbits seen by the user station. For analytical simulations, the fading has been modeled as a Rayleigh distributed envelope process with a typical 3 dB fading bandwidth of B_F = 0.3 Hz. It is proposed to mitigate the effect of fading using implicit time diversity in the form of baseband symbol interleaving of coded modulation.

3.3 Selection of Modulation and Coding schemes

A trade-off has been made between constant envelope continuous phase modulation (CPM) schemes representing an attractive power and spectral efficient alternative (e.g. GMSK) to more conventional Nyquist-shaped schemes. Due to the satellite HPA non-linearity, the raised-cosine bandlimited signal spectrum is affected by the sidelobes regrowth phenomenon. Simulations showed that the potential power efficiency advantage of GMSK is expected to be less than of 1.5 dB at low operating points (uncoded BER of 2x10E-2). Consequently, the advantage of CPM was found to be limited, although not negligible. GMSK would exceed the specified PFD limitations and the higher availability and easier implementation of conventional QPSK demodulators went against GMSK.

Differential QPSK was chosen for LRPT to allow for non-coherent demodulation and easier ambiguity resolution. Standard QPSK forms the baseline for HRPT. Differential coding of the latter is [TBD].

Concatenated coding is considered necessary for HRPT and LRPT to fulfil the required link performances. The modulation spectral efficiency (available bandwidth over coded bit rate) determines the minimum FEC coding rate. The following practical values have been chosen:
HRPT coding rate r=3/4, LRPT r=1/2.

Due to the spectral regrowth phenomenon no bandwidth reduction for roll-off factors $\alpha < 0.6$ is possible.

Section 4 summarizes the results of this brief discussion and presents the further detailed technical parameters.

4 BASELINE OF METOP LRPT/HRPT PHYSICAL LAYER

4.1 METOP Space Segment and Communication Link Parameters

The input to the physical layer consists of Reed-Solomon (255,223) coded VCDUs originating from the source packet described in section 2. The data rates in table 4-1 include the CADU attached sync markers.

	LRPT	HRPT
data rate (incl. RS-coding and transfer frame overhead)	72 kbps	3.5 Mbps
Viterbi convolutional coding	K=7, rate 1/2 G1=1111001, G2=1011011 symbol inversion [TBD]	K=7, rate 3/4 G1=1111001, G2=1011011 symbol inversion [TBD]
interleaving of the input signal	YES	NO [TBC]
insertion of a UW for interleaving synchronisation and delimitation	every 4096 bits	N/A
size of interleaving matrix	4096 rows x 64 columns	N/A
modulation	QPSK format with Gray encoding	
differential coding	YES	NO [TBC]
pulse shaping	raised cosine, roll-off factor α=0.6	
bandwidth (99% of total power)	150 kHz	4.5 MHz
EIRP	see table 4-2	
carrier frequency	137.1000 MHz (nominal) 137.9125 MHz (back-up)	1701.3 MHz (nominal) 1707.0 MHz (back-up)
modulation losses	1.0 dB	
carrier frequency stability	5 x 10^{-6}	
polarisation	RHCP	
ionospheric losses	Due to their random nature and geographical distribution, these losses will not be identified numerically. Instead, the link budgets provide margins for this phenomenon as identified in table 4-3	
required BER at the Viterbi decoder output	1x 10^{-3}	
required Eb/No in a non-linear AWGN channel	7.5 dB (non-coherent detection)	5.5 dB (coherent detection)

Table 4-1 METOP Space Segment and Communication Link Parameters

Angle wrt nadir [degrees]	min. S/C EIRP [dBW]	
	LRPT	HRPT
0	3.21	2.46
5.0	3.24	2.49
10.0	3.36	2.61
15.0	3.55	2.80
20.0	3.82	3.07
25.0	4.19	3.44
30.0	4.65	3.90
35.0	5.23	4.48
40.0	5.95	5.20
45.0	6.85	6.10
50.0	8.00	7.25
55.0	8.00	8.80
58.0	8.00	10.10
60.0	8.00	10.10
62.0	8.00	10.10

Table 4-2 LRPT/HRPT EIRP

The values given in table 4-2 are such to meet the L-band PFD limitations defined in the ITU Radio Regulations:

whole L-band:

- 154 dBW/m^2 in any 4 kHz band for elevation angle lower than 5°
- 154 + 0.5 (δ-5) dBW/m^2 in any 4 kHz band for elevation angle (δ) between 5° and 25°
- 144 dBW/m^2 in any 4 kHz band for elevation angle greater than 25°

1670 - 1700 MHz: - 133 dBW/m^2 in any 1.5 MHz band at any elevation angle

4.2 METOP LRPT/HRPT User Segment

The required RF front-end parameters are identical to the current APT and HRPT user stations operating with NOAA/TIROS-N spacecraft. The following performances have been specified:

	LRPT (type 1)	LRPT (type 2)	HRPT
antenna type	steerable yagi	omni-directional	parabolic
polarisation	RHCP		RHCP
axial ratio	< 3.5 dB		< 1 dB
pointing losses	0 dB		0.5 dB
G/T	-22.4 dB/°K	-30.4 dB/°K	6.0 dB/°K
min. elevation	5°	13°	5°
demodulator technical losses	2.0 dB		2.0 dB
demodulator detection type	non-coherent		coherent
de-interleaver	size as defined table 4-1 ≈1.6 Mbit assuming 3 bit soft decision in I and Q		N/A
resulting link margin for iono-spheric scintillation	9.8 -15.7 dB [TBC]	3.1 - 6.8 dB [TBC]	4.3 - 9.3 dB

Table 4-3 LRPT/HRPT User Station Performances

The link margins identified in table 4-3 show that LRPT user stations have a certain margin for propagation effects. In critical geographical locations as identified in section 3.2, the LRPT user station may have to choose the LRPT type 1 front-end (steering yagi antenna) to achieve high availability figures.

A number of commonalities between the future low rate and high rate user stations (LRUS/HRUS) of the geostationary MSG and LRPT/HRPT METOP user stations exist:

- coherent BPSK/QPSK demodulators for HRPT/HRIT/LRIT with adaptable data rates
- low loss digital bit and frame synchronizers
- nearly identical concatenated coding concepts
- common METOP LRPT and MSG compression algorithm [TBC]

Such potential synergy should be exploited for cost saving or sharing. In addition, standard off-the-shelf items were identified in a number of areas.

The following baseband modules are unique to LRPT and would require some additional effort

- non-coherent LRPT QPSK demodulator
- de-interleaver

The applicability of identical encryption schemes and algorithms for the European geostationary and polar orbiting spacecraft is [TBC].

5 CONCLUSION

It was shown that the METOP instrumentation requires modification in the direct broadcast service compared to current NOAA/TIROS-N spacecraft to disseminate more products with higher data rates to the end-users. EUMETSAT will employ a scheme based on the CCSDS AOS standards as laid out in [1] for the METOP LRPT and HRPT broadcast service. Such protocol with its inherent flexibility is an ideal candidate for the additional required expansion of data sets of the next generation of polar meteorological satellites.

All current RF front-ends are compatible with future communication link requirements. The baseband equipment will have to change due to the selected different modulation and coding schemes. Synergy effects from parallel LRUS and HRUS development are expected to reduce development costs significantly.

The upgrade of current HRPT user stations will be fairly straight forward. More effort has to be spent in the LRPT user station design because of the replacement of the current analog broadcast by a low rate digital data stream, its compression and the impairments of the VHF communication link. But this effort is well compensated by the availability of more channels and higher resolution perfectly matching the results of a user poll.

CGMS members are invited to take note of the proposed LRPT/HRPT implementation plan.

References: [1] Low Resolution Picture Transmission and High Resolution Picture Transmission (LRPT/HRPT), General Specification, NASA GSFC-S-480-77, 25/6/93

Glossary

AMSU	Advanced Microwave Sounding Unit
AOS	Advanced Orbiting Systems
APID	Application Process Identifier
APT	Automatic Picture Transmission
ASCAT	Advanced Wind Scatterometer
AVHRR	Advanced Very High Resolution Radiometer
AWGN	Additive White Gaussian Noise
BER	Bit Error Rate
BPSK	Bi-Phase Shift Keying
CCSDS	Consultative Committee for Space Data Systems
CPM	Continuous Phase Modulation
DBS	Direct Broadcast Service
dBW	decibel Watt
DCS	Data Collection System
Eb/No	Bit Energy over Noise Density
FEC	Forward Error Correction
GHz	Gigahertz
GMSK	Gaussian Minimum-Shift Keying
GPS	Global Positioning System
G/T	Figure of Merit (antenna gain over system noise temperature)
HIRS	High Resolution Infrared Sounder
HPA	High Power Amplifier
IASI	Infra-red Advanced Sounder Interferometer
ISO	International Organisation for Standardization
ITU	International Telecommunication Union
JPEG	Joint Photographic Expert Group
HRIT	High Rate Image Transmission
HRPT	High Rate (Resolution) Picture Transmission
LRIT	Low Rate Image Transmission
LRPT	Low Rate Picture Transmission
Mbps	Megabit per Second
METOP	European Meteorological Polar Orbiting Satellite
MHS	Microwave Humidity Sounder
MHz	Megahertz
MIMR	Multi-frequency Imaging Microwave Radiometer
MSG	Meteosat Second Generation
NPOESS	National Polar-Orbiting Environmental Satellite System
OMI	Ozone Monitoring Instrument
OSI	Open Systems Interconnection
PFL	Probability of Frame Loss
QPSK	Quadri-Phase Shift Keying
RHCP	Right Hand Circular Polarized
SEM	Space Environment Monitor
TBC	To Be Confirmed
TBD	To Be Defined
UW	Unique Word
VHF	Very High Frequency

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Agenda Item: II/2

VISIBLE CHANNEL CALIBRATION OF METEOSAT-5

This document reports on the results from the calibration campaign for the visible channels of METEOSAT-5 carried out in summer 1995.

ABSOLUTE CALIBRATION OF THE METEOSAT-5 VISIBLE CHANNELS

INTRODUCTION

Meteosat 5 was launched on 2 March 1991. A calibration campaign for the visible channels was prepared for the summer of 1991. Shortly before the start of the campaign, EUMETSAT became aware of the anomaly of the imaging radiometer (the "rotating lens problem"). Therefore, EUMETSAT postponed the campaign in order to first ensure that METEOSAT-5 would deliver useful operational image data. The rotating lens anomaly could be cured by image processing on ground, so that METEOSAT-5 became operational in February 1994 and preparation of the calibration campaign of the visible channels could be resumed.

Flights

The flights were carried out during the period from 24. July - 5. August 1995. The method was the same as for earlier campaigns carried out by Kriebel, DLR, Germany, for the METEOSAT 1, 2 and 4 satellites. An exhaustive overview is given in: K.T. Kriebel, V. Amann: " Vicarious Calibration of the METEOSAT Visible Channel", Journal of Atmospheric and Ocean Technology, Vol. 10, April 1993, pp.225-232.

Flights were performed over the following ground targets:

- Vegetated land in the La Mancha region in Spain, 39N, 3W
- Sand desert over Libya, 33N, 9.5E
- Closed cloud layer over the Bay of Biscay, 44N,4W
- Cloud free area of the Atlantic Ocean between Portugal and Maroc, 36N, 8W

The target areas, in particular the cloud cover over the Bay of Biscay and the cloud free area over the Atlantic, were sufficiantly homogeneous to ensure that results were useful for extraction of calibration coefficients.

Calibration Factors

The resulting calibration factors for these four scenes are:

- Vegetated land 1.07 $Wm^{-2}sr^{-1}count^{-1}$
- Sand desert 1.10 $Wm^{-2}sr^{-1}count^{-1}$
- Closed cloud layer 1.10 $Wm^{-2}sr^{-1}count^{-1}$
- Cloud free ocean area 1.31 $Wm^{-2}sr^{-1}count^{-1}$

The overall accuracy of these calibration factors is estimated to be within ±5%, whereby 1% is attributed to inaccuracy of the atmospheric contribution above flight alitude, and 4% due to the accuracy limit of the calibration lamp used to calibrate the radiometer.

THE OPERATIONAL CLOUD MOTION WINDS FROM THE METEOROLOGICAL PRODUCTS EXTRACTION FACILITY (MPEF) IN THE NEW EUMETSAT MTP GROUND SEGMENT

This document describes the methods used for extracting the cloud motion winds in EUMETSAT's new Meteorological Products Extraction Facility (MPEF) and compares the methods with the previously used ones at ESA/ESOC's MIEC.

THE OPERATIONAL CLOUD MOTION WINDS FROM THE METEOROLOGICAL PRODUCTS EXTRACTION FACILITY (MPEF) IN THE NEW EUMETSAT MTP GROUND SEGMENT

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Abstract

The new EUMETSAT MTP ground segment took full control of all Meteosat satellites starting 15 November 1995. The MTP ground segment includes a Mission Control Centre (MCC) located in the new EUMETSAT headquarters building in Darmstadt, Germany.

The Meteorological Products Extraction Facility (MPEF) is a facility in the MCC. It is the function of the MPEF to produce a range of meteorological products for the end users. The main product is the Cloud Motion Wind product, extracted from all three Meteosat channels.

The MTP MPEF is the replacement of the MOP MIEC run by ESOC until November 1995. MTP MPEF features increased modularity and a number of improved processing and algorithms implementation. The general structure of the wind extraction in MTP MPEF is described.

The algorithms are extensions of the MIEC algorithms and incorporate improvements in several areas. These differences are described in detail.

The new Automatic Quality Control is described in detail. It provides a flexible means of controlling efficiently the quality of the generated product and will provide quality indicators to be used in advanced data assimilation schemes.

1 GENERAL CONCEPT OF THE MPEF DESIGN

The MTP MPEF is the successor to the Meteosat Information Extraction Centre (MIEC) for MOP. It features modular software design and incorporates a number of improvements in image data processing and product generation algorithm implementations. In addition the product algorithms are configured at run-time by a set of user-defined parameters whose values are under operator control. In this way the product generation processes may be tuned to produce optimum results. An example of these parameters are the thresholds used in the automatic quality control of the products.

The whole MTP ground segment is defined as a near real-time processing system in which the MPEF is embedded. The MPEF receives pre-processed (rectified) satellite image data from the Image Processing System normally on a line-by-line basis, and it processes these data to derive and distribute meteorological products. The near real-time derivation and distribution of the MPEF products minimizes the delay for product distribution and reduces the overall processing load on the system. The system for instance extracts products from a half-hourly image slot for the southern hemisphere while Meteosat is still scanning the northern part of the earth disk.

2 MPEF PRODUCT PROCESSING

2.1 General Description

The MPEF algorithms are extensions of the MIEC algorithms incorporating improvements in several areas. The products distribution is currently almost the same as the one used previously at MIEC:

MPEF Product	Distribution Times (UTC)
Cloud Motion Wind (CMW)	0000, 0006, 1200, 1800
Sea Surface Temperature (SST)	0000, 1200
Cloud Analysis (CLA)	0000, 0600, 1200, 1800
Upper Tropospheric Humidity (UTH)	0000, 0600, 1200, 1800
Cloud Top Height (CTH)	0300, 0900, 1500, 2100
Climate Data Set (CDS)	0000, 0100, 0200 . . . . 2200, 2300
Precipitation Index (PI)	Extracted at 0000, 0300, 0600 . . . . 1800, 2100 and accumulated for 5 days
ISCCP Data Set (IDS)	0000, 0300 . . . . 1800, 2100 (for B1 and B2 data sets) AC data set according to coordinated schedule

Table 1: List of MPEF products and their daily distribution times

The CMW, SST, CLA and UTH products are distributed to users via the GTS in WMO coded SATOB form, the CTH in pictorial form as part of the Meteosat Wefax dissemination mission and the CDS, PI and IDS products are archived in the Meteosat Archive and Retrieval Facility (MARF) from where they are retrieved by non-realtime users. The overall structure of the MPEF products extraction process is shown in figure 1.

2.2 Overview of CMW Extraction

The Cloud Motion Wind (CMW) product is computed by identifying and localizing the same cloud pattern ("tracer") in consecutive METEOSAT images. This tracking is done in all 3 spectral channels independently. Using the knowledge of the tracer displacement, combined with the measurement of its temperature, the following values are extracted which constitute the CMW product : wind location, wind speed, wind direction, temperature and pressure level.

The first operation performed is the selection of the clouds that will be used as the tracers, based on the information provided by the Histogram Analysis. This tracer selection is done in a channel-specific way, including cluster merging or rejection when necessary. When a useful tracer has been identified, height assignment is performed and the corresponding wind component can be extracted. The wind-component extraction process comprises the definition of the Target and Search areas taken from the current and previous image, their enhancement, followed by their cross-correlation. The extracted wind components are thereafter subject to automatic quality control and combined to generate the intermediate CMW product, which potentially contains 3 winds per geographical location. Finally, the best wind per geographical location is selected from this intermediate product, presented to the operator for Manual Quality Control and if accepted, distributed in SATOB code. The original intermediate product is archived in the archive facility (MARF) and is available for retrievals from there.

The overall internal structure of the CMW process is shown in Figure 2.

2.3 Detailed differences in the MIEC and MPEF wind processing schemes

2.3.1 Tracer selection

The tracer selection is principally the same in the new scheme as compared to the old scheme. The main inputs are the results from the histogram analysis, which provides information on the different scenes within a segment. The IR CMWs are as before based on the coldest cloud in the scene and similar input for image enhancement is derived from the scenes analysis. Also the low level visible winds are tracked for a similar set of tracer, i.e. only segments where no high or medium cloud, but only low clouds are present are utilised. For the WV winds the approaches differ slightly. In the MIEC the tracking was performed in every segment, but only segments with high level clouds were considered for dissemination. At present the MPEF is tracking WV features only in segments where medium or high level clouds are present, but again only WV winds derived at levels above 400 hPa are considered for dissemination.

2.3.2 Height assignment

The height assignment is different for all winds in the new scheme. The MPEF corrects the height for atmospheric absorption, which makes a significant difference for low level clouds. The differences are however not so pronounced as this effect was in the MIEC for low level clouds compensated by the cloud base height assignment. Also MPEF utilises cloud base heights for low level IR winds, but the correction is smaller and the overall effect, including atmospheric absorption, is on average the same as in the MIEC scheme.

The height assignments for VIS winds differ significantly. In the MIEC the VIS wind heights were derived equivalently to the IR low level CMW heights. The MPEF uses for the height assignment the low level tracer with the highest entropy. This will most likely select the warmest cloud cluster for the height assignment, which in practice is very similar to using cloud base heights.

In the MIEC also the WV height assignment was based on the IR cloud EBBT. This was a good approach only in areas where high level clouds were identified. In other areas the WV height was corrected by an approximation of the moisture content above the highest identified scene. Even though these corrections provided a reasonable cloud height, they were still inferior to the IR EBBT in high cloud areas. In the MPEF the WV heights are based on the WV EBBT for the coldest scene. Semi-transparency correction, as applied for IR EBBT, is also utilised. This method provides for high clouds of very similar heights as the IR EBBT, but a more stable height in areas where no high clouds are present.

2.3.3 Tracking

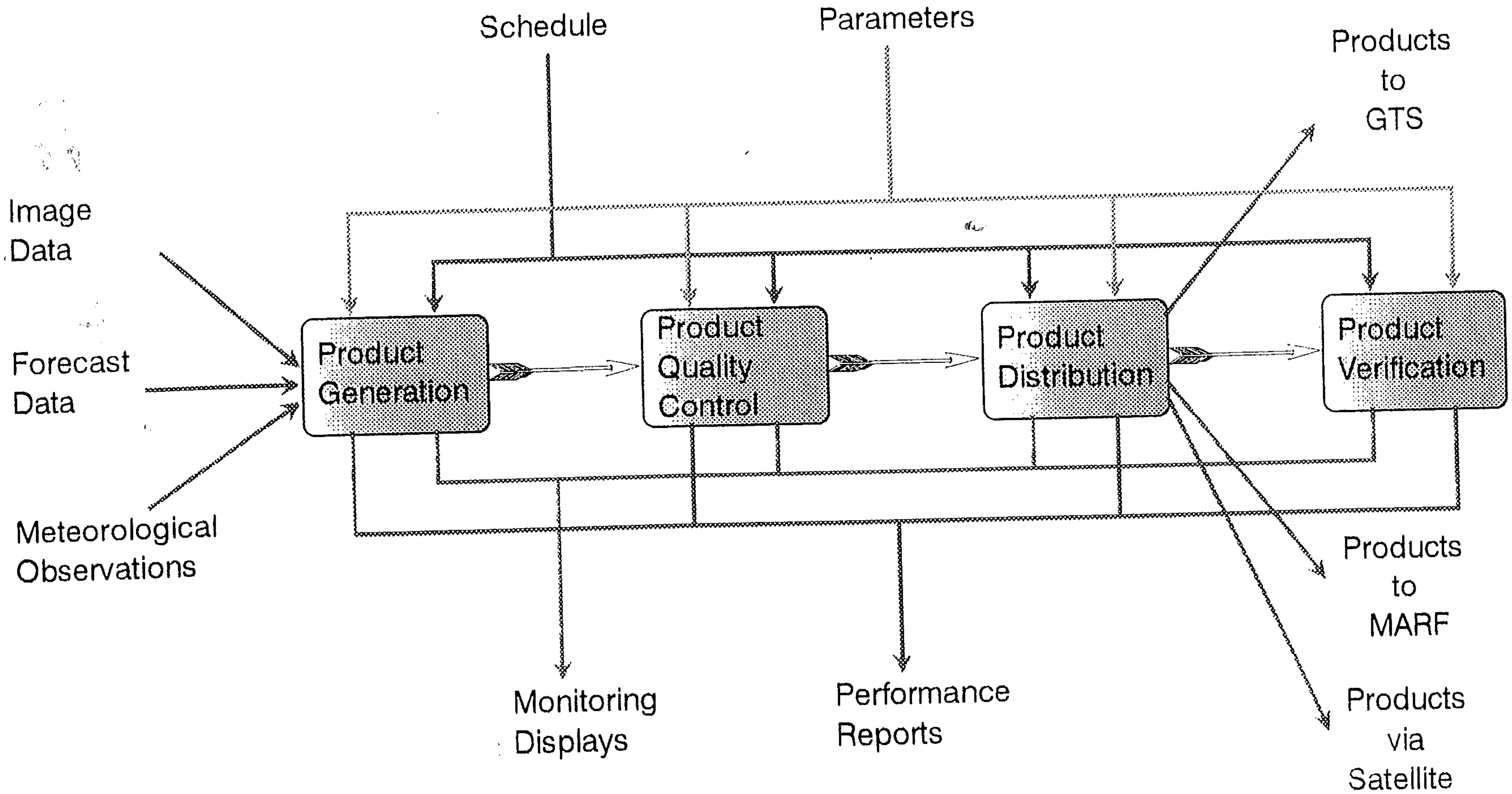
The actual tracking in the two schemes is based on cross correlation. The MIEC scheme was however utilising a first guess, provided by a numerical forecast, to reduce the amount of computations. This had a marginal impact on the quality and number of winds. The new scheme is completely independent of the forecast winds field for the tracking. It computes a larger correlation surface and is hence more reliable.

2.3.4 Automatic quality control

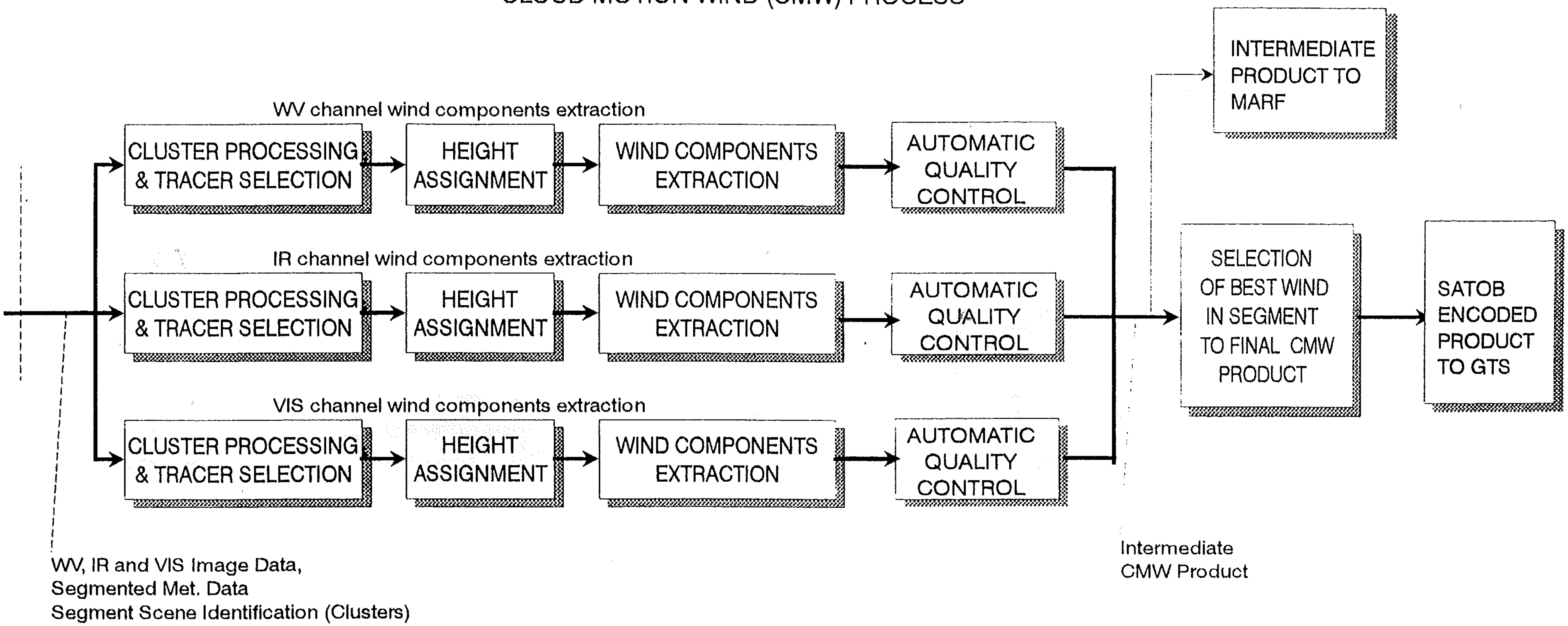
The largest difference occurs in the automatic quality control. The MIEC quality control was for the different channels non uniform. The VIS and IR winds used symmetry (consistency in time) checks for speed and direction as definite filters, i.e. no wind that failed to pass this test could be considered for dissemination. As a final check a comparison against the forecast was performed, which then was used to flag suspect winds. The final manual quality control could then either reinstate these winds or reject further poor vectors. The MIEC WV wind AQC was completely forecast independent. It utilised the vector symmetry (consistency in time) check together with a local consistency check in order to filter out bad vectors. These winds were automatically disseminated, without manual intervention.

The MPEF quality control is uniform for all channels. Similar tests as those applied at MIEC were used to create a set of six tests (vector, speed and direction consistency in time, local consistency for vector and height difference and a forecast check). These tests are now continuous functions instead of definite filters and they all return a reliability assessment between 0 and 1. The final quality is a weighted mean of the individual qualities. The final quality is used to define the vectors with an acceptable quality for dissemination. For dissemination and manual quality control purposes the best wind, as defined by the final quality per segment, is selected. During manual quality control rejected winds can be reinstated and further winds deleted.

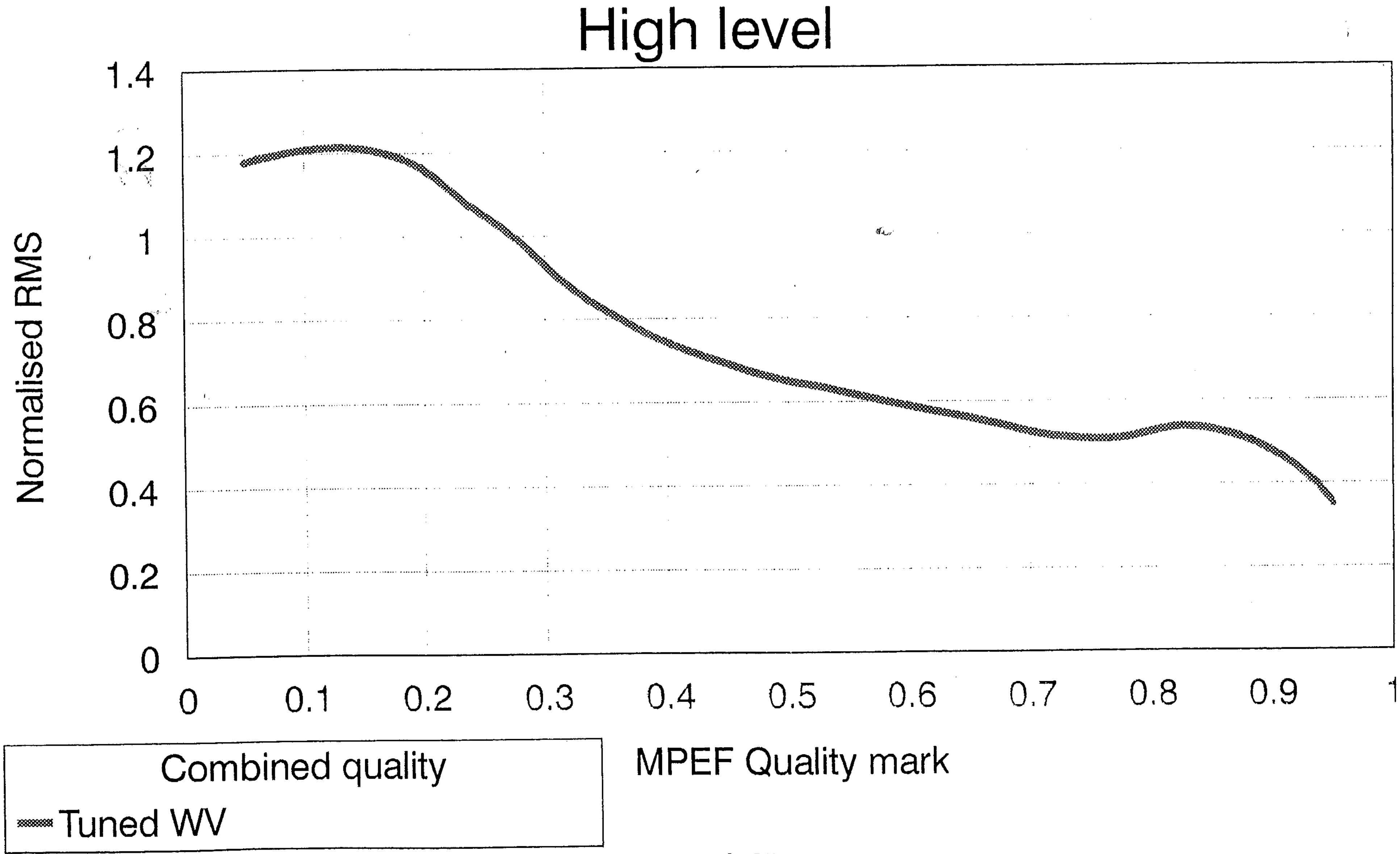
An example of the performance of the quality control is given in Fig. 3, which presents the relationship between MPEF quality mark for high level WV winds and an estimate of the real quality of the winds based on radiosonde statistics. The estimated quality is the vector RMS difference computed between collocated MPEF WV winds and radiosonde measurements normalised by the mean radiosonde observation speed. The good performance of the quality control is apparent. At the moment roughly 5% of the water vapour winds have a MPEF quality mark higher than .9, but the real quality as estimated by radiosonde statistics is higher than for the MIEC water vapour winds. 40% of the water vapour winds have a quality higher than .7 showing the high potential to increase the upper level coverage by the water vapour winds.


Schedule
Parameters
Products to GTS
Image Data
Forecast Data
Meteorological Observations
Product Generation
Product Quality Control
Product Distribution
Product Verification
Products to MARF
Products via Satellite
Monitoring Displays
Performance Reports

CLOUD MOTION WIND (CMW) PROCESS



MPEF Wind Quality



CGMS-XXIV WP-16
Prepared by Japan
Agenda Item:II/2

GMS-5 Calibration Status

Summary and Purpose of the Document

The purpose of this document is to report the Status of GMS-5 Calibration.

No action required

CGMS-XXIV WP-16
Prepared by Japan
Agenda Item:II/2

GMS-5 Calibration Status

The GMS-5 satellite was launched in March 1995, and hourly observation with VISSR started on June 13, 1995. GMS-5 has three infrared channels. The infrared calibration procedure of each channel is the same as that for GMS-4, which utilizes the space and the calibration shutter as the reference targets. The radiometric performance of three infrared channels has remained as good as the GMS-4 calibration up to now.

The Stretched-VISSR (S-VISSR) data service via GMS-5 also began at the same time. The S-VISSR data via GMS-5 includes additional information such as calibration information in the documentation sector. The calibration information contains a temperature-level conversion table for each three infrared channel with the original temporal resolution. This enables S-VISSR users to interpret the infrared data more effectively than using the fixed conversion table. The fixed conversion table, released in October 1993, and the calibration tables in the documentation sector were compared for some cases. Results are as follows;

	Temp(K)	<Fixed table - S-VISSR table>(K)		
		8/4 07UT	9/22 07UT	9/22 16UT
IR1	300	4.13	4.13	4.90
	220	1.27	1.11	1.54
	200	0.19	-0.03	0.31
	180	-1.45	-1.90	-1.61
IR2	300	1.32	1.16	2.48
	220	0.96	0.87	1.28
	200	1.00	0.92	1.01
	180	1.17	1.11	0.71
WV	260	-1.09	-1.60	-1.56
	220	-0.89	-1.26	-1.24
	200	-0.95	-1.24	-1.22

This table shows differences between the temperatures obtained in fixed conversion table and those with the calibration table in the S-VISSR data at each temperature. The differences in IR1, over 4K at 300K, are larger than the expectation. This seems to be caused by the difference between pre-launch calibration and in-flight calibration, because the fixed table was made based on pre-launch results. So we made new fixed calibration tables for the sake of reduction of the above-mentioned problem. New fixed calibration tables will be available from 03 UTC dated

1 MAY, 1996.

The visible channel of GMS-5 has been producing excellent images of the earth. The silicon photodiode detectors used in GMS-5 have been proven to be more stable all the times than the photomultiplier tubes used in GMS-4. Only one normalization procedure was carried out through the operation period.

CGMS–XXIV WP–17
Prepared by Japan
Agenda Item: II/4

Sea surface temperatures

Summary and Purpose of Document

The purpose of this document is to introduce estimation of sea surface temperatures in MSC of JMA

No action required

CGMS-XXIV WP-17
Prepared by Japan
Agenda Item: II/4

Sea surface temperatures

Description

Meteorological Satellite Center of Japan Meteorological Agency has operationally derived sea surface temperatures (SSTs) from infrared split window channels of GMS-5 since June 13, 1995.

The operational procedure of SSTs estimation is the same as the tentative one reported on the 23rd session of CGMS except that cloud screening techniques using multi-channel data are additionally installed. The techniques were developed by National Oceanic and Atmospheric Administration/ National Environmental Satellite, Data and Information Service (NOAA/NESDIS) for polar orbit satellites.

SSTs are calculated using a Multi-Channel SST (MCSST) retrieval algorithm. Coefficients calculated by model computation using the LOWTRAN-7 radiative transfer code were used. After that, coefficients were determined from a set of matches of satellite observation with buoy measurements. The data of drifting buoys and moored buoys in GMS coverage are used, and coefficients are computed by linear regression method from the set of matches. The coefficients have been updated three times. At the present the coefficients based on the observations in November 1995 are used. The current retrieval equation is:

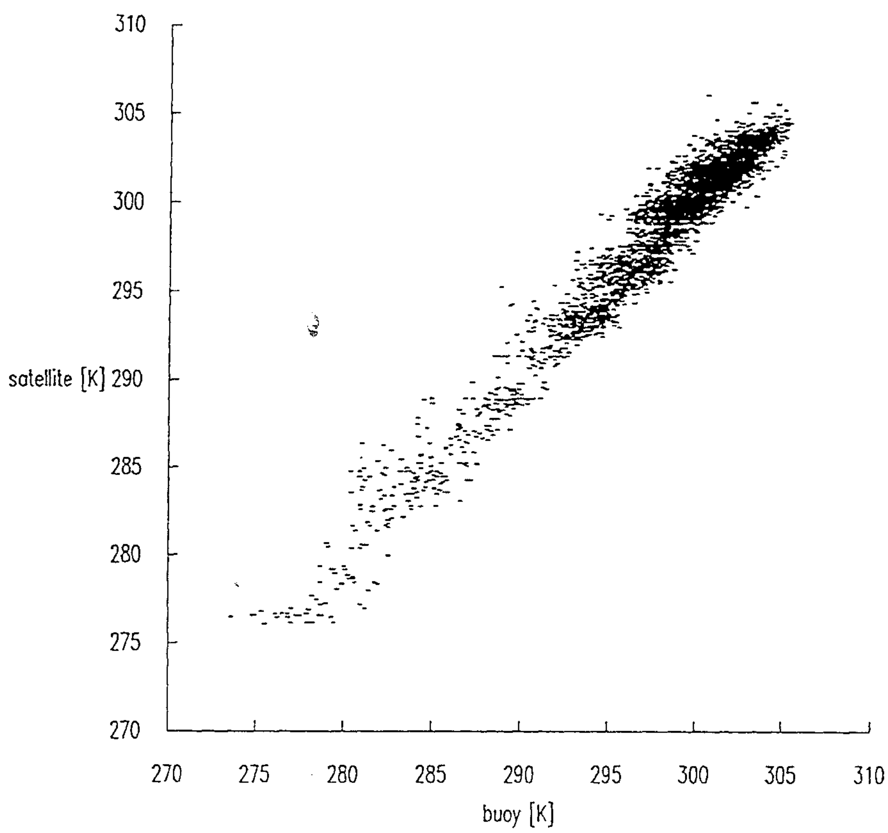
$$SST = 1.03554\, T_{IR1} + 3.6286\, (T_{IR1} - T_{IR2}) + 1.7253\, (T_{IR1} - T_{IR2})(\sec\theta - 1) - 5.4319$$

where T_{IR1} and T_{IR2} are brightness temperatures of the 10.5 to 11.5 μm and 11.5 to 12.5 μm channel respectively, θ is the satellite zenith angle. The scale of T_{IR1}, T_{IR2} (regression input) and SST (output) are expressed in Kelvin.

Verification was made to compare the satellite SSTs with the buoy measurements. RMS of difference of them was in the order of 1 Kelvin. The result of the comparison in January 1996 is shown in Figure-1 and Table-1.

SSTs observed with GMS-5 are distributed to both domestic and international users. The daily mean SSTs with 0.5 latitude/longitude resolution within the area from 50 degree North to 50 degree South and from 90 degree East to 170 degree West are sent to the Headquarters of JMA in GRIB code. Five-day mean SSTs are distributed through Global Telecommunication System (GTS) in SATOB code.

CGMS-XXIV WP-17
Prepared by Japan
Agenda Item: II/4



Figure–1. Comparison between satellite SSTs and buoy measurements in January 1996.

Table–1. Result of comparison between satellite SSTs and buoy measurements in January 1996.

correlation	bias	RMS
0.97	–0.38	1.20

CGMS−XXIV WP−18
Prepared by Japan
Agenda Item: II/5

Upper Tropospheric Air Humidity

Summary and Purpose of Document

The purpose of this paper is to report on the GMS−5 upper tropospheric air humidity product.

No action required.

CGMS−XXIV WP−18
Prepared by Japan
Agenda Item: II/5

Upper Tropospheric Air Humidity

Description

1. The Upper Tropospheric Air Humidity (UTH) is the new product retrieved from GMS−5 water vapor (WV) channel (6.7μm band) data. UTH is defined as mean humidity in the upper troposphere, which corresponds to a layer between 600hPa and 300hPa levels. The Meteorological Satellite Center (MSC), JMA, started to produce the GMS−5 UTH data on June 13, 1995. MSC produces the GMS−5 UTH data six hourly and disseminates routinely to the JMA HQ. In this report, we use 'percentage' as a unit of UTH. Details of the UTH data processing have been reported at CGMS−XXIII Agenda Item:II/4 on the working paper No. 12 prepared by Japan.

2. MSC has developed the GMS−5 UTH retrieval program based upon the algorithm applied to the METEOSAT image data (Schmetz and Turpeinen, 1988). The GMS−5 WV channel sensor is sensitive to water vapor amount and temperature in the upper troposphere. A model of atmosphere is used to relate the GMS−5 WV radiance with UTH. The radiance in the GMS−5 WV channel is calculated for the model according to the radiation transfer theory. The model's temperature profile is forecast data on every 2.5 degree grid provided by the Numerical Weather Prediction (NWP) of JMA. The model's humidity profile in upper troposphere is assumed to be constant at UTH value in the upper troposphere, and that in lower troposphere adopts NWP forecast data.

3. The GMS−5 WV radiance calculated by the model varies with the model's UTH value. Before the UTH retrieval processing, a table of GMS−5 WV radiance and UTH value is prepared. Interpolation of the radiance observed by GMS−5 to the table derives the GMS−5 UTH on every 0.25 degree grid. The UTH values on cloudy area have large errors, so they are rejected by the result of the clear sky radiance retrieval.

4. Evaluation of the GMS−5 UTH data uses radiosonde UTH data (mean humidity in the layer between 600hPa and 300hPa levels) as truth data. The evaluation shows that the mean error (bias) is 2.5% and the root mean square error is 11.2% in January 1996 (See Figure). MSC expects to reduce the root mean square error of GMS−5 UTH to 10% or less that is reported for METEOSAT UTH by EUMETSAT using almost same algorithm. To improve the accuracy of GMS−5 UTH product, MSC is going to examine the accuracy of radiance calculation using in the GMS−5 UTH retrieval.

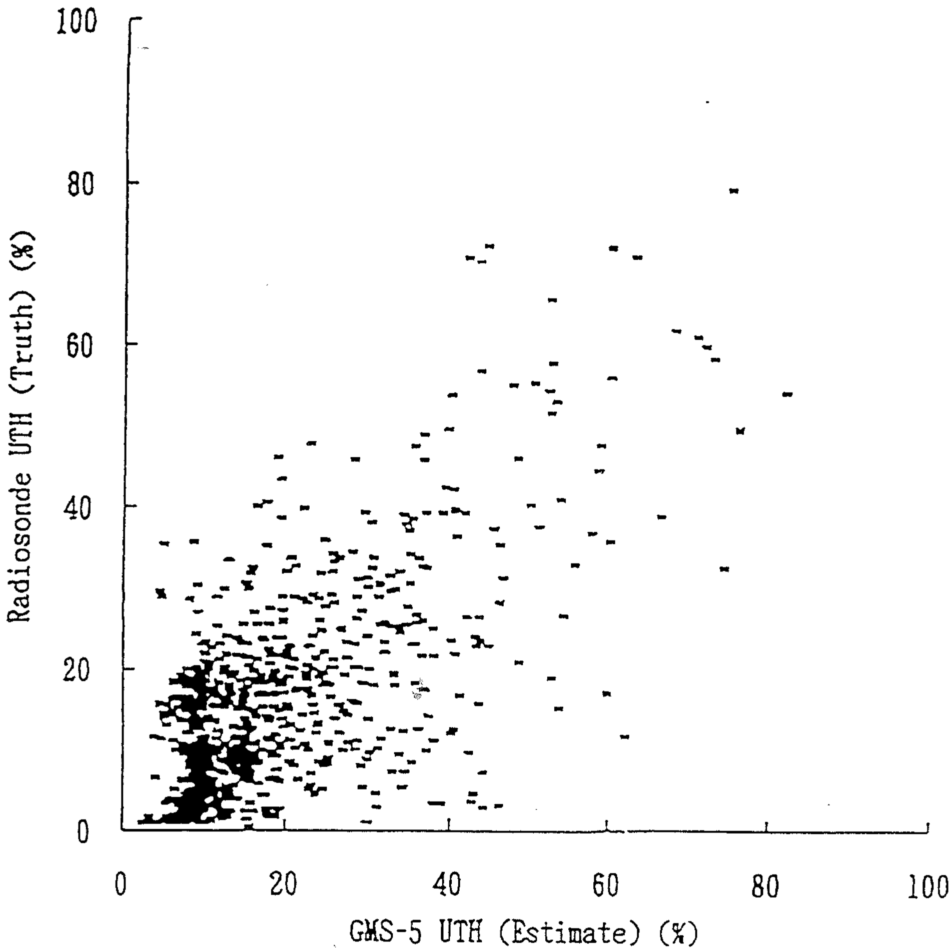


Figure : Scatter diagram of UTH estimates versus truth values in January 1996

CGMS–XXIV WP–20
Prepared by Japan
Agenda Item: III/1

Current Status of the GMS Cloud Motion Wind

Summary and Purpose of the Document

The purpose of this document is to present the status of the GMS cloud motion winds.

No action required

CGMS–XXIV WP–20
Prepared by Japan
Agenda Item: III/1

Current Status of GMS Cloud Motion Wind

The monthly mean differences between Cloud Motion Winds (CMWs) and radiosonde winds were calculated in the same method as the International Comparison of the Satellite Winds. The vector and speed differences from January 1992 to February 1996 are shown in Figs. 1 and 2.

1. Low–level

The Root Mean Square (RMS) vector differences are smaller than 5.0 m/s and the absolute values of the speed differences are smaller than 0.5 m/s since 1992 except for February, June 1994 and July 1995.

2. High–level

The cloud top height of semi–transparent cirrus is estimated using an IR and WV intercept technique after the initiation of GMS–5. The new height assignment method using cloud top height involving semi–transparent cirrus correction was tested and the new method was implemented from 29 August 1995.

The average values of RMS vector differences and speed differences after September 1995 are 8.6 m/s and –1.5 m/s respectively. These values are comparable with previous CMWs using height assignment table. It is necessary to study the height assignment method concentrated on semi–transparent cirrus correction.

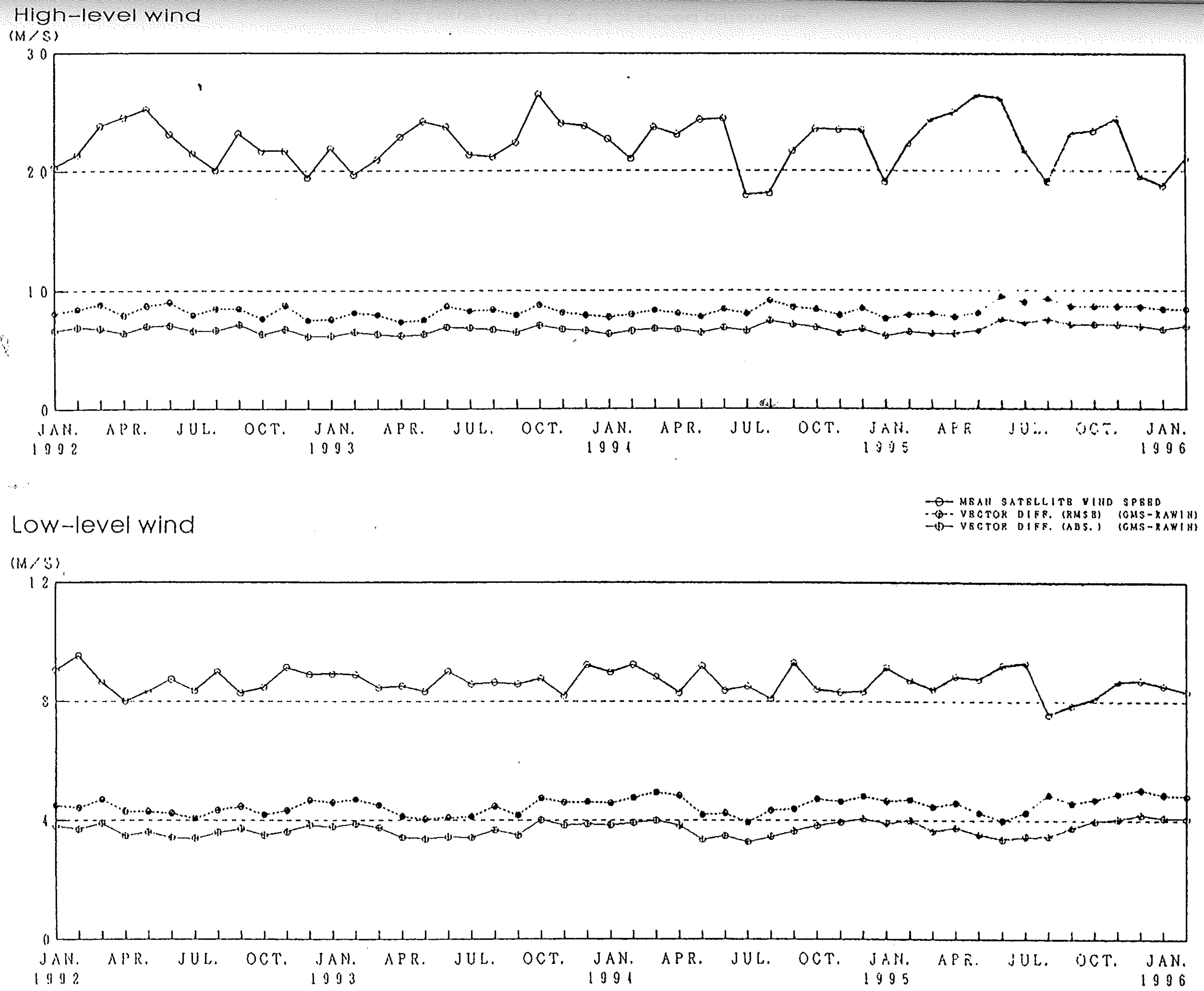


Fig.1 Monthly means of vector differences between CMW and radiosonde wind.

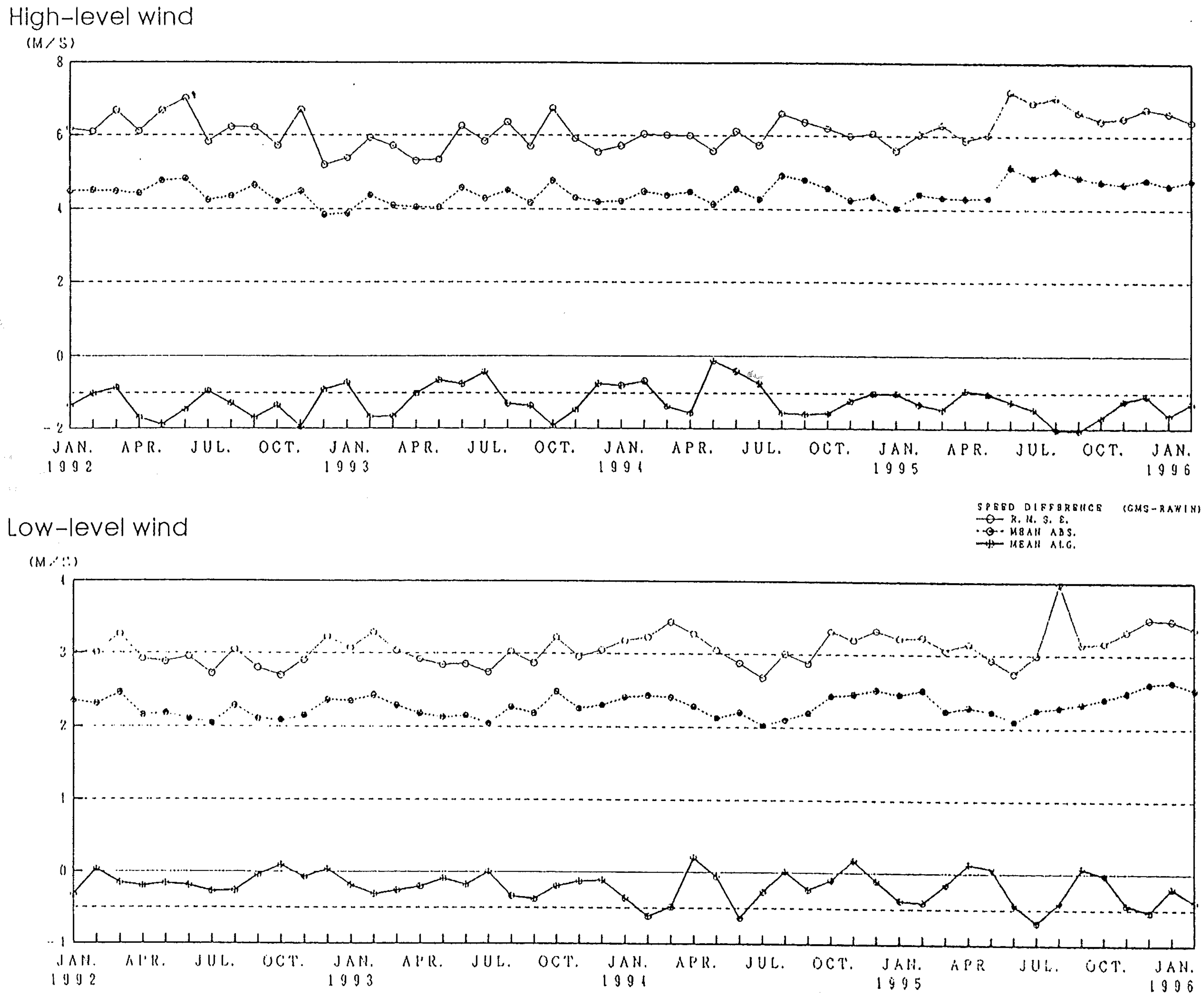


Fig.2 Same as fig.1, but for speed differnces.

CGMS-XXIV WP-21
Agenda Item : III/3
Prepared by Japan

Derivation of Water Vapor Motion Winds

Summary and Purpose of Document

The purpose of this document is to present methods of water vapor motion wind extraction for GMS-5.

No action required

CGMS–XXIV WP–21
Agenda Item : III/3
Prepared by Japan

Derivation of Water Vapor Motion Winds

The MSC has produced water vapor motion winds (WVMWs) since 13 June 1995. An example of WVMWs is shown in Fig. 1. WVMWs are calculated automatically four times a day, i.e., at 00, 06, 12, and 18 UTC using three consecutive images at 30–minute intervals. They are transmitted to the Numerical Prediction Division of JMA for the quality evaluation. We have a plan to begin transmission of WVMW data via GTS after the completion of the evaluation.

A flow chart of the WVMW extraction system is shown in Fig. 2. Main processes are described briefly as follows.

1. Target selection

Targets are selected on the middle image of three successive WV images. Small areas of 32 lines x 32 pixels in which the lowest brightness temperature is lower than a threshold temperature are selected as a target.

2. Tracking

A target selected on the middle image is tracked using the cross–correlation backward on the previous image and forward on the subsequent one. Two successive displacement vectors are calculated from the target in consequence. If the magnitude of the difference between the two successive vectors does not exceed a threshold value, the latter of the two successive vectors is adopted as the resultant WVMW.

3. Height assignment

The height determined from the WV brightness temperature in the small area is assigned to the WVMW. We adopted the height corresponding to the lowest 1.0 % of the WV brightness temperature until August 1995. As from September, we have used the lowest 10 % of the temperature.

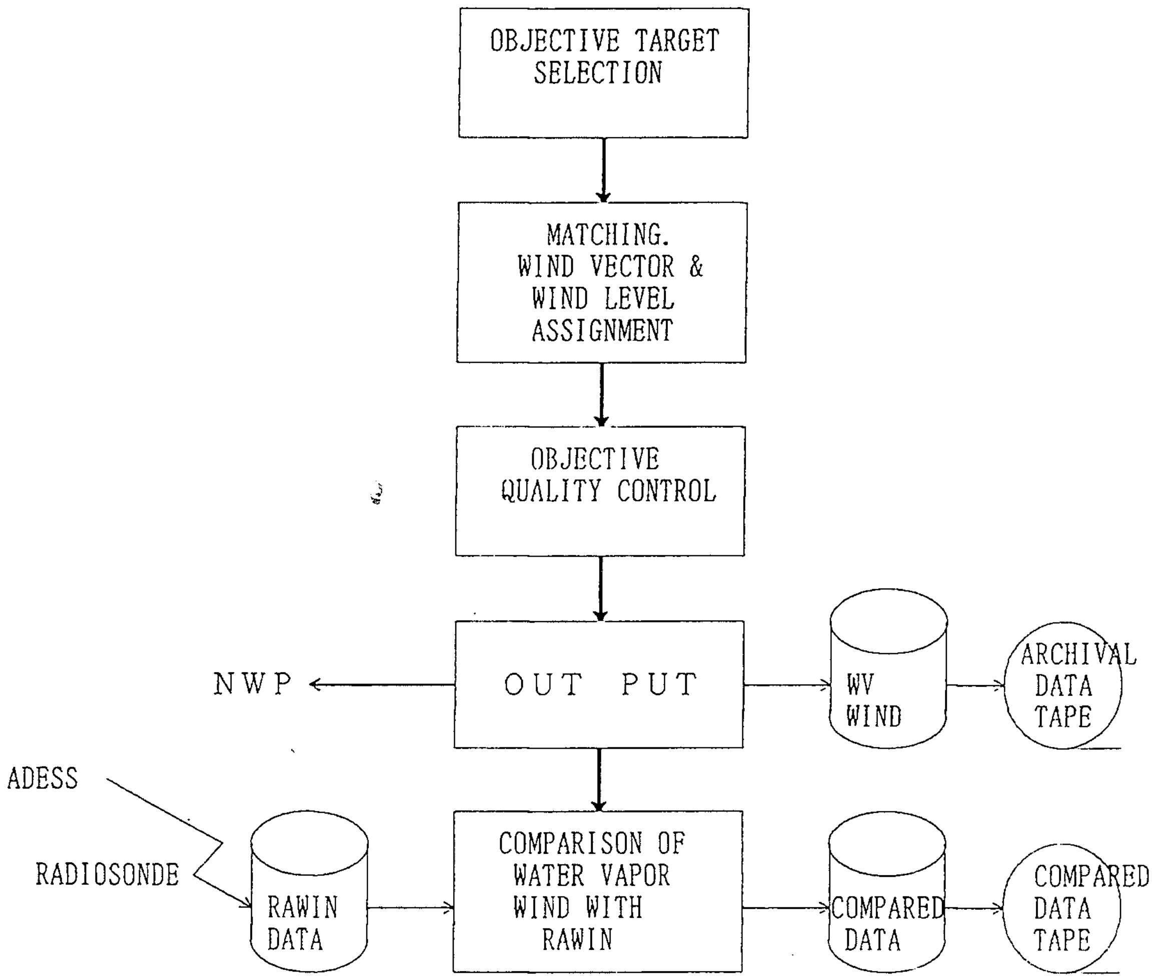
4. Objective quality control

A quality check of a WVMW is performed only automatically. The homogeneity of speed, direction, and height is checked and, if the WVMW is determined to be unreliable, the wind is rejected automatically.

5. Accuracy

To evaluate the accuracy, WVMWs were compared with radiosonde winds. The statistics are summarized in Table 1. For high–level (p<400hPa) WVMWs, RMS vector difference and bias are comparable with that of the operational high–level cloud motion winds. The accuracy of mid–level WVMWs (p>400hPa) is poorer than that of high–level WVMWs.

WATER VAPOR MOTION WIND



NWP:Numerical Weather Prediction
ADESS:Automated Data Editing and Switching System

Fig. 2. Flow chart of the Water Vapor Wind Extraction System.

Table 1. WVMW statistics against radiosonde winds.

		RMS vector diff.	Bias	Mean speed WVMW	Mean speed Radiosonde	sample
1995 July	100-400hPa	8.7	-1.7	17.5	19.2	1705
	400hPa-	11.1	-0.7	15.1	15.8	156
Aug.	100-400hPa	8.0	-0.5	14.4	14.9	1101
	400hPa-	10.1	1.1	14.0	12.9	168
Sep.	100-400hPa	8.5	-0.8	18.8	19.6	1133
	400hPa-	10.0	-0.5	15.9	16.4	244
Oct.	100-400hPa	9.0	-1.7	18.6	20.2	1048
	400hPa-	9.2	0.3	16.0	15.7	318
Nov.	100-400hPa	8.0	-0.5	18.2	18.6	882
	400hPa-	11.2	0.4	19.4	19.0	246
Dec.	100-400hPa	9.0	-0.6	14.6	15.2	728
	400hPa-	9.9	-0.4	18.1	18.4	287
1996 Jan.	100-400hPa	8.3	0.1	16.4	16.3	830
	400hPa-	9.5	0.2	17.3	17.1	216

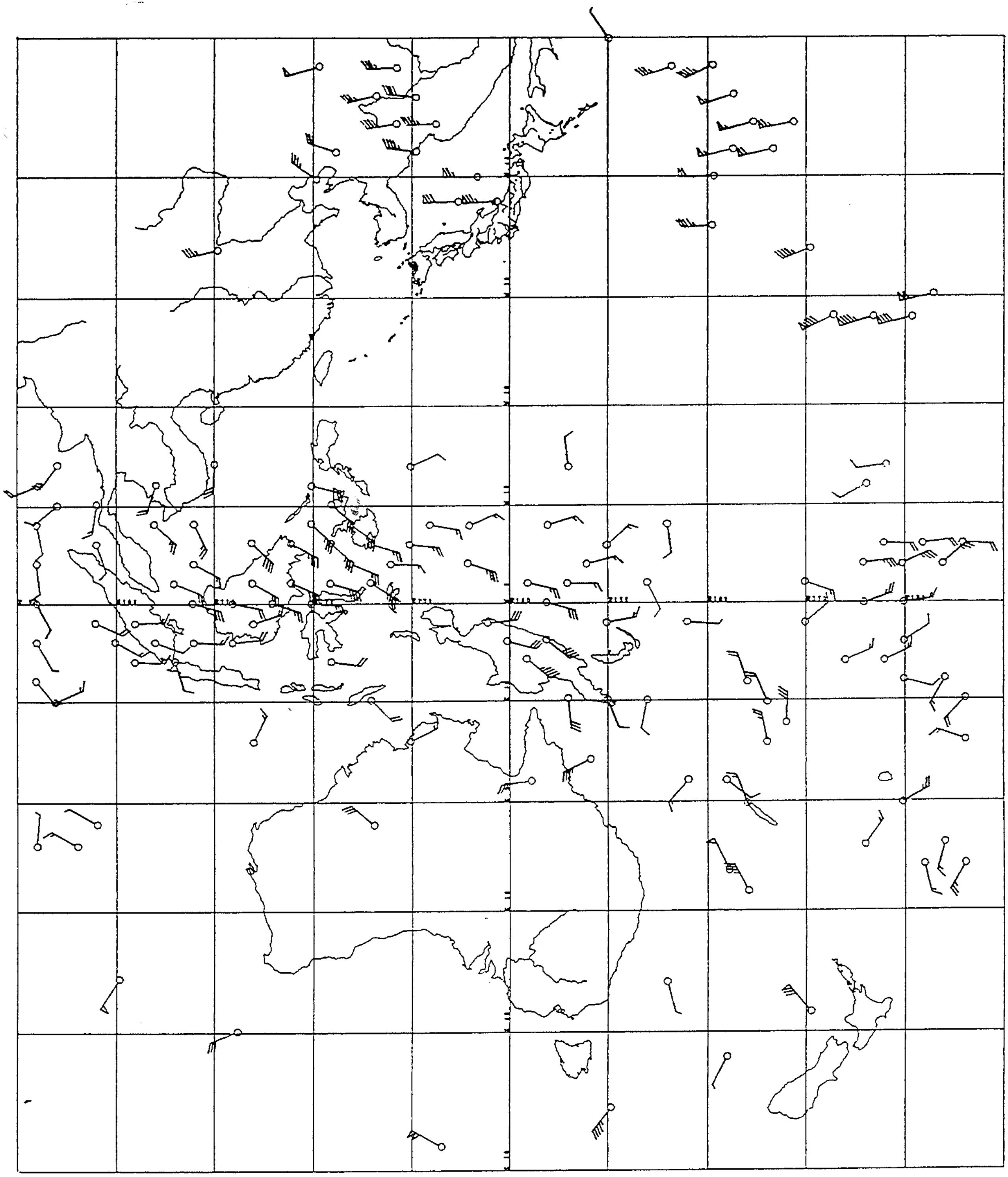


Fig. 1. WVMW at 00UCT on February 13, 1996.

CGMS-XXIV PRC WP-05
Prepared by China
Agenda Item : II/2

The Characteristics of Chinese Remote Sensing

Radiometric Calibration Sites

Summary and Purpose of Document

In response to CGMS Action 23.26, this describes the characteristics of Chinese remote sensing radiometric calibration sites, Dun Huang and Qing Hai Lake. These sites are now being designed and established.

Action Proposed

None

CGMS-XXIV PRC WP-05
Prepared by China
Agenda Item : II/2

The Characteristics of Chinese Remote Sensing Radiometric Calibration Sites

----- Response to CGMS action 23.26 -----

Three years ago China planned to establish remote sensing radiometric calibration sites . According to the results of sites inspecting, Dun Huang had been chosen as the absolute radiometric calibration site for visible, near IR and short wave IR band , and Qing Hai Lake as the absolute radiometric calibration site for thermal IR band and the absolute radiometric calibration of low reflectance target in visible and near IR band.

This project has been approved . It is expected that these calibration sites will be operated in 1998 .

The characteristics of Dun Huang site are as following :

-- Location : southwest of Gansu Province (at the west of Dun Huang City), 40.1° N, 94.3° E
-- Size : 30km X 40km
-- Surface of the site : Gobi desert , it is few covered by vegetation
-- Average altitude : 1139 m
-- Climate : continental climate average temperature , 9.5 centigrade/year average rainfall , 34.1 mm/year average humidity ,43.9 %
-- Visibility : greater than 10 Km at horizontal direction
-- Average reflectance : 0.20 (0.4-2.5 micrometer), good bidirection reflectance function(Lambert characteristic)

The characteristics of Qing Hai Lake are as following :

-- Location : at the Northeast of Qing Hai Province, 37° N, 100° E
-- Size : 360 Km circumference, 4685 Km X Km , one of the biggest continental saltwater lakes in China.
-- Average altitude : 3196 m
-- Depth : 19 m (average) , 28 m (deepest)
-- Visibility : greater than 10 Km at horizontal direction
--Temperature change : less than 1 centigrade in 20Km X 20Km area
-- Climate :
  average rainfall, 352 mm/year
  average temperature , 0.9 centigrade
  average humidity , 58 %
  average sunshine , 3000 hour

CGMS-XXIV RUS-WP-03
Prepared by RUSSIA
Agenda Item: C.1

REPORT ON THE STATUS OF FUTURE POLAR ORBITING METEOROLOGICAL SATELLITE SYSTEMS

Summary and purpose of document

The purpose of this document is to provide a report on next series of russian polar orbiting meteorological satellites

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Action

No action required

CGMS-XXIV RUS-WP-03
Prepared by RUSSIA
Agenda Item: C.1

REPORT ON THE STATUS OF FUTURE POLAR ORBITING METEOROLOGICAL SATELLITE SYSTEMS

In 1998 and in 2000 we are planning to start the operation of the satellites Meteor-3M No. 1 and Meteor-3M No. 2. On board of these satellites modified radiometers of visible and IR range as well as micro-wave sounding devices will be installed. Agreement has been concluded between Russian Space Agency and NASA for the installation of American instruments SAGE-III and TOMS on board of the satellites Meteor-3M No. 1 and Meteor-3M No. 3 respectively. The satellite Meteor-3M will be launched on sun-synchronized orbit and will have improved radio downlink. Planned onboard instruments and their characteristics are given in Table 1 and 2 below. The characteristics of future Russian environmental satellite RESURS-01#4 are given in Table 3. The payload of this space system will namely include some instruments for a meteorological mission. Preliminary schedule for launch of Russian satellites is given in Table 4.

PAYLOAD FOR RUSSIAN OPERATIONAL SATELLITES METEOR-3M N. 1

NAME	APPLICATION	SPECTRAL BAND μm	SWATH WIDTH km	RESOLUTION km
MR-2000M	Cloud cover mapping	05. - 0.8	2500	0.7 * 1.4
MR-900M	Cloud cover mapping	0.5 - 0.8	2100	1 * 2
Klimat	Cloud cover mapping	10.5 - 12.5	2500	2.5 * 2.5
MIVZA	Total humidity of the atmosphere	20.0 35.0 94.0 GHz (5 channels)	1500	80 - 40
MTZA	Atmospheric temperature profile	20.0 35.0 52.2 52.9 53.3 54.4 55.5 57.0 94.0 GHz (15 channels)	1500	80 - 40
ScaRaB	Radiation balance of the Earth	0.2-4.0 0.2-50.0 0.5-0.7 10.5-12.5	2200	60
SAGE III	Profiles of aerosols, ozone, NO_2, NO_3, OCIO, humidity temperature, pressure	0.29 - 1.55 (9 channels)		1 - 2 (vertical)
ISP-2M	Solar irradiance	0.2-10.5 0.3-3.0		
KGI-4	Space environment monitoring	Protons, electrons, Alpha particles, ions fluxes		
MSGI-5	Space environment monitoring	Geo-active irradiances		
RMK-2	Space environment monitoring	5-90MeV-protons, 0.15-3MeV-electrons		

PAYLOADS FOR RUSSIAN OPERATIONAL SATELLITES
METEOR-3M N 2

SENSOR	ATMOSPHERIC PARAMETERS	SPECTRAL BAND	SWATH WIDTH km	RESOLUTION km
MSR	Cloud cover mapping	0.5 - 0.7, 0.8 - 1.0, 10.4 - 11.3, 11.5 - 12.5 μm	2700	1
MTZA	Atmospheric temperature profile	20.0, 35.0, 52.2, 52.9, 53.3, 54.4, 55.5, 57.0, 94.0 GHz (15 channels)	1500	30 - 40
MZOAS	Ocean, atmosphere and ground monitoring	0.2, 10.3, 20.0, 22.2, 35.0, 94.0 GHz (11 channels)	1500	160 - 9
MVZA	Atmospheric humidity profile	94.0, 155.0, 183.0 GHz (5 channels)	1500	20 - 10
TOMS	Total ozone mapping	312 - 380 nm (6 channels)	3100	64
KGI-4	Space environment monitoring	Protons, electrons, Alpha particles, ions fluxes		
MSGI-5	Space environment monitoring	Geo-active irradiances		

PAYLOADS FOR RUSSIAN OPERATIONAL SATELLITES RESURS-01 to -04

SENSOR	ATMOSPHERIC PARAMETERS	SPECTRAL BAND	SWATH WIDTH km	RESOLUTION km
MSU-E	Images of the Earth's surface	0.5 - 0.6 0.6 - 0.7 0.8 - 0.9 μm	56/100	0.028
MSU-SK	Images of the Earth's surface	0.5 - 0.6 0.6 - 0.7 0.7 - 0.8 0.8 - 1.1 10.4 - 12.6 μm	760	0.215
MR-900M	Cloud cover mapping	0.5 - 0.3 μm	2500	1.6 * 1.8
RMK-M	Space environment monitoring	1... 600 MeV 30 MeV ...	- protons	
		0.15 ... 3.1 MeV 2 MeV ...	- electrons	
ScaRaB	Radiance from the Earth	0.2 - 4.0 0.2 - 50.0 0.5 - 0.7 10.5 - 12.5 μm	2200	60
MIVZA	Humidity profile	0.32 cm (H) 0.86 cm (H, V) 1.5 cm (H, V)	1100	60 60 80
ISP-2M	Irradiance from the sun Radiance from the Earth	0.2 - 10.5 μm 0.3 - 3.0 μm		
NINA	Space environment monitoring	2 ... 15 MeV 21 ... 75 MeV 80 ... 300 MeV 0.7 ... 2.5 GeV	- electrons, - protons, - nucleus of helium, - nucleus of oxygen	

PRELIMINARY SCHEDULE FOR RUSSIAN SATELLITES IN 1996 - 2002

Spacecraft	Presently	1996	1997	1998	1999	2000	2001	2002
GOMS	# 1 (1994)			# 2		# 3		
METEOR-3	# 5 (1991)							
METEOR-3M				# 1		# 2		# 4 (Arctic)
RESURS-01	# 3 (1994)		# 4 (+Meteo)		# 5 (+ Meteo) (+ Arctic)			

CGMS XXIV
USA WP-12
Agenda Item II/3

GOES-8 Temperature and Moisture Soundings

Summary and Purpose of Document

to provide a status report on initial assessment of the performance of the GOES-8 sounder temperature and moisture retrievals

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Action Requested: None

Evaluation of the NOAA/NESDIS Operational GOES-8 Temperature and Moisture Soundings

W. Paul Menzel[1], Timothy J. Schmit[2], Christopher Hayden[2], and Don Gray[1]
1 - NOAA/NESDIS
2 - Cooperative Institute for Meteorological Satellite Studies

I. Introduction

Since July 1995, NESDIS has been producing operational GOES-8 hourly temperature and moisture soundings over the continental United States using a simultaneous physical retrieval algorithm (Hayden, 1988). Moreover, since February 1996, GOES-9 soundings over the eastern Pacific Ocean and the western United States have been routinely available every hour. Validation of the GOES-8 retrievals has been accomplished with collocated radiosonde observations. It has been demonstrated that the retrievals are more accurate than the National Center for Environmental Prediction (NCEP) short-term, regional forecasts, for both temperature and moisture, even in the vicinity of the radiosonde where they must necessarily be verified (Hayden and Schmit, 1996).

II. Background on Soundings

There are several GOES products that come under the category of soundings. They include the clear field of view (FOV) brightness temperatures, profile retrievals of temperature and moisture, as well as their layer mean values, lifted indices, and thermal wind profiles. In cloudy skies, the cloud top pressure and cloud amount are sounder products also.

Vertical temperature profiles from sounder radiance measurements are produced at 40 pressure levels from 1000 to 0.1 mb using a simultaneous, physical algorithm that solves for surface skin temperature, atmospheric temperature and atmospheric moisture. Also, estimates of surface emissivity and cloud pressure and amount are obtained as by products. The retrieval begins with a first guess temperature profile that is obtained from a space/time interpolation of fields provided by the NCEP forecast models. Hourly surface observations are also used to provide surface boundary information. Soundings are produced from a 5x5 array of FOVs whenever 9 or more FOVs are determined to be either clear or "low cloud". The FOVs are "cloud filtered" and co-registered to achieve an homogeneous set. The location (latitude and longitude) of the retrieval is assigned to the mean position of the filtered sample. A "type" indicator is included to indicate if the sounding represents "clear" or "low cloud" conditions. A quality indicator is included to indicate if the retrieval has failed any internal quality checks.

Vertical moisture (specific humidity) profiles are obtained in the simultaneous retrieval, and thus are provided at the same levels as temperature. Since the radiance measurements respond to the total integrated moisture above a particular pressure level, the specific humidity is a differentiated quantity rather than an absolute retrieval. Geopotential height profiles are derived from the full resolution temperature and moisture profiles. Precipitable water is integrated from retrievals of specific humidity for several layers.

III. GOES Sounding Verification

The retrieved temperature and dewpoint profiles as well as the layered precipitable water are evaluated. The last is included because it is this quantity which has been first introduced into the NCEP regional forecast (Lin et al., 1996). An example of typical retrieval coverage, for GOES-8 located at 75 W, is given in Figure 1. Typically between 800 and 1500 retrievals, depending on cloud cover, are made each hour over the area indicated.

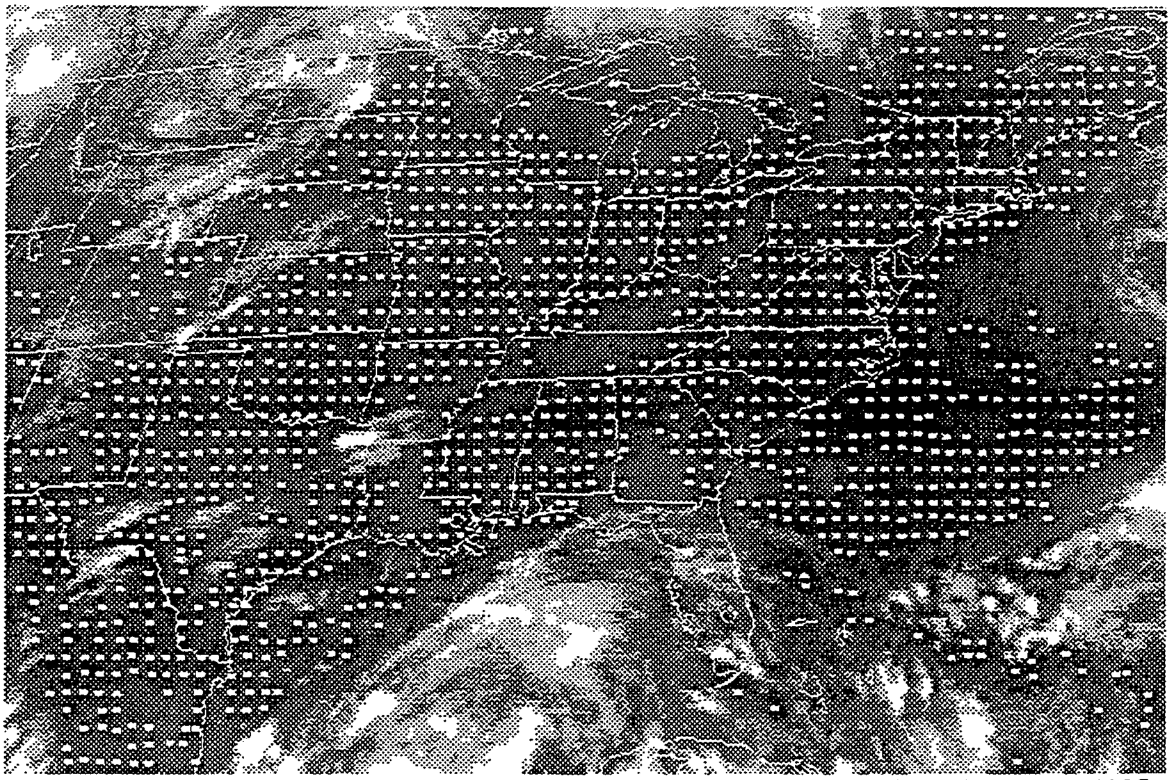

Figure 1. An example of GOES-8 sounder coverage (white dash) for 00 UT on October 2, 1995.

Results for temperature are graphed in Figure 2. Bias and RMS estimates for both the retrieval and the forecast are shown as solid and dashed lines respectively. Collocation with radiosonde must be within 1 degree. Seven levels have been measured from 1000 to 200 hPa. The retrieval RMS and bias values are only slightly, though consistently, better than the forecast values. In general, the temperature profiles of the forecast guess are not changed much by the retrieval, due to their high quality over the U.S. The period of the 5471 comparisons is between August and December, 1995.

Corresponding bias and RMS results for moisture are shown in Figure 3. The improvements to the moisture profile are more substantial than those of temperature; there is skill in differentiating the vertical distribution of moisture. Four layers have been measured: total column, surface to 0.9 sigma, 0.9 to 0.7 sigma and 0.7 to 0.3 sigma (where sigma is the ratio of the pressure over the surface pressure). RMS is reduced for all layers, plus the bias is significantly reduced for the lowest layers.

Figure 4 shows the temperature profile results for matches where the 700 hPa guess deviates from the radiosonde by over 2 degrees; this represents situations where the guess is not as accurate as the usual temperature profile over the U.S. and can be improved by the sounding retrieval. 519 of the 5471 comparisons met this criterion. Now, both the RMS and bias values show a larger improvement over the first guess.

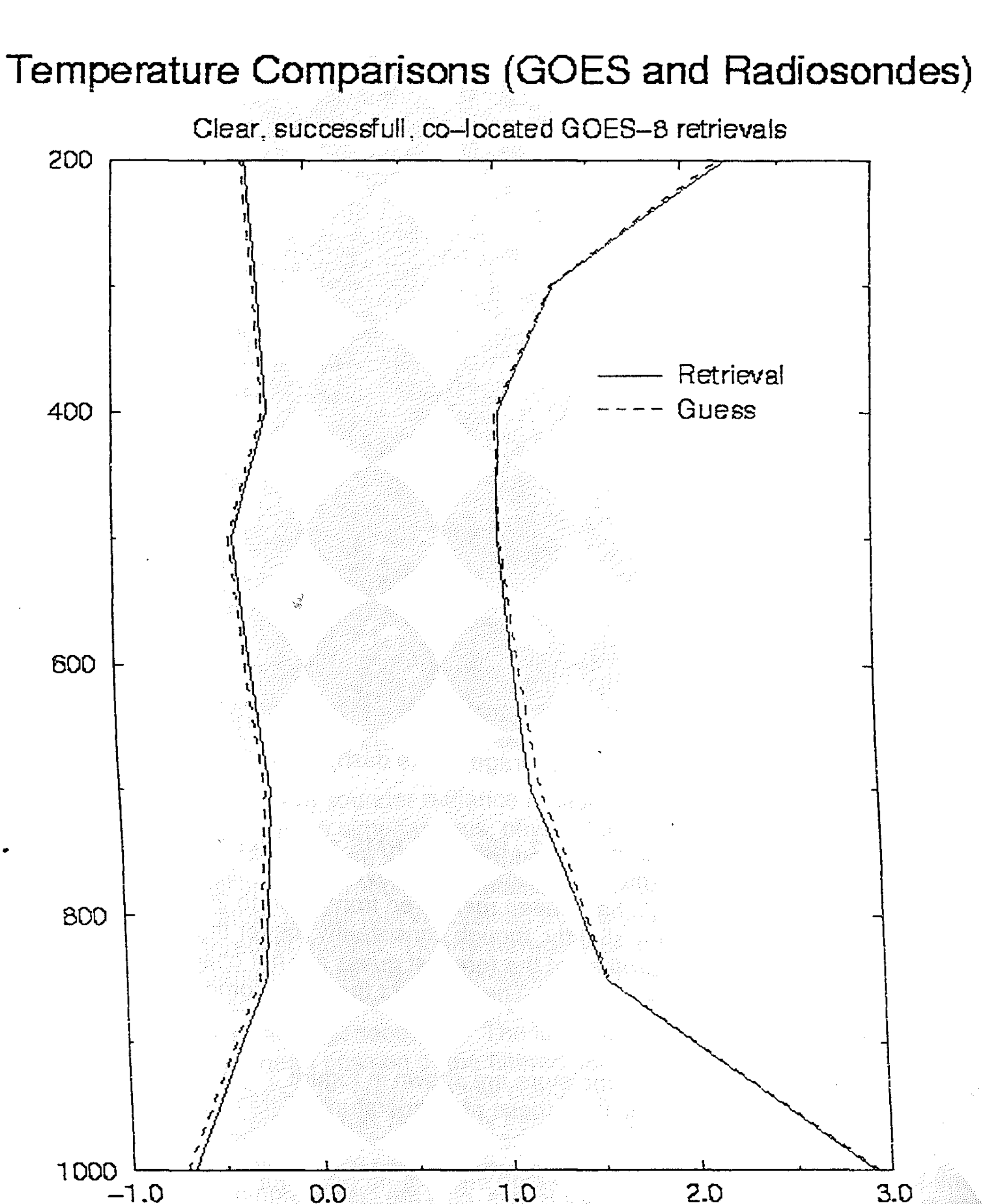

Figure 2. Verification of temperature retrievals collected between August and December 1995. Units are degrees K. Solid line is retrieval vs. radiosonde; dashed line is forecast guess vs. radiosonde. Bias plots are to the left, RMS plots are to the right. GOES temperature retrieval improves upon guess by about 0.1 C in bias and RMS.

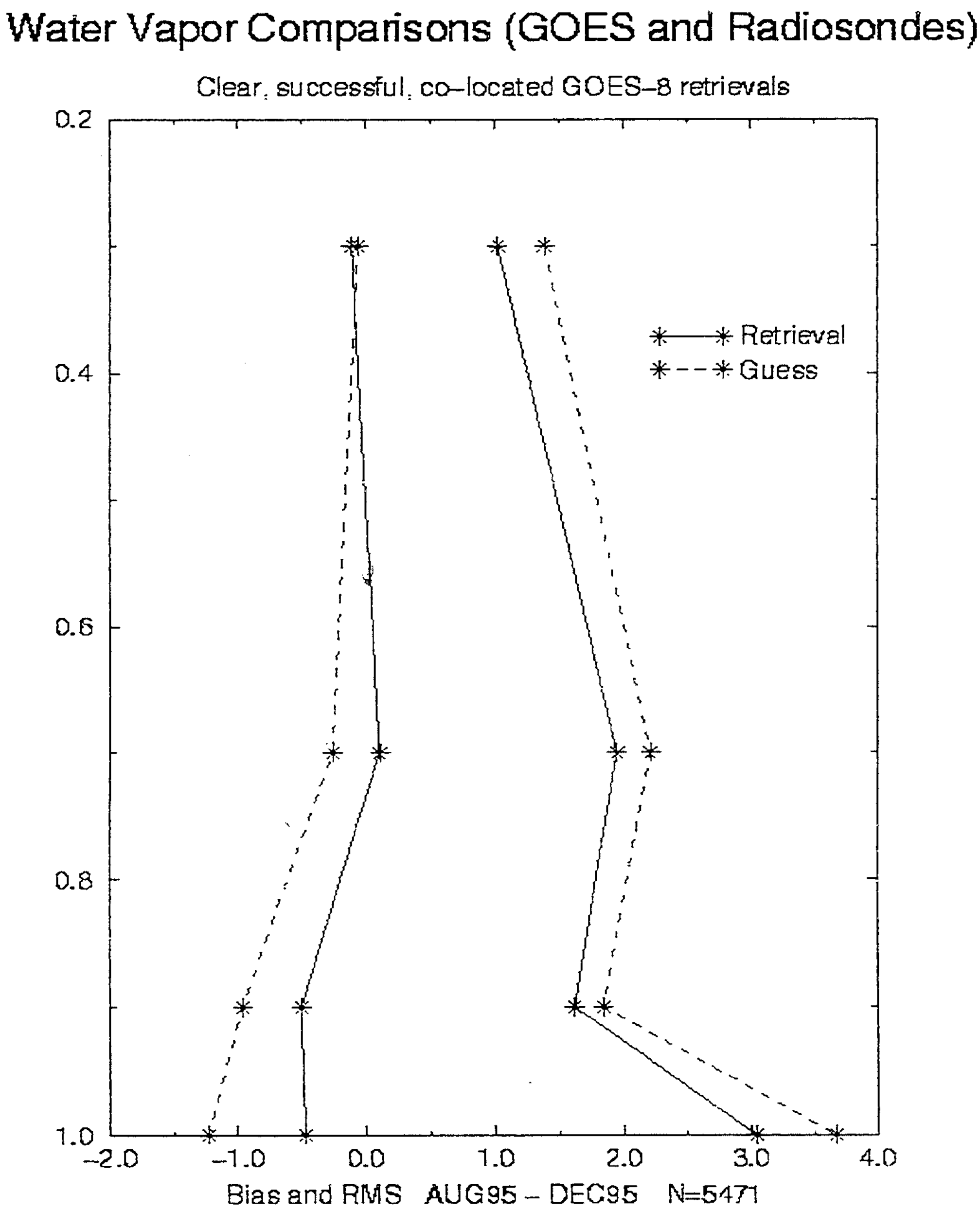

Figure 3. Verification of layer precipitable water (PW) vapor retrievals collected between August and December 1995. Levels are indicated in sigma coordinates (P/Ps). Water vapor determinations at 1.0 represent total cloumn, determinations at other levels represent integrated PW from lower level to that level. Units are mm of water. Solid line is retrieval vs. radiosonde; dashed line is forecast guess vs. radiosonde. Bias plots are to the left, rms plots are to the right. GOES PW improves upon guess bias by 0.5 to 1.0 mm and improves upon guess RMS by about 0.3 mm.

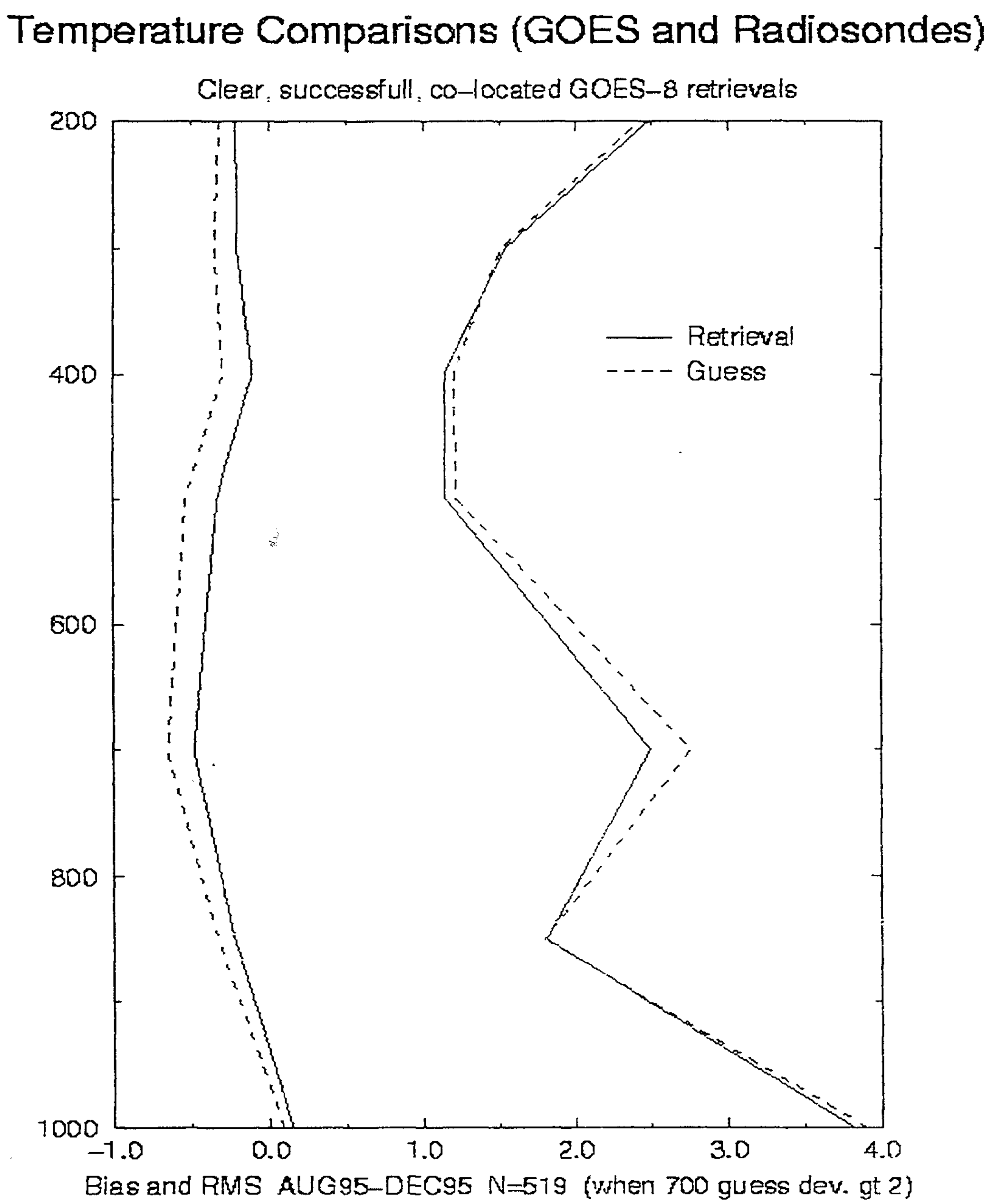

Figure 4. Temperature comparisons between those derived from the GOES-8 sounder and radiosonde observations, with a guess deviation at 700 hPa greater than 2 C. GOES temperature retrieval for this set improves upon the guess by about 0.3 C in bias and as much as 0.5 C in RMS.

IV. Summary

GOES-8 is providing retrievals which are an improvement over the short term NCEP regional forecasts for both moisture and temperature. This result is obtained in the only place it can be demonstrated, in the vicinity of radiosondes where the short term forecast has the advantage of recent observations. It seems reasonable to us that the improvement upon the forecast in data sparse areas is probably greater.

REFERENCES

Hayden, C. M., 1988: GOES VAS simultaneous temperature moisture retrieval algorithm, *J. Appl. Meteor.*, **27**, 705-733.

Hayden, C. M., and T. J. Schmit, 1994: GOES-I temperature moisture retrievals and associated gradient wind estimates. Preprint volume, Seventh Conference on Satellite Meteorology and Oceanography. June 6-10, 1994, Monterey CA. 477-480.

Hayden, C. M., H. E. Fleming, and T. J. Schmit, 1996: GOES radiance bias tuning and temperature/moisture sounding validation. Submitted to *J. Appl. Meteor.*

Hayden, C. M., G. S. Wade and T. J. Schmit, 1996: Derived Product Imagery from GOES-8. *J. Appl. Meteor.*, **35**, 153-162

Lin, Y., E. Rogers, G. J. DiMego, K.E. Mitchell and R. M. Aune, 1996: Assimilation of GOES moisture data into NMC's ETA model. Preprint volume, AMS Eigth Conference on Satellite Meteorology, 28 Jan - 2 Feb., 1996, Atlanta, GA.

CGMS XXIV
USA WP-13
Agenda Item III-1

GOES-8 Winds Performance

Summary and Purpose of Document

to provide a report on recent GOES-8 winds performance and to distribute an example evaluation in the newly suggested CGMS winds reporting format

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Action Requested: None

Recent Performance of the NOAA/NESDIS Automated Cloud-Motion Vector System

W. Paul Menzel [1], Steve Nieman [2], Don Gray [1], and Christopher Hayden [2]
1 - NOAA/NESDIS
2 - Cooperative Institute for Meteorological Satellite Studies

I. Introduction

Since 1994, NESDIS has been producing GOES-8 cloud motion vectors (CMV) without manual intervention. Suitable tracers are automatically selected within the first of a sequence of images and heights are assigned using the H2O intercept method (Nieman et al., 1993). The tracking of features through the subsequent imagery is automated using a covariance minimization technique (Merrill et al., 1991) and an automated quality-control algorithm (Hayden, 1993; Hayden and Nieman, 1996) is applied. Results show that the automated GOES-8 cloud-drift winds are superior to any previous NESDIS CMV product.

II. Improvements in Tracer Selection and Automated Quality Control

Tracer selection for GOES-8 has been improved. In the old tracer selection algorithm, the highest pixel brightness values within each target domain were found, local gradients were computed around those locations, and adequately large gradients were assigned as target locations (figure 1).

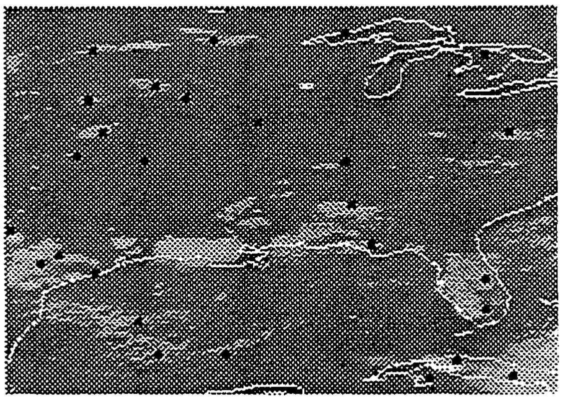

Figure 1. Typical target distribution resulting from the old tracer selection algorithm

In the new tracer selection algorithm, maximum gradients undergo a spatial-coherence analysis. Too much coherence indicates coastlines and leading edges of thunderstorm anvils and thus is undesirable. The presence of more than two coherent scenes often indicates mixed level clouds; such cases are screened. The resulting targets from the new scheme (figure 2) show a higher density of tracers in desirable locations, and almost none in the large clear areas where the old tracer selection algorithm selected targets (figure 1). These selection procedures are not enabled for water vapor motions, where clear air coverage in areas of relatively weak water-vapor gradients is sought to complement the CMV cloudy area coverage.

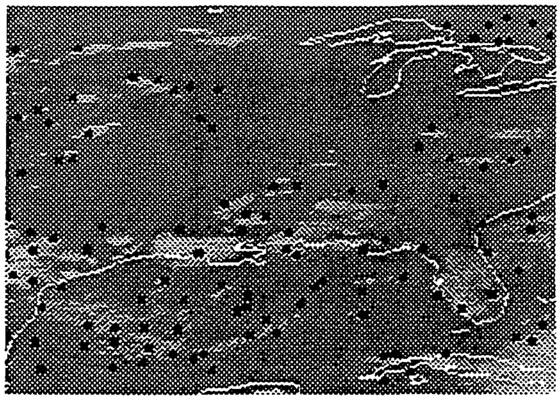

Figure 2. Typical target distribution resulting from the new tracer selection algorithm

Editing the CMVs through analyses with respect to a first guess wind and temperature profile field involves speed adjustment, height adjustment, and quality assessment (figure 3). To mitigate the well known slow bias of the CMV, each vector is incremented by 7 percent of the speed of the forecast, interpolated to the assigned level. The pressure or height reassignment is constrained to 100 hPa. A tropopause test looks for lapse rates of less than 0.5 K per 25 hPa above 300 hPa and prohibits re-assignment to some stratospheric heights. The quality assessment (Hayden and Purser, 1995) relies on a 3-dimensional recursive filter objective analysis developed at CIMSS.

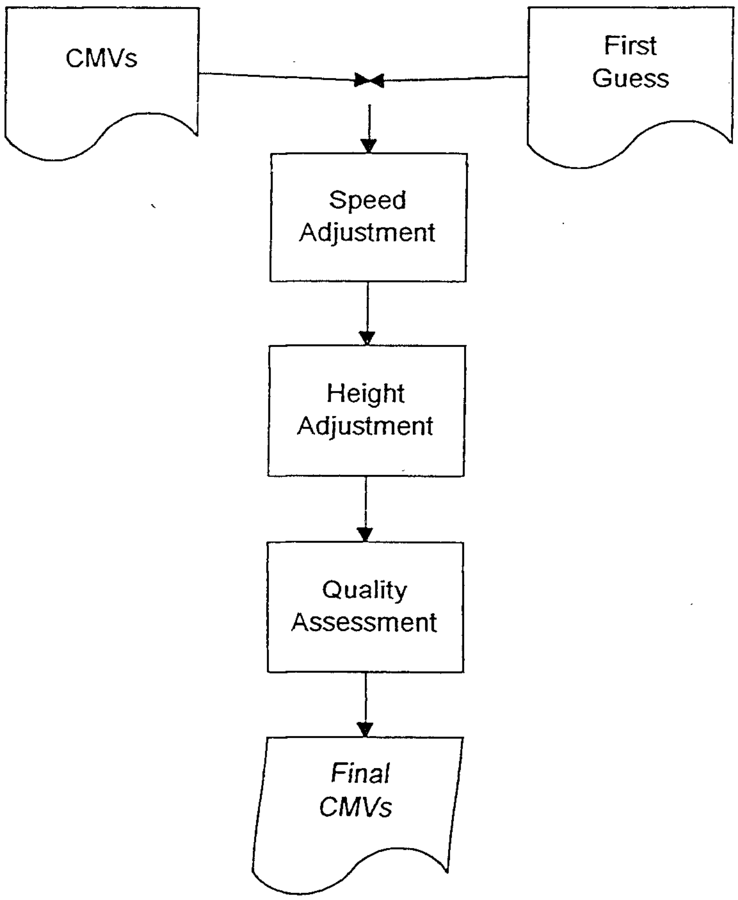

Figure 3. Procedure for editing cloud motion vectors.

III. CGMS Wind Evaluation Reporting Guidelines

At the CGMS XXIII the Working Group on Satellite Tracked Winds recommended that evaluation of operational wind production quality should be accomplished with a new standardized reporting method. They recommended three parts to the report. (1) Monthly means of speed bias and rms vector difference between radiosondes and satellite winds for low- (> 700 hPa), medium- (700-400 hPa), and high- (< 400 hPa) levels together with the radiosonde mean wind speed. This should be done for three latitude bands: north of 20 N, the tropical belt (20N to 20S), and south of 20 S. (2) Trends of the evaluation statistics for the monthly cloud motion vectors and water vapor motion vectors through the last 12 months. (3) Information on recent significant changes in the wind retrieval algorithm.

The vector difference $(VD)_i$ between an individual wind report (i) and the collocated rawinsonde (r) report used for verification is given by,

$$(VD)_i = \sqrt{(U_i - U_r)^2 + (V_i - V_r)^2}.$$

The speed bias is given by

$$(BIAS)_i = \frac{1}{N}\sum_{i=1}^{N}\left(\sqrt{U_i^2 + V_i^2} - \sqrt{U_r^2 + V_r^2}\right)$$

The mean vector difference (MVD) traditionally reported is,

$$(MVD) = \frac{1}{N}\sum_{i=1}^{N}(VD)_i.$$

And the standard deviation (SD) about the mean vector difference traditionally reported is,

$$(SD) = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left((VD_i) - (MVD)\right)^2}.$$

The root-mean-square error (RMSE) traditionally reported is the square root of the sum of the squares of the mean vector difference and the standard deviation about the mean vector difference,

$$(RMSE) = \sqrt{(MVD)^2 + (SD)^2}.$$

It must be noted that this definition of the mean vector difference is not the same as the mean component difference. The mean difference is calculated from the sum of the squares of the deviations of each component (u and v) of the wind vector

$$(\Delta U^2) = \sum_{i=1}^{N} (U_i - U_R)^2,$$

$$(\Delta V^2) = \sum_{i=1}^{N} (V_i - V_R)^2,$$

$$(MCD) = \sqrt{\left((\Delta U^2) + (\Delta V^2)\right)} \neq (MVD).$$

To avoid confusion, a common terminology must be accepted . We suggest reporting mean vector difference (MVD) and standard deviation (SD).

IV. Example Evaluation Results

Following the new guidelines for CMV evaluation, the GOES-8 winds are assessed through collocation with rawinsonde (RAOB) observations. Statistics for the last quarter of 1995 are given in table 1 for the suggested 3 levels of the atmosphere and 3 latitudinal regions. Monthly statistics do not provide adequate number of collocations in the southern hemisphere, hence quarterly statistics are presented here and also recommended for the CGMS reporting. Similar statistics for the water vapor drift winds are shown in table 2.

	ALL REGIONS	NH EX-TROP	TROP	SH EX-TROP
ALL LEVELS				
MVD	5.61	5.97	4.57	5.78
SD	4.26	4.54	2.98	4.85
BIAS	-.40	-.41	-.46	.36
SPD	19.20	22.31	10.48	16.46
N	2823	2039	703	81
HI				
MVD	5.97	6.31	5.01	6.57
SD	4.41	4.72	3.19	5.12
BIAS	-.43	-.26	-.97	.54
SPD	22.59	26.81	11.81	20.80
N	1917	1346	517	54
MID				
MVD	5.14	5.38	3.91	3.47
SD	3.72	3.90	2.04	2.40
BIAS	-.52	-.70	.61	-.70
SPD	13.94	15.18	6.43	12.18
N	554	469	75	10
LOW				
MVD	4.43	5.14	2.96	4.63
SD	3.95	4.52	1.46	4.56
BIAS	-.04	-.66	1.15	.39
SPD	8.96	10.23	6.97	5.18
N	352	224	111	17

Table 1. Rawinsonde verification statistics for GOES-8 cloud-drift winds during Oct-Dec 1995. The collocation match radius is 2 degrees. N indicates the number of collocations. SPD gives the mean raob wind speeds.

	ALL REGIONS	NH EX-TROP	TROP	SH EX-TROP
ALL LEVELS				
MVD	6.04	6.43	4.70	6.46
SD	4.45	4.71	3.08	4.77
BIAS	-.26	-.32	-.16	.78
SPD	23.04	26.87	10.69	18.97
N	9337	7030	2118	194
HI				
MVD	5.99	6.40	4.69	6.78
SD	4.43	4.71	3.09	4.92
BIAS	-.13	-.14	-.17	.74
SPD	23.38	27.70	10.75	19.72
N	8378	6151	2067	165
MID				
MVD	6.47	6.63	4.84	4.63
SD	4.60	4.70	2.63	3.32
BIAS	-1.41	-1.58	.18	.97
SPD	20.15	21.02	8.15	14.66
N	959	879	51	29

Table 2. Rawinsonde verification statistics for GOES-8 water-vapor (WV) winds during Oct-Dec 1995. The collocation match radius is 2 degrees. There are no low water vapor vectors to compare.

The last 12 months of statistics are summarized figure 4. Only statistics corresponding to all levels and regions are plotted for each product. The history of operational processing changes is also appended.

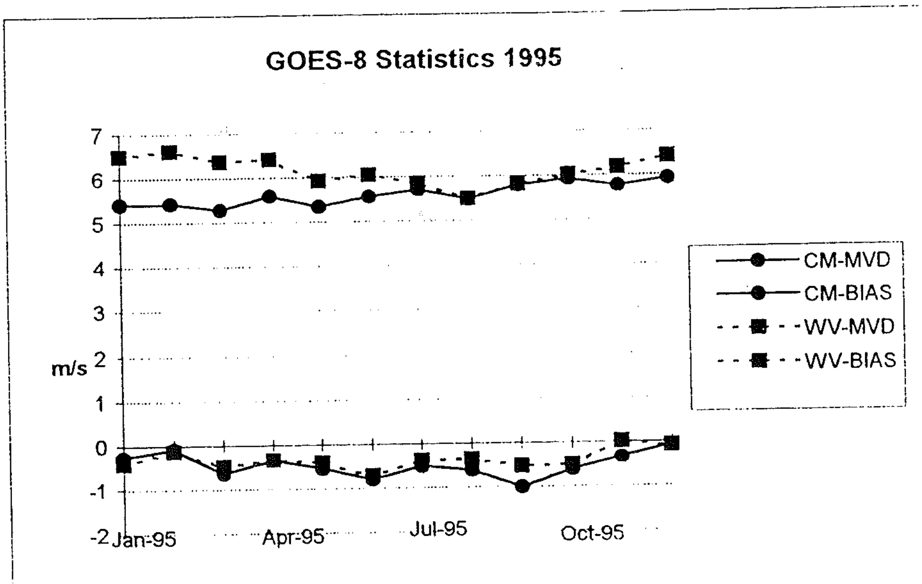

Figure 4. The GOES-8 cloud motion vector (CM) and water vapor motion (WV) winds evaluated each month of 1995.

The verification statistics were adjusted in April 1995 to include collocations with RAOBs beyond the continental US. Prior statistics only reflected continental US collocations.

IV. Summary

The GOES-8 automated cloud motion vectors are significantly improved. Operational automated cloud motion vectors are now equal or superior in quality to those which had the benefit of manual quality control a few years ago. The single most important factor in this improvement has been the upgraded auto-editor. Improved tracer selection procedures eliminate targets in difficult regions and allow a higher target density and therefore enhanced coverage in areas of interest. The incorporation of the H2O-intercept height assignment method allows an adequate representation of the heights of semi-transparent clouds in the absence of a CO2-absorption channel. GOES-8 water-vapor motion winds resulting from the automated system are superior to any done previously by NESDIS and should now be considered as an operational product.

Example GOES-8 performance statistics are included to demonstrate new CGMS guidelines for winds reporting by the operational centers.

References

Hayden, C. M. and R. J. Purser, 1995: Recursive filter objective analysis of meteorological fields - applications to NESDIS operational processing. *J. Appl. Meteor.*, **34**, 3-15.

Hayden, C. M. and S. Nieman, 1996: A primer for tuning the automated quality control system and for verifying satellite-measured drift winds. Submitted for publication as a NESDIS Technical Memorandum.

Merrill, R. T., W. P. Menzel, W. Baker, J. Lynch, and E. Legg, 1991: A report on the recent demonstration of NOAA's upgraded capability to derive cloud motion satellite winds. *Bull. Amer. Meteor. Soc.*, **72**, 372-376.

Nieman, S., J. Schmetz and W. P. Menzel, 1993: A comparison of several techniques to assign heights to cloud tracers. *J. Appl. Meteor.*, **32**, 1559-1568.

CGMS-XXIV
WMO WP-11
Prepared by WMO
Agenda item: H.4

WMO STRATEGY FOR EDUCATION AND TRAINING

(Submitted by the WMO Secretariat)

Summary and purpose of document

To inform CGMS of WMO activities related to education and training.

ACTION PROPOSED

CGMS is invited to note the report and comment as appropriate.

DISCUSSION

1. INTRODUCTION

The following is an excerpt from the report of the CBS Working Group on Satellites Rapporteurs on Education and Training.

Liaison With CEOS and CGMS

2. WMO's preliminary analysis of the capabilities of RMTCs to meet the specifications of Specialized Centres was presented to the CEOS meeting in Brazil in May 1994 and also to the 22nd meeting of the Co-ordination Group for Meteorological Satellites (CGMS) held in Washington DC in 1994. Both CEOS and CGMS supported the strategy in principle. Subsequently EUMETSAT initiated action to investigate the feasibility of co-sponsoring the establishment of Specialized Satellite Applications Training Centres at the RMTCs in Nairobi and Niamey (see below)

Establishment of Specialized Satellite Applications Training Centres

3. Following a survey mission (in which one of the CBS WGSAT-I Rapporteurs, Mr Gideon Kinyoda, participated) and the consideration of a funding proposal by the EUMETSAT Policy Advisory Group, the EUMETSAT Council decided at its 26th Meeting in November 1994 to "adopt" the RMTCs in Nairobi and Niamey as an extension of the EUMETSAT satellite meteorology training scheme to developing nations in Africa. The Council also decided to establish a EUMETSAT User Forum for Developing Countries which would be open to all registered users of EUMETSAT data, products and services in developing countries, with particular emphasis on the African countries in RA I of WMO.

4. It is understood that EUMETSAT's co-sponsorship of the Specialized Satellite Applications Training Centres at Nairobi and Niamey provides support for:

- development of a tailored foundation course;
- presenting the foundation course to "trainers" within the RMTCs;
- publications, slides, videos, etc.;
- sponsorship of visiting expert lecturers;
- organization of appropriate conferences within WMO RA I;
- sponsorship of RMTC staff participation in EUMETSAT scientific conferences;
- placement of graduates for work experience;
- development of appropriate CAL modules; and
- hardware and software for satellite training purposes.

5. To the Rapporteurs' knowledge, there has been no positive response from any of the other satellite operators to the WMO's RMTC sponsorship proposal. Nevertheless, the foundations have been laid and the initial part of the strategy was to get sponsorship for one or two

Specialized Centres operating for trial and evaluation, as a basis for later concerted efforts to extend the concept to other parts of the world.

6. *Consideration by WMO Congress*

7. At Cg-XII in June 1995, Congress noted with satisfaction the increasing attention given to satellite technology in WMO training activities. Congress endorsed the decision of the Executive Council on the strategy for education and training in the use of information provided by satellites and agreed that this approach could be suitable for training in other subject areas.

8. Congress was also pleased to note the two recent initiatives taken by EUMETSAT to sponsor a Users Forum in Niamey in April 1995, which would increase the dialogue between the user and provider communities, and to approve the co-sponsorship of two RMTCs in Niamey and Nairobi, under which EUMETSAT would provide resources to elevate the capabilities at the two RMTCs to enable specialized satellite applications training. This commitment was meant to both complement and supplement the WMO satellite training programme.

9. Congress noted that WMO's role in this partnership would require a concurrent increase in the number of its satellite training events in order to provide a proper balance for the respective roles of each partner. Two training events in a four-year cycle were insufficient and Congress felt that up to eight events per cycle may be required to satisfy all the requirements in the new Satellite Education and Training strategy. Congress urged all members and satellite operators to do their utmost to provide resources to attain that goal.

10. Congress agreed that the Education and Training Programme should give high priority to satellite training as this is supportive to all WMO Programmes. The necessary resources for additional WMO training events will have to be found in various ways, such as through extra-budgetary resources, alternative funding arrangements and the offsetting of associated WMO costs through the withdrawal or delaying of other appropriate activities.

Satellite Applications Training Events

11. Good progress is being made in developing this component of the WMO satellite education and training strategy in various parts of the world. EUMETSAT hosted a Users' Forum at the Niamey RMTC in April 1995 during the week following a WMO RA I training event. One of the CBS WGSAT Rapporteurs, Dr Marlene Elias Ferreira, conducted an 8 day satellite applications seminar attended mainly by Brazilians, at the Universidade do Vale do Paraiba (UniVap) in October 1995. This seminar utilized the Australian developed CAL module on cloud interpretation, which is now available in the public domain. WMO conducted a satellite training ('train the trainer") seminar in Spanish at the RMTC in Costa Rica in October-November 1995. The results are recorded in WMO WP-13 .

12. The Japan Meteorological Agency sponsored a special international training seminar in Tokyo in November 1994 on the utilisation of GMS satellite data. The objective was to prepare users for the potential applications of the new water vapour and split IR window data provided by the GMS-5 satellite. This seminar was attended by representatives from 11 Asia-Pacific countries, most of whom were from developing countries.

13. As a follow-up to this initiative, the WMO, the Japan Meteorological Agency and the Australian Bureau of Meteorology are co-sponsoring a two week Asia-Pacific Satellite Applications Seminar to be held in Melbourne in November 1996. This will proceed within the objectives of the WMO Satellite Education and Training Strategy with a major theme on training in water vapour imagery applications, a principal focus on the use of GMS-5 data and secondary emphasis on TOVS and NOAA AVHRR applications. It will be aimed at participants from RA II and RA V countries with

special emphasis on people from RMTCs in these Regions. There will be a strong emphasis on computer assisted learning (CAL) during the seminar. All participants will be provided with the training material on CD-ROM and some follow-up work will be requested.

14. With the recent launch of the Russian GOMS and the expected launch of the Chinese FY-2 satellite towards the end of 1996, it will be very important to initiate satellite applications training programmes for RMTCs in the Regions covered by those satellites. These regions will have partial or full overlapping coverage from GMS-5, FY-2, GOMS and INSAT, so a wealth of data is potentially available. As a first step, the China Meteorological Administration and the Australian Bureau of Meteorology have had bi-lateral discussions towards co-sponsoring a FY-2 satellite applications seminar in Beijing about 12-18 months after FY-2 is launched. It is hoped to draw on some of the people from the CBS WGSAT's list of satellite training experts to assist in this seminar.

Progress with Computer Assisted Learning (CAL)

15. Significant progress has been made within the scope of WMO satellite education and training strategy, on the development of Computer Assisted Learning (CAL) modules for satellite education and training. There are now many CAL systems in use or under development in various parts of the world. An excellent summary of CAL systems and developments is contained in the Report on West European Cooperation in Computer Aided- and Distance- Learning in Meteorology (January 1994) which was prepared for an informal conference of West European Directors of Meteorological Services.

16. CAL activities are now being extensively promoted at various international seminars and are being co-ordinated by various bodies including Météo France and the Standing Committee of Heads of Training Institutes of National Meteorological Services (SCHOTI) which has strong links with the WMO Education and Training Programme. Météo France organized CALMET 95, the second world conference on the use of CAL in meteorology.

17. The SCHOTI Working Group on CAL, in co-operation with COMET (a major US CAL organization) has recommended that WMO adopt a uniform CAL delivery systems configuration comprising a plain PC, a multi-media PC and an advanced CAL workstation which can be used in various upgradable combinations according to cost, technical support capability and personnel skill level. This appears to be an excellent complementary development to the low cost satellite work station system specification which was undertaken by CBS WGSAT, specifically for consideration by RMTCs and National Meteorological Services in developing countries (see CBS/WG/SAT-II/INF.2).

18. The German Foreign Aid Programme (GTZ) has agreed to fund a project on CAL development within the goals and objectives of the WMO satellite education and training strategy. This involves co-operation between the VCP (Voluntary Co-operation Programme), the German Weather Service (DWD), the WMO, the GTZ and EUMETSAT. The Director for WMO Basic Systems chaired a session dealing with the definition and policy development for project at a meeting convened by GTZ in Nairobi on 2-7 October 1995. It emerged that the GTZ welcomed the balanced involvement of both the Niamey and Nairobi RMTCs in the project because the resulting CAL system will achieve a bigger return on the investment when it is designed for and used by more training centres. In this context the dual language (French/English) concept was seen to be fundamental.

19. Measures for the active participation of selected staff from Niamey and Nairobi RMTCs in the development of CAL modules in the GTZ sponsored project were agreed and the level of hardware technology to be used, the long-term sustainability aspects and potential co-operation with other related activities, such as ECALPRO, were discussed. At last report, a meeting was to take place on 2 November between EUMETSAT, DWD and GTZ consultants to finalise the Nairobi

meeting report and the documents needed for submission to the relevant German Federal Ministry. An update on progress will be provided at CBS WGSAT-II in April 1996.

20. Other arrangements are being established to help instructors in developing countries to learn about CAL techniques and to develop their own CAL modules. A particular success within the WMO framework has been the production of a CAL module on volcanic ash monitoring by satellite which was developed at the RMTC in Manila with guidance from the Bureau of Meteorology Training Centre in Melbourne. This module has now been distributed internationally free of charge. The Australian developed CAL module on cloud interpretation is also available in the public domain.

21. The trend in CALMET (Computer Assisted Learning in Meteorology) now seems to be towards the establishment of a small number of major CAL module production centres from which individual National Meteorological Centres, RMTCs and other organizations can feed and interact. A European focus is already emerging; the USA has a focus in North America (with the possibility of extending to Central and South America) with its COMET organisation, and the rapporteurs understand that there is a possibility of an Asia-Pacific focus emerging in China.

Electronic Bulletin Boards and Improved Communications Systems

22. The expansion of electronic mail, electronic bulletin board systems and Internet facilities incorporating things such as the World Wide Web, is now opening up easy access to satellite training information and training modules. It is pleasing to note that WMO headquarters itself is now connected to Internet and has developed a series of useful home pages which provide information via the World Wide Web (See WMO WP-4 and 5). NOAA/NESDIS has set-up a Web home page containing three satellite interpretation tutorials (basic; GOES 8 imager; and GOES 8 sounder). EUMETSAT and several other organisations also have information available for electronic access in this manner. Most such modules are still in their developmental stages and no doubt will rapidly improve and become much more informative and effective in the future. The main immediate problem is to put in place the basic communications and computing infrastructure to enable the specialized satellite RMTC to connect to these systems (which would also automatically allow them to connect to each other). This involves matters of funding, technical know-how, and consideration of the problems of improving the basic communications technology in many developing countries.

23. In the USA a company, AT&T, has begun marketing a new video-teleconferencing service which could make distance-learning easier by enabling instructors to transmit CAL modules over telephone lines from desktop computers equipped with small video-conferencing cameras. The digital video information is sent over the telephone lines using ISDN (Integrated Services Digital Network) technology to a satellite uplink centre and then relayed via communications satellites (in this case Telstar) for broadcast directly to users or to downlink centres which users could access by telephone lines. This system is still in the developmental stages and clearly would not be available immediately to developing countries because of cost and communications infrastructure factors. However, once established, such a system would be an efficient and cost effective way to train people who are geographically dispersed (e.g., such as people needing to specialize in meteorological satellite applications). There is a growing body of opinion which says that this is the way most of the training in the future will be delivered.

24. The above topics will be discussed at the Second Session of the CBS Working Group on Satellites and results of the Working Group's deliberations will be made available at CGMS-XXIV, as appropriate.

Appendix B:

GENERAL CGMS INFORMATION

CHARTER FOR

THE COORDINATION GROUP FOR METEOROLOGICAL SATELLITES (CGMS)

PREAMBLE

RECALLING that the Coordination on Geostationary Meteorological Satellites (CGMS) has met annually as an informal body since September 1972 when representatives of the United States (National Oceanic and Atmospheric Administration), the European Space Research Organisation (now the European Space Agency), and Japan (Japan Meteorological Agency) met to consider common interests relating to the design, operation and use of these agencies' planned meteorological satellites,

RECALLING that the Union of Soviet Socialist Republics (State Committee for Hydrometeorology), India (India Meteorological Department) and the People's Republic of China (State Meteorological Administration) initiated development of geostationary satellites and joined CGMS in 1973, 1978, and 1986 respectively,

RECOGNIZING that the World Meteorological Organization (WMO) as a representative of the meteorological satellite data user community has participated in CGMS since 1974,

NOTING that the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) has, with effect from January 1987, taken over responsibility from ESA for the METEOSAT satellite system and the current Secretariat of CGMS,

CONSIDERING that CGMS has served as an effective forum through which independent agency plans have been informally harmonized to meet common mission objectives and produce certain compatible data products from geostationary meteorological satellites for users around the world,

RECALLING that the USA, the USSR, and the PRC have launched polar-orbiting meteorological satellites, that Europe has initiated plans to launch an operational polar-orbiting mission and that the polar and geostationary meteorological satellite systems together form a basic element of the space based portion of the WMO Global Observing System,

BEING AWARE of the concern expressed by the WMO Executive Council Panel of Experts over the lack of guaranteed continuity in the polar orbit and its recommendation that there should be greater cooperation between operational meteorological satellite operators world-wide, so that a more effective utilisation of these operational systems, through the coordination and standardisation of many services provided, can be assured,

RECOGNIZING the importance of operational meteorological satellites for monitoring and detection of climate change,

AND **RECOGNIZING** the need to update the purpose and objectives of CGMS,

AGREE

I. To change the name of CGMS to the Coordination Group for Meteorological Satellites -

II. To adopt a Charter, establishing Terms of Reference for CGMS, as follows:

OBJECTIVES

a) CGMS provides a forum for the exchange of technical information on geostationary and polar orbiting meteorological satellite systems, such as reporting on current meteorological satellite status and future plans, telecommunications matters, operations, intercalibration of sensors, processing algorithms, products and their validation, data transmission formats and future data transmission standards.

b) CGMS harmonises to the extent possible meteorological satellite mission parameters such as orbits, sensors, data formats and downlink frequencies.

c) CGMS encourages complementarity, compatibility and possible mutual back-up in the event of system failure through cooperative mission planning, compatible meteorological data products and services and the coordination of space and data related activities, thus complementing the work of other international satellite coordinating mechanisms.

MEMBERSHIP

d) CGMS Membership is open to all operators of meteorological satellites, to prospective operators having a clear commitment to develop and operate such satellites, and to the WMO, because of its unique role as representative of the world meteorological data user community.

e) The status of observer will be open to representatives of international organisations or groups who have declared an intent, supported by detailed system definition studies, to establish a meteorological satellite observing system. Once formal approval of the system is declared, membership of CGMS can be requested by the observer.

Within two years of becoming an observer, observers will report on progress being made towards the feasibility of securing national approval of a system. At that time CGMS Members may review the continued participation by each Observer.

f) The current Membership of CGMS is listed in an annex to this charter.

g) The addition of new Members and Observers will be by consensus of existing CGMS Members.

ORGANISATION

h) CGMS will meet in plenary session annually. Ad hoc Working Groups to consider specific issues in detail might be convened at the request of any Member provided that written notification is received and approved by the Membership at least 1 month in advance and all Members agree. Such Working Groups will report to the next meeting of CGMS.

i) One Member, on a voluntary basis, will serve as the Secretariat of CGMS.

j) Provisional meeting venues, dates and draft agenda for plenary meetingswill be distributed by the Secretariat 6 months in advance of the meeting, for approval by the Members. An agreed Agenda will be circulated to each Member 3 months in advance of the meeting.

k) Plenary Meetings of CGMS will be Chaired by each of the Members in turn, the Chairman being proposed by the host country or organisation.

l) The Host of any CGMS meeting, assisted by the Secretariat, will be responsible for logistical support required by the meeting. Minutes will be prepared by the Secretariat, which will also serve as the repository ofCGMS records. The Secretariat will also track action items adopted at meetings and provide CGMS Members with a status report on these and any other outstanding actions, four months prior to a meeting and again at the meeting itself.

PROCEDURE

m) The approval of recommendations, findings, plans, reports, minutes of meetings, the establishment of Working Groups will require the consensus of Members. Observers may participate fully in CGMS discussions and have their views included in reports, minutes etc., however, the approval of an observer will not be required to establish consensus.

n) Recommendations, findings, plans and reports will be non-binding on Members or Observers.

o) Once consensus has been reached amongst Members on recommendations, findings, plans and reports, minutes of meetings or other such information from CGMS, or its Working Groups, this information may be made publicly available.

p) Areas of cooperation identified by CGMS will be the subject of agreement between the relevant Members.

COORDINATION

q) The work of CGMS will be coordinated, as appropriate, with the World Meteorological Organisation and its relevant bodies, and with other international satellite coordination mechanisms, in particular the Committee on

Earth Observation Satellites (CEOS) and the Earth Observation International Coordination Working Group (EO-ICWG) and the Space Frequency Coordination Group (SFCG).

Organisations wishing to receive information or advice from the CGMS should contact the Secretariat; which will pass the request on to all Members and coordinate an appropriate response, including documentation or representation by the relevant CGMS Members.

AMENDMENT

r) These Terms of Reference may be amended or modified by consensus of the Members. Proposals for amendments should be in the hands of the Members at least one month prior to a plenary meeting of CGMS.

EFFECTIVE DATE AND DURATION

s) These Terms of Reference will become effective upon adoption by consensus of all CGMS Members and will remain in effect unless or until terminated by the consensus of CGMS Members.

MEMBERSHIP OF CGMS

The current Membership of CGMS is :

EUMETSAT	-	Joined 1987. Currently CGMS Secretariat
India Meteorological Department	-	Joined 1979.
Japan Meteorological Agency	-	Founder Member, 1972
State Meteorological Administration of the PRC	-	Joined 1989
NOAA/NESDIS	-	Founder Member, 1972
Hydromet Service of the Russian Federation	-	Joined 1973
WMO	-	Joined 1973

(The table of Members shows the lead Agency in each case. Delegates are often supported by other Agencies, for example, ESA (with EUMETSAT) and NASDA (with Japan)

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LIST OF ABBREVIATIONS AND ACRONYMS

ACARS	Automated Communications Addressing and Reporting System
ACC	ASAP Coordinating Committee
ADC	Atlantic Data Coverage
AMDAR	Aircraft Meteorological Data Relay
AMS	American Meteorological Society
AMSU	Advanced Microwave Sounding Unit
APT	Automatic Picture Transmission
ARGOS	Data Collection and Location System
ASAP	Automated Shipboard Aerological Programme
ASCII	American Standard Code for Information Interchange
ASDAR	Aircraft to Satellite Data Relay
ATOVS	Advanced TOVS
AVHRR	Advanced Very High Resolution Radiometer
BBC	Black Body Calibration (METEOSAT)
BUFR	Binary Universal Form for data Representation
CBS	Commission for Basic Systems
CCIR	Consultative Committee on International Radio
CCSDS	Consultative Committee on Space Data Systems
CD	Compact Disk
CEOS	Committee on Earth Observations Satellites
CEPT	Conference Européenne des Postes et Télécommunications
CGMS	Coordination Group for Meteorological Satellites
CHRPT	Chinese HRPT (FY-1C and D)
CIS	Commonwealth of Independent States
CIIS	Common Instrument Interface Studies
CLS	Collecte Localisation Satellites (Toulouse)
CMS	Centre de Meteorologie Spatiale (Lannion)
CMV	Cloud Motion Vector
CMW	Cloud Motion Wind
COSPAR	Committee on Space Research
DAPS	DCS Automated Processing System (USA)
DCP	Data Collection Platform
DCS	Data Collection System
DIF	Directory Interchange Format
DOMSAT	Domestic telecommunications relay Satellite (USA)
DPT	Delayed Picture Transmission
DRS	DCP Retransmission System (Meteosat)
DRT	Data Relay Transponder (INSAT)
DSB	Direct Soundings Broadcast
DUS	Data Utilisation Station (USA) (Japan)
DWS	Disaster Warning System (India)
EBB	Electronic Bulletin Board
EC	Executive Council (WMO)
ECMWF	European Centre for Medium range Weather Forecasts
ENVISAT	ESA future polar satellite for environment monitoring
EO	Earth Observation
EOS	Earth Observation System

EPS	EUMETSAT Polar System
ERBE	Earth Radiation Budget Experiment
ESA	European Space Agency
ESJWG	Earth Sciences Joint Working Group
ESOC	European Space Operations Centre (ESA)
EUMETSAT	European Meteorological Satellite Organisation
FAA	Federal Aviation Authority (USA)
FAO	Food and Agriculture Organisation (UN)
FAX	Facsimile
FXTS	Facsimile Transmission System (USA)
FY-1	Polar Orbiting Meteorological Satellite (PRC)
FY-2	Future Geostationary Meteorological Satellite (PRC)
GCOS	Global Climate Observing System
GIMTACS	GOES I-M Telemetry and Command System
GMR	GOES-Meteosat Relay
GMS	Geostationary Meteorological Satellite (Japan)
GOES	Geostationary Operational Environmental Satellite (USA)
GOMS	Geostationary Operational Meteorological Satellite (Russ. Fed.)
GOS	Global Observing System
GSLMP	Global Sea Level Monitoring Programme
GPCP	Global Precipitation Climatology Project
GTS	Global Telecommunications System
GVAR	GOES Variable (data format) (USA)
HR	High Resolution
HRPT	High Resolution Picture Transmission
HIRS	High Resolution Infra-red Sounder
HSRS	High Spectral Resolution Sounder (MSG)
ICWG	International Coordination Working Group (EO)
IDCP	International DCP
IDCS	International Data Collection System
IDN	International Directory Network (CEOS)
IFRB	International Frequency Registration Board
INSAT	Indian geostationary satellite
IPOMS	International Polar Orbiting Meteorological Satellite Group
IR	Infrared
IRTS	Infrared Temperature Sounder (EPS)
ISCCP	International Satellite Cloud Climatology project
ISY	International Space Year
ITT	Invitation to Tender
ITU	International Telecommunications Union
ITWG	International TOVS Working Group
JMA	Japanese Meteorological Agency
LR	Low Resolution
LRIT	Low Rate Information Transmission
LRPT	Low Rate Picture Transmission
LST	Local Solar Time

MARF	Meteorological Archive and Retrieval Facility (EUMETSAT)
MCP	Meteorological Communications Package
MDD	Meteorological Data Distribution (Meteosat)
MDUS	Medium-scale Data Utilization Station (for GMS S-VISSR)
METOP	Future European meteorological polar orbiting satellite
METEOR	Polar orbiting meteorological satellite (CIS)
METEOSAT	Geostationary meteorological satellite (EUMETSAT)
MHS	Microwave Humidity Sounder (EPS)
MIEC	Meteorological Information Extraction Centre (ESOC)
MOCC	Meteosat Operational Control Centre (ESOC)
MOP	Meteosat Operational Programme
MPEF	Meteorological Product Extraction Facility (EUMETSAT)
MSC	Meteorological Satellite Centre (Japan)
MSG	Meteosat Second Generation
MSU	Microwave Sounding Unit
MTP	METEOSAT Transition Programme
MTS	Microwave Temperature Sounder (EPS)
MVIS	Multi-channel VIS and IR Radiometer (FY-1C and D of PRC)
NASA	National Aeronautics and Space Agency
NASDA	Japanese National Space Agency
NEDT	Noise Equivalent Delta Temperature
NESDIS	National Environmental Satellite Data and Information Service
NGDC	National Geophysical Data Centre (USA)
NMC	National Meteorological Centre
NOAA	National Oceanographic and Atmospheric Administration
NOS	National Ocean Service (USA)
NTIA	National Telecommunications and Information Agency (USA)
NWP	Numerical Weather Prediction
NWS	National weather service (USA)
OCAP	Operational Consortium of ASDAR Participants
OWSE-AF	Operational WWW Systems Evaluation for Africa
PC	Personal Computer
POEM	Polar Orbiting Earth Observation Mission (ESA)
POES	Polar orbiting Operational Environmental Satellite (USA)
PRC	Peoples Republic of China
PTT	Post Telegraph and Telecommunications authority
RDCP	Regional DCP (Japan)
RMS	Root Mean Square
RMTC	Regional Meteorological Training Centre (WMO)
RSMC	Regional Specialised Meteorological Centre
SAR	Synthetic Aperture Radar
S&R	Search and Rescue mission
SAM	Satellite Anomaly Manager
SAF	Satellite Applications Facility (EUMETSAT)
SAFISY	Space Agency Forum on the ISY
SARSAT	Search And Rescue, Satellite supported facility
SATOB	WMO code for Satellite Observation
SBUV	Solar Backscattered Ultra-Violet (ozone)
SEAS	Shipboard Environmental (data) Acquisition System

SEM	Space Environment Monitor
SEVIRI	Spinning Enhanced Visible and Infra-Red Imager (MSG)
S-FAX	S-band facsimile broadcast of FY-2 (PRC)
SFCG	Space Frequency Coordination Group
SMA	State Meteorological Administration (PRC)
SSP	Sub Satellite Point
SST	Sea Surface Temperature
SSU	Stratospheric Sounding Unit
S-VISSR	Stretched VISSR
TOMS	Total Ozone Mapping Spectrometer
TOVS	TIROS Operational Vertical Sounder
UHF	Ultra High Frequency
UK	United Kingdom
UN	United Nations
USA	United States of America
UTC	Universal Time Coordinated
VAS	VISSR Atmospheric Sounder
VHF	Very High Frequency
VIRSR	Visible and Infra-Red Scanning Radiometer (EPS)
VIS	Visible channel
VISSR	Visible and Infra-red Spin Scan Radiometer
VLSI	Very Large Scale Integrated circuit
WARC	World Administrative Radio Conference
WCRP	World Climate Research Programme
WEFAX	Weather facsimile
WG	Working Group
WMO	World Meteorological Organization
WP	Working Paper
WV	Water Vapour
WWW	World Weather Watch
X-ADC	Extended Atlantic Data Coverage