CGMS

REPORT OF THE TWENTIETH MEETING OF THE CO-ORDINATION GROUP FOR METEOROLOGICAL SATELLITES

TOKYO, JAPAN

CGMS XX

27 - 31 JANUARY 1992

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FINAL REPORT

A. PRELIMINARIES

A.1 Introduction

CGMS-XX was convened at 10.00 a.m. on 27 January 1992 by Dr. Koichi Nagasaka, Senior Assistant for International Affairs of the Japan Meteorological Agency in Tokyo, who introduced Dr. Ryozo Tatehira, Director General of the Japan Meteorological Agency to the Members of CGMS.

In his welcome address, Dr. Tatehira said that it was a great honour and privilege for the Japan Meteorological Agency to host the twentieth meeting of the Coordination Group for Meteorological Satellites at its Headquarters in Tokyo. He was pleased to note that the twentieth meeting would be a major milestone in the long history of the CGMS, established in 1972.

He expressed great pleasure in cordially welcoming individual participants to the twentieth meeting of CGMS, in particular, those from the People's Republic of China, EUMETSAT, the European Space Agency, the United States of America and the World Meteorological Organization. It was unfortunate that the delegations from the other two active meteorological satellite operating countries, India and the Commonwealth of Independent States (CIS), were unable to attend due to unavoidable circumstances.

Dr. Tatehira remarked that, being a meteorologist, he was well aware that meteorological satellites both in geostationary and polar orbits were significantly contributing to meteorological services as key elements of the space segment of the Global Observing System of the World Weather Watch programme of the WMO. Today, it was almost impossible to imagine national meteorological services not using satellite data in some form or other.

Although meteorological satellites had great capabilities which could be used by the meteorological services, we could never maintain harmonized and comprehensive operations without global co-ordination and co-operation. He was confident that the CGMS had been satisfactorily providing the satellite operators and the WMO with an excellent forum for the discussion of various topics leading to the establishment of a well coordinated network of meteorological satellites, together with its contingency plan which could be implemented in the event of a satellite failure.

He was very honoured to note that Japan had been successfully operating a series of Geostationary Meteorological Satellites since a first launch in 1977.

Data obtained from GMS were being received by around 30 WMO Members in Asian and Oceanic regions and were used by their national meteorological services on a daily basis. In addition, derived meteorological products were put onto the GTS for global exchange. More recently, GMS had been playing an important role in such programmes as the Global Precipitation Climatology Project for the monitoring of climate change which was now one of the most crucial issues being addressed by mankind.

Dr. Tatehira pointed out that the applications of meteorological satellite data were many and were increasing year by year in the fields of weather forecasting, climate monitoring and global environment issues. At the same time, rapid development of spacecraft technology had enabled the use of new observational techniques from space. The satellite operators now had the challenge to fully utilize new spacecraft technology in order to meet widely expanding demands from the meteorological community.

He had learned from participants that the present meeting would cover a very wide-range of subjects and would address a heavy agenda. However, he was confident that the meeting would have fruitful and comprehensive outcome throughout its active and friendly discussions, as in previous meetings. The local secretariat would, as far as possible, offer all necessary logistical support for a successful meeting in co-operation with the CGMS Secretariat.

In conclusion, Dr Tatehira wished the overseas participants a comfortable and enjoyable stay in Tokyo.

(The reader should note that a full list of abbreviations and acronyms can be found in Annex I, and that the numbering of chapters in this report corresponds to those used in the Agenda, as shown in Annex II. A full list of Working Papers (WP) submitted to CGMS XX can be found in Annex III).

A.2 Election of Chairman

Mr. Larry Heacock, Director of Satellite Operations, NOAA/NESDIS, USA was elected Chairman of this session of CGMS.

Dr. Kazuhi Kiriyama, Director General of the Meteorological Satellite Center of the JMA, was elected Vice Chairman.

A.3 Arrangements for the Drafting Committee

A Drafting Committee was appointed and CGMS Members were requested to nominate representatives to provide inputs for the Final Report to this drafting committee.

A.4 Adoption of Agenda and Work Plan of Working Group Sessions

The Agenda (see Annex II) was adopted. CGMS agreed to the work programmes for the Telecommunications and the Satellite Products Working Groups. Mr. Wolf was elected Chairman of the Telecommunications Working Group and Dr. Szejwach the Chairman of the Satellite Products Working Group.

A.5 Review of Actions from Previous Meetings

The Secretariat reviewed actions from previous CGMS meetings:

i) CONTINUING ACTIONS BY ALL PARTIES

1. Circulation of satellite Operational Quarterly Reports and Image Photography

   Operations reports and selected images were being regularly distributed to CGMS members.

2. Intercomparison of Extracted Winds

   Latest results from USA were dated June 1991. Regular results had been received from Japan. See Report of Working Group II.

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.

   Information was being sent to NOAA when available.

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

   Information was being regularly exchanged. This task is currently the responsibility of the Secretariat. This particular action is thus closed.

ii) OUTSTANDING ACTIONS FROM CGMS XVIII

Action 18.2

EUMETSAT to inform CGMS on the altitude of ejection of METEOSAT-2 from the geostationary orbit.

METEOSAT-2 was de-orbited on 2 December 1991. CGMS was informed accordingly. This Action is closed. See ESA WP-2 for details.

Action 18.3

The Commonwealth of Independent States (CIS) to provide Meteor-3 temperature sounding data over the GTS as soon as practical.

Continuing. The WMO noted that the CIS, in a cooperative agreement with ECMWF and WMO, were participating in an evaluation of the sounding data produced by Meteor-3. A preliminary set of soundings containing 2500 observations has already been delivered to ECMWF for evaluation. Additional data sets are being prepared for ECMWF. After completion of the evaluation, the data will be placed on the GTS, if appropriate.

Action 18.4

WMO to continue its efforts to acquire INSAT image data tapes

Closed. WMO advised that 35 INSAT image data tapes and information concerning its data format had been received and are available to CGMS Members.

Action 18.5

WMO to obtain information on INSAT satellite image transmission schemes.

Continuing.

Action 18.9

The Secretariat to co-ordinate inputs made by members on IDCS channel assignments and provide consolidated listings to members on a quarterly basis.

Closed. A consolidated IDCS listing was distributed in November 1991 for verification by Japan and USA. Revisions are being noted by the Secretariat and will be distributed to all CGMS members.

Action 18.11

The People's Republic of China and CIS to inform the Secretariat when IDCS channels will be implemented.

Continuing.

Action 18.30 CGMS Secretariat to provide information on satellite products to the relevant WMO-designated lead centre on a regular basis.

Closed. Copies of the CGMS Final Report are distributed to lead centres.

Action 18.33 CGMS members to ascertain if there is a general requirement for new VAS products.

Closed.

Action 18.44 EUMETSAT to provide CGMS members with copies of the Directory of Meteorological Satellite Applications

This publication was distributed in December 1991. Closed

Action 18.46 CGMS members to submit proposals for topics to be included in the CGMS Directory of Meteorological Satellite Applications, in time for further discussions of this activity at CGMS XIX.

Closed. See Agenda Item H.2.

iii) REVIEW OF ACTIONS FROM CGMS XIX

ACTION 19.1 All CGMS Members to submit corrections or modifications to the 8th Edition of the CGMS Consolidated Report to the Secretariat by 1 April 1991.

Closed. Response received from Japan. An updated issue to be prepared and distributed in 1992.

ACTION 19.2 All Members to review the CGMS Charter, adopted on a provisional basis on 12 December 1990, and pass any comments and suggestions to the Secretariat by 1 April 1991.

Closed. Responses received from Japan, WMO and USA. See Agenda Item A.6.

ACTION 19.3 The USA (Acting as the IPOMS Secretariat) to inform the CGMS Secretariat of any decisions of the IPOMS meeting in September 1991, which might affect the CGMS Charter.

Continuing

ACTION 19.4 The CGMS Secretariat to distribute comments on the Charter to all Members, to place consideration of the Charter on the Agenda of CGMS XX, and to coordinate proposals for any necessary changes.

Closed. See Agenda Item A.6.

ACTION 19.5 EUMETSAT to provide CGMS members with information on the spectral resolution requirements for its proposed advanced IR sounder and/or interferometer.

Closed. An information paper was distributed in October 1991.

ACTION 19.6 EUMETSAT to inform EO-ICWG about CIS concerns over spacecraft compatibility and to request if information from the EO-ICWG CIIS can be made available to CGMS members.

Closed.

ACTION 19.7 The USA and EUMETSAT to prepare a paper on future direct broadcast standards.

Closed. See Agenda Item G.1.3.

ACTION 19.8 EUMETSAT to work with NOAA, the Secretariat of IPOMS, on behalf of CGMS in consideration of the roles to be played by the Group in relation to CEOS and IPOMS activities, and report to the next meeting of CGMS.

Continuing. USA informed the Meeting that IPOMS did not meet in 1991, and hence took no actions relevant to CGMS activities. IPOMS intends to finalize its activities in March 1992, possibly through an exchange of letters. The USA will inform CGMS members of final IPOMS developments at CGMS XXI.

ACTION 19.9 WMO to provide PRC and USSR with details of the data requirements of the ISCCP and GPCP programmes.

Closed.

ACTION 19.10 All CGMS Members to investigate the possibility for monitoring the interference levels on all IDCS channels on a regular basis and to coordinate the most suitable time slot for this purpose by correspondence with the Secretariat.

Closed. See Agenda Item F.1.

ACTION 19.11 CGMS members to provide the Secretariat with information concerning the type of data and type of processing used by DCP within their IDCS by 1 April 1991.

Closed.

ACTION 19.12 The Secretariat to make a proposal for the content of fields 6 and 7 of the exchange file format, based on inputs provided by CGMS members under Action Item 19.11, in time for CGMS XX.

Closed.

ACTION 19.13 USA to investigate why the call sign of ship with ID A69591FA was changed without notification to JMA.

Closed.

ACTION 19.14 WMO (ACC) to provide the CGMS Members, through the Secretariat, with full details of the end to end data flow from ASAP vessels as soon as possible.

Closed.

ACTION 19.15 All CGMS members to provide the Secretariat with any corrections or modifications to the IDCS Users' Guide (6th edition) by 1 April 1991.

Continuing. See Agenda Item F.5.

ACTION 19.16 The Secretariat to note the modifications to Annexes 12 and 14, proposed by Japan, in the next revision of the IDCS Users Guide.

Closed.

ACTION 19.17 Japan to provide CGMS with full details of its current WEFAX digital header information.

Closed.

ACTION 19.18 The Secretariat to include both the Japanese and the EUMETSAT/USA versions of the WEFAX digital header in the Consolidated Report.

Closed.

ACTION 19.19 All Members of CGMS to study the preliminary definition of LRIT/LRPT, as proposed in document CGMS XIX EUM-WP-13, and to transmit comments and proposals to the Secretariat before 1 April 1991.

Closed.

ACTION 19.20 EUMETSAT to prepare a detailed LRIT/LRPT definition and submit it to Members 3 months before the next meeting of CGMS.

Closed. See Agenda Item G.1.3.

ACTION 19.21 All Members to come to CGMS XX fully prepared to discuss and agree the definition of LRIT/LRPT formats.

Closed.

ACTION 19.22 EUMETSAT to study the possibilities to include Antarctic region charts and products recommended by WMO in routine MDD broadcasts.

Closed.

ACTION 19.23 The PRC to schedule ranging for FY-2 in periods that will avoid ranging periods (4 x 10 minutes/day) of GMS-4, (GMS-4 schedule provided by Japan at the meeting).

Closed. See Report of Working Group I.

ACTION 19.24 Once informed of the schedule of ranging operations for FY-2 by the PRC, Japan to schedule ranging for GMS-3 to avoid interference.

Closed. See Report of Working Group I.

ACTION 19.25 The PRC to transmit the EUMETSAT request for a cessation of interfering transmissions from FY-B to the Chinese frequency authorities.

Closed.

ACTION 19.26 All CGMS Members to consult with National Authorities to confirm that the transmission intervals in the 1670 to 1710 Mhz band are acceptable and to report results at CGMS XX.

Closed. See report of Working Group I.

ACTION 19.27 WMO to inform its Member States of the request of mobile services for allocations within the frequency band 1670-1710 Mhz and to request the national frequency authorities of its Member States to protect the interests of meteorological satellite services within this band.

Closed. See report of Working Group I.

ACTION 19.28 WMO to request Member states to formally register meteorological satellite user stations with their national authorities.

Closed.

ACTION 19.29 All CGMS Members to inform users to register user stations within their responsibility.

Continuing.

ACTION 19.30 USA to provide the CGMS Secretariat with documentation confirming the performance of wind profilers as radio location devices.

Closed. See Report of Working Group I.

ACTION 19.31 WMO to distribute a letter requesting that WMO Members notify their respective PTT why wind-profilers should be considered as radio location devices.

Cancelled.

ACTION 19.32 Satellite operators of CGMS to conduct notification campaigns with respect to frequency issues within their national entities and/or memberships and their user community. WMO to conduct notification campaigns with respect to frequency issues through its Members and within the UN system including ITU and FAO.

Closed.

ACTION 19.33 USA to investigate the creation of a CGMS EBB similar to the NOAA.SAT EBB with access to CGMS Members for exchange of operational messages, satellite status reports, and similar items. A report to be made to CGMS XX.

Closed. See Report of Working Group I.

ACTION 19.34 Japan to provide CGMS members with information on its current IR calibration scheme.

Closed

ACTION 19.35 USA to provide CGMS members with copies of a detailed paper explaining the "$C0_2$ slicing method" for height assignment.

Closed.

ACTION 19.36 CGMS members to indicate if they can be represented at the wind workshop in Washington in September 1991.

Closed

ACTION 19.37 CGMS members generating cloud motion winds to check that monthly statistics are sent and received on a quarterly basis.

Continuing. See report of Working Group II.

ACTION 19.38 ESA to inform CGMS members about the details of its cartridge archive system (data capacities, physical size, etc.)

Closed. See ESA WP-8.

ACTION 19.39 EUMETSAT to provide CGMS Members with the information content of the CGMS Directory of Meteorological Applications.

Closed.

ACTION 19.40 USA to act as the Coordinator of information from CGMS Members concerning operations involving Search and Rescue facilities on future satellite systems.

Closed.

ACTION 19.41 USA to provide information to CGMS Members on the COSPAS-SARSAT ad hoc meeting on geostationary Search and Rescue systems.

Closed.

ACTION 19.42 The Secretariat to foreword a report on CGMS frequency coordination matters, based on the Report of the Telecommunications WG, to the Space Frequency Coordination Group (SFCG).

Closed.

A.6 CGMS Charter

EUMETSAT WP-2 presented the CGMS Charter, establishing Terms of Reference for CGMS and provisionally adopted on 12 December 1990, in Tashkent. CGMS members were invited to review any comments from members and formally adopt the CGMS Charter.

The Secretariat informed the meeting that comments had been received from Japan, WMO and the USA which confirmed their agreement with the principles and text of the Charter.

Working Paper (WP-2) from the USA used a letter from the Assistant Administrator of NOAA/NESDIS to reiterate support for the final draft of the CGMS Charter, which had been provisionally accepted by members at CGMS XIX in Tashkent. The USA proposed that the final draft charter be formally adopted.

A comment from Japan, recognising the support role of NASDA in CGMS since its inception was noted by CGMS and an appropriate modification to the Preamble was agreed. The USA recommended that the support role of NASA should also be noted in the text. Both modifications were accepted and the CGMS Senior Officials formally adopted a revised version of the Charter (see Appendix IV) on 31 January 1992.

B. REPORT ON THE STATUS OF SATELLITE SYSTEMS

B.1 Polar Orbiting Meteorological Satellite Systems

B.1.1 C.I.S.

Mr Bridge reported that there was no new information available on the status of the METEOR satellite programme.

B.1.2 Peoples Republic of China

In its WP-1, the PRC informed CGMS on the Status of the FY-1B satellite. FY-1B was launched on 3 September 1990. From 23 September 1990 to 14 February 1991, FY-1B was continuously operational, but it suffered a failure on 14 February 1991 when attitude control of the satellite was lost. By successful operation of the earth magnetic damping system FY-1B re-acquired earth lock on 2 May 1991. The satellite now works intermittently. HRPT transmissions are on 1704.5 Mhz.

B.1.3 USA

The USA reported that there were four NOAA polar satellites in use at this time; NOAA-9, 10, 11 and 12. NOAA-11, and NOAA-12 were the current operational satellites, with NOAA-11 serving as the 'afternoon' satellite, and NOAA-12 the 'morning' satellite. NOAA-9 and 10 were still providing ERBE data used for heat balance studies, and additional ozone data from the Solar Back Scatter Ultra-Violet (SBUV) instrument on NOAA-10, as well as Search and Rescue (S&R) data using NOAA-10.

B.2 Geostationary Meteorological Satellite Systems

B.2.1 EUMETSAT

EUMETSAT WP-3 presented a status report on the Meteosat Operational Programme (MOP) and the future Meteosat satellite launch schedule.

CGMS noted that METEOSAT-2 had been removed from the geostationary orbit on 2 December 1991, METEOSAT-3 had been moved to 50° West for the ADC mission and METEOSAT-4 remained the operational satellite, pending the development of a ground segment software solution to cope with the effects of the cold optics rotating lens of the METEOSAT-5 imaging radiometer. ESOC reported that corrective software was being developed and tested, however, it would be several months before METEOSAT-5, presently located at 4° West as the stand-by satellite, could be brought into regular operational use.

ESA reported that METEOSAT-2 had been placed into an orbit with a perigee of 317 km and apogee of 542 km above the geostationary orbit. A final manoeuvre, using only the hydrazine pressurant, had improved the circularisation of the orbit.

B.2.2 India

A status report on the INSAT-I system was received after the meeting and can be found in Annex V, pages 1 to 5.

B.2.3 Japan

Japan WP-02 and WP-03 provided a status report on GMS-4 and the GMS system as a whole. The VISSR observation status of GMS-4 was also summarized in WP-02 and CGMS were pleased to note that observations continued to be carried out normally. In WP-03 the detailed health statuses of GMS-4 and GMS-3 were presented. GMS-4 had been stationed at 140° east, and had experienced very few anomalies, whilst GMS-3, located at 120° east, lacked fuel for north-south orbit station keeping. Its orbit inclination was over 3° as of September 1991 and slowly increasing.

B.2.4 USA

USA (WP-4) presented the status of the current GOES satellites and informed the meeting that GOES-7 was the operational satellite, supporting Mode AAA, VAS, simultaneous WEFAX, East DCS, SEM and SAR, and located close to 108° west. In the light of user experience the satellite would be moved a little further west in the near future. EUMETSAT informed CGMS that it was no longer processing GOES-7 high resolution data relayed through GOES-2. USA commented that NOAA would consider discontinuing this function in the short term. It was reported that the GOES-6 (semi-operational west satellite, supporting DCS, WEFAX relay, SEM METEOSAT image relay and simulated GVAR) fuel situation was critical, and remaining station keeping fuel could be exhausted at any time. USA therefore requested that when (or if) GOES-6 runs out of station keeping fuel (and subsequently drifts off station), JMA consider the use of the GMS DCS to collect data from approximately 40 USA DCPs in the western Pacific.
A Japanese proposal to discuss this idea with NOAA and to consider the development of a bi-lateral contingency plan for this situation was welcomed by WMO/CBS. The Vice President of CBS noted that this type of contingency planning demonstrated the strong desire by the satellite operators to cooperate in order to maintain an established global observing system.

C. REPORT ON FUTURE SATELLITE SYSTEMS

C.1 Polar Orbiting Meteorological Satellite Systems

C.1.1 C.I.S.

No reports were offered.

C.1.2 EUMETSAT

EUMETSAT WP-4 provided a brief overview of current activities leading to the development of a EUMETSAT Polar System (EPS). The document reviewed the status of ongoing activities of the three main elements of EPS, i.e. the meteorological payload, the platform and the ground segment :

EPS Space Segment Payload

Concerning the space segment, CGMS noted that the NOAA instruments studies would be awarded to industry once the specification of the ESA polar platform environment had been finalised. They would comprise a Visible Infra-Red Scanning Radiometer (VIRSR), a Microwave Temperature Sounder (MTS) and an Infra-Red Temperature Sounder (IRTS). Discussions were still ongoing with NOAA to ensure that instrument delivery dates matched the ESA need dates. Meanwhile, the ESA Preparatory Programme accommodation study would further iterate interface aspects such as mass, data rate, physical envelope, etc.

Concerning NOAA/EUMETSAT Instrument Coordination, CGMS was informed that the aim of present activities was to provide a consistent specification for the morning and afternoon systems. The main objectives being the provision of support to the NOAA 2000 instrument specifications, the coordination of the interface activities between NOAA/NASA and ESA and the preparation of a joint project plan and a "Memorandum of Understanding" between NOAA and EUMETSAT.

The EUMETSAT provided instruments will include a Microwave Humidity Sounder (MHS) and a Meteorological Communication Package (MCP)

EUMETSAT added that it was continuing to monitor work on the design of an advanced infra-red sounder to provide high spectral resolution soundings from Polar Orbit.

EPS Space Segment

The baseline for the space segment was the ESA Polar Platform (ESA POEM-1). A complementary satellite based on a smaller version of the polar platform, which could be used for a back-up or follow on series, had also been studied.

Ground Segment

Various options for the ground segment were also being studied at this time by industry, ESA and EUMETSAT.

C.1.3 Peoples Republic of China

In PRC WP-2, CGMS was informed that the future developments of FY-1 were still under consideration. The FY-1 series satellite could be further developed in order to improve the reliability, to extend the lifetime and to enhance the capabilities of the imaging radiometer.

USA commented that image data from FY-1B had been regularly received using standard HRPT stations.

C.1.4 USA

USA plans for future polar satellite systems were detailed in USA WP-5. CGMS were pleased to note that the USA will celebrate its 32nd anniversary of continuous operation of the Polar-orbiting Operational Environmental Satellites (POES) in 1992. USA added that it intended to continue its dual satellite configuration (morning and afternoon orbits) until the late 1990's. The next satellite scheduled for launch will be NOAA-I, to be launched in September 1992 and NOAA-J, to be launched around December 1993.

The last POES to use the advanced TIROS-N spacecraft will be NOAA-K, L, M and N, scheduled for launch in the period 1995 to 2000. The follow-on satellites, NOAA-O, P and Q (afternoon orbit) are scheduled to be launched from October 2000 and will complement the European morning orbit mission and will carry the same upgraded sensors as the morning craft.

The USA, in response to a question from the Vice-president of CBS, noted that the NOAA launch scenario would not preclude the possibility to place one of the NOAA-O, P, Q series in a morning orbit if Europe were not ready to launch its morning polar meteorological satellites in time.

C.2 Geostationary Meteorological Satellite Systems

C.2.1 C.I.S.

No papers were offered, however, Mr. Bridge reported that in a recent conversation with Dr. Kharitonov, he was informed that the launch of GOMS was expected in the second half of 1992. There was no new information on the satellite.

C.2.2 EUMETSAT

METEOSAT Transition Programme

A report on the current status of the METEOSAT Transition Programme (MTP) was presented in EUMETSAT WP-5. MTP is intended to provide a bridge between the present METEOSAT Operational Programme (MOP) which will terminate in November 1995 and the METEOSAT Second Generation (MSG) programme which is scheduled to start in the 1999/2000 time frame.

The MTP will be established in two phases:

1. Manufacture of one new spacecraft of METEOSAT design and advance procurement activities for a possible second spacecraft. Definition of the ground segment and programme management.

2. Implementation of the ground segment, satellite launch and five years of operations.

CGMS were informed that both phases have commenced. Full go-ahead was given, through ESA, to manufacture one new METEOSAT spacecraft, to be ready for launch in the third quarter of 1995. Advance activities for a second spacecraft were also authorized.

The ground segment would be implemented via the following procurement activities:

1. The ground station will be procured by direct negotiations with potential suppliers.

2. The Mission Control Center core facilities including spacecraft control, mission control, and image processing elements are presently the subject of an Invitation to Tender (ITT), the objective of which is to award a contract in mid 1992.

3. The development of a new Meteorological Product Extraction Facility (MPEF) which will replace the present MIEC together with an archiving system are currently in the definition phase.

Additionally, satellite launch negotiations will be carried out during 1992.

Programme management will be shared between ESA and EUMETSAT. ESA will manage the satellite procurement while EUMETSAT will take direct responsibility for the procurement of the remaining elements, including the ground segment, and for the overall programme management.

METEOSAT Second Generation

EUMETSAT WP-6 reviewed current and future activities leading to the development of a series of METEOSAT Second Generation satellites. Since the last CGMS meeting, EUMETSAT had established a Preparatory Programme for METEOSAT Second Generation (MSG). This programme would include the definition phases of the MSG system, starting with Phase-A, which was initiated during 1991, in close cooperation with ESA. The status of the MSG programme can be summarized as follows:

a) the MSG spacecraft will rely on a spin-stabilized platform carrying a main imaging radiometer (SEVIRI), a Meteorological Communication Package (MCP) and an additional payload of experimental instruments and/or a Search & Rescue beacon,

b) the Spinning Enhanced Visible and Infra-Red Imager (SEVIRI) will include three sets of channels:

   i seven VISIR channels, with a sampling distance of 3 km at SSP and a repeat cycle of 15 min for the whole disk.

   ii six channels in the water vapour and carbon dioxide absorption bands, similar to those used on the existing METEOSAT imager and GOES VAS, these channels having the same sampling characteristics as those under (i)

   iii a high resolution visible broad-band channel with a sampling distance of 1 km at SSP and 15 min repeat cycle, mainly covering the European area

c) the dissemination of data and products to the user will rely on the same frequency bands as for MOP, and will be based on the HRIT and LRIT formats already under discussion within the CGMS.

Further details of the SEVIRI instrument proposal can be found in Annex VI.

The launch of the first MSG flight model is foreseen in the 1999/2000 time-frame. Three other satellites will follow, in order to ensure twelve years of operations. The programme is now under definition, in cooperation with ESA, for a main development starting in 1994.

C.2.3 India

A status report on the future INSAT-II system was received after the meeting and can be found in Appendix V, pages 5 to 7.

C.2.4 Japan

In Japan WP-04, CGMS was informed that GMS-5 was being manufactured and was scheduled for launch in late Japanese fiscal year 1993 (early 1994).

GMS-5 would have one visible and three IR channels; one water-vapour (6.5-7.0 um) and split thermal windows (10.5-11.5 and 11.5-12.5 um). It was explained that all of the observational image data would be broadcast as S-VISSR formats, and that water-vapour pictures would be added to the broadcast as WEFAX formats, but only a few times a day. The planning of satellites to follow GMS-5 was still under consideration.

The PRC asked about the broadcast of RSMC Meteorological products by GMS-4 and GMS-5. In response, JMA reported that whilst this issue was still under consideration, GMS-5 would generally have the same communications capability as GMS-4.

C.2.5 The People's Republic of China

CGMS noted (PRC WP-3 refers) that there would not be a facility for the interrogation of DCP, or a UHF WEFAX broadcast provided by the FY-2 satellite system.

The FY-2 satellite would be launched in the 1994-1995 time frame. Some ground segment elements (e.g 20 m antenna) had been installed and were currently under test. The computer system (Fujitsu M 770/10) in the Data Processing Center had been installed and was undergoing checkout, and software was being developed. The working paper also presented the layout of the DPC and the Satellite Operation and Control Center.

In response to a question from WMO, the PRC confirmed that S-band WEFAX would be retained. Products to be derived from FY-2 imagery were still under consideration.

The PRC also noted that the S-VISSR data from FY-2 would be archived in a format similar to Japan and that the data would be available upon request to interested parties.

CGMS strongly recommended that, wherever feasible, FY-2 products should be disseminated to the user community on the GTS.

C.2.6 USA

Working Paper (WP-7) from the USA reported on the current status of the GOES I-M spacecraft series. Despite a history of problems, the series has made some recent progress. GOES-I instruments were currently undergoing thermal vacuum tests. The planned launch of GOES-I was foreseen in the December 1993 - early 1994 time-frame.

The USA reported in its WP-6 the development of a GOES-N+ series of satellites. This development is entering the phase-B and detailed specifications were being finalized. It was noted that GOES-N+ satellites will have two WEFAX transponders and a switchable DCPR receiver to allow the satellites to receive either the GOES/GOMS domestic and international channels or the GMS/METEOSAT domestic and international channels. This will allow GOES-N+ satellites to "back-up" neighbouring satellite domestic and international DCS programmes. Further details can be found in Annex VII.

D. OPERATIONAL CONTINUITY AND RELIABILITY

D.1 Inter-regional Planning

In its WP-7, EUMETSAT informed CGMS that METEOSAT-3 was being used in support of the Atlantic Data Coverage (ADC) mission (Annex VIII refers). The primary purpose of this mission being the provision of additional image information to users in North and South America whilst only one GOES satellite is operated by NOAA. The ADC satellite is currently located at 50° west in order that it can be controlled directly from ESOC in Germany. Plans are being developed for the operation of METEOSAT-3 at around 100° west. Control of the satellite will still be performed from Germany. Satellite telecommunications and image data would flow via a trans-Atlantic data link and an uplink/downlink station at Wallops Island, on the east coast of the USA. The WP also described ADC-HR and WEFAX image formats and schedules.

Working Paper (WP-8) from the USA was submitted to provide further information on the current state of METEOSAT Atlantic Data Coverage (ADC). This paper used the example of METEOSAT-3 to highlight the current success and cooperation between ESA/EUMETSAT and NOAA. In related discussions, the USA thanked Japan for its willingness to discuss backup support to GOES-7.

Both Japan and WMO/CBS congratulated and welcomed the successful contingency planning and its implementation through collaboration and coordination between the USA and EUMETSAT/ESA. They commented that this was a very good example of mutual assistance to maintain geostationary meteorological satellite coverage. JMA considered it very helpful for the future contingency planning by CGMS members to be acquainted with related technical aspects. The relevant agencies were invited to provide full technical details on the arrangements.

ACTION 20.1 : **NOAA and EUMETSAT to provide CGMS members with technical details of the ADC extension.**

In ESA WP-3, it was stated that preparations were well under way for an extended Atlantic Data Coverage mission. In order to provide more useful imagery METEOSAT-3 would be located at a more westerly position, nominally 100° west. Since a satellite at this location is not visible from the ESOC ground station, the NOAA ground station at Wallops will be equipped to support the METEOSAT spacecraft and connected to the Meteosat Operations Control Center (MOCC) in ESOC via a suitable communications facility (see above). The MOCC will then control the satellite via the ground facility at Wallops. The extended mission will be conducted under a trilateral agreement between ESA, EUMETSAT and NOAA. The communication links between Wallops and ESOC will be provided by NOAA whilst the new equipment will be manufactured and integrated by Dornier under the supervision of ESOC. Installation of the equipment is scheduled for the end of December 1992.

Dr. Szejwach informed CGMS that the AMS Committee on Satellite Meteorology and Oceanography had met in Atlanta, Georgia on January 9, 1992. The committee had asked him to convey the following message to the CGMS from its Chairman. It had strongly endorsed the statement given below :

"The committee recognizes the extreme importance of continuity in observations from geostationary and polar orbiting satellites. In that respect, the committee expresses its enthusiasm for the successful agreement between NOAA/DOC, EUMETSAT and ESA concerning satellite data coverage over the Atlantic basin.

Furthermore, the committee encourages the providers of meteorological satellite data through the Coordination Group for Meteorological Satellites (CGMS) to take reasonable measures to maintain and improve backup capabilities and compatibility between systems."
Signed by James F. W. Purdom, PhD, Chairman, AMS Committee on Satellite Meteorology and Oceanography

The Vice-president of CBS expressed the gratitude of WMO members for the ADC extension. He further noted that from a system continuity point of view, this was an excellent example of cooperation between satellite operators.

D.2 Global Planning

No papers were offered. The Senior Officials agreed to address this item, in particular, the setting up of a small Working Group to study possibilities for global contingency planning. See paragraphs E and J for further details.

E. METEOROLOGICAL SATELLITES AS PART OF WMO PROGRAMMES

E.1. World Weather Watch

Contingency Planning for the Space-based Subsystem of the Global Observation System

In WP-8 the WMO discussed the need for contingency planning for the space-based subsystem of the Global Observing System (GOS) and added that this would be a topic for the forthcoming meeting of the EC Panel of Experts/CBS Working Group on Satellites in March 1992.

The Vice-president of CBS (who is also the Chairman of the EC Panel of Experts) felt that it was appropriate for the WMO to have a policy statement concerning contingency planning. He suggested that the recent experiences of EUMETSAT and NOAA/NESDIS, if generalized, could assist the WMO in developing such a policy statement. He invited CGMS XX to develop recommendations for contingency plans for the space-based subsystem of the Global Observing System which could be submitted to the Tenth Session of the EC Panel of Experts on Satellites.

CGMS XX discussed their ongoing activities in this area and the need for a reference document based on their collective experiences. Although it felt that it would not be able to develop a suitable, final document at CGMS-XX, it agreed that it was an important endeavour which should be started. In this regard, CGMS noted that it would be in attendance at the tenth session of the EC Panel of Experts/CBS Working Group on Satellites and that it would forward to all CGMS Members results of that meeting. CGMS then agreed to review the work of the tenth session of the EC Panel and to forward the results of its deliberations to the WMO when available.

ACTION 20.2 : CGMS Secretariat to forward a report of discussions in EC Panel of Experts/CBS Working Group on Satellites to CGMS members.

CGMS Representation at EC Panel of Experts on Satellite Meetings

The meeting noted that the recent WMO Executive Council had felt that CGMS was an important group with which WMO must interact directly and that CGMS should be invited to be represented at meetings of the EC Panel of Experts/CBS Working Group on Satellites as observers and on the new ad hoc Working Group within CBS for frequency coordination.

CGMS accepted the invitation to be represented at these meetings and decided that at each meeting of CGMS it would be decided who should represent CGMS at WMO and other relevant meetings scheduled for the coming year. The annual review would allow CGMS to select representatives based on geographic proximity and/or to select experts, if appropriate. For the forthcoming tenth session EC Panel meeting in March, it was agreed that Mr. Bridge would represent CGMS at ECSAT and that Mr. Wolf would represent CGMS at the next CBS Frequency Coordination and SFCG meetings.

ACTION 20.3 : **The Secretariat to include "request for nomination of CGMS representatives at WMO and other meetings" on the Agenda of future CGMS Meetings.**

E.2 Other Programmes

In WP-15, Japan informed CGMS that it has been contributing to ISCCP and GPCP by producing the respective data from GMS data, and forwarding them to the relevant data centers.

Support to the ISCCP and GPCP was also summarised in ESA WP-04. METEOSAT-3 ADC data were being used by the ISCCP project with Colorado State University providing B1 and B2 formats and ESOC providing data for satellite inter-calibration. METEOSAT will also contribute data to the Surface Radiation Budget Climatology project.

Before closing this agenda item, the Vice-president of CBS highlighted the very important support provided by the satellite operators to other WMO Programmes. He specifically mentioned all programmes related to the climate change issue, the Global Climate Observing System (GCOS), the Global Atmospheric Watch (GAW) and joint programmes such as the Global Ocean Observing System (GOOS) of WMO and the International Oceanographic Commission (IOC).

F. CO-ORDINATION OF INTERNATIONAL DATA COLLECTION & DISTRIBUTION

F.1 Status and Problems of the IDCS - Interference Monitoring

ESA WP-05 presented the latest status on monitoring of METEOSAT IDCS channel frequences. At the present time the primary tool is use of the "Abort Message" which generates an error message whenever a channel receiver which has locked onto a received signal does not identify a valid frame synchronization pattern within the specified time window. The generated message is then sent to ESOC, processed and stored. It includes information on signal strength, modulation index and frequency offset. This monitoring facility is used on all suspected interfered channels.

Japan (WP-5 and 6) informed CGMS of the status of IDCP whose data were being relayed by the GMS satellite. Japan described a method of monitoring the interference on IDCS channels and presented the results of experimental monitoring. It was explained that in the Japanese system any channel could be monitored semi-automatically (see Annex IX for details).

USA WP-10 also contained a proposal for monitoring interference levels on IDCS channels. It was agreed that this method will be considered along with those proposed by other CGMS members by Working Group I.

EUMETSAT also briefly described a DCP frequency monitoring system which is currently under development.

A new ESA prototype DCS processing, archiving and management system was described in ESA WP-06. The system is stand-alone and therefore could be installed at any location where the necessary communications are available. The system is based on two workstations which in the nominal configuration would individually support the functions of real-time processing and the management system respectively. A commercially available Relational Data Base Management System (RDBMS) supports both the real time and management aspects of the system. In case of a single workstation failure both the real-time and management sub-system can be run on a single workstation, with a small degradation of the management capability. Archiving of data is completely disk based and occurs in real-time on both work stations, thus minimising loss of data. An improved mission performance monitoring of level 2 and 3 disconnects (from the ground station) and archiving interruptions is also achieved.

IDCS Databases

EUMETSAT WP-9 presented the latest status (November 1991) of the Consolidated IDCS listings. In its WP-10 EUMETSAT recommended adoption of a proposal from Japan for fields 6 and 7 in this database format (see Appendix VIII). CGMS adopted this proposal.

F.2 Ships, including those in the Automated Shipboard Aerological Programme (ASAP)

The USA submitted a paper (USA WP-11) updating the status of the U.S. National Ocean Service (NOS) Shipboard Environmental Data Acquisition System (SEAS) Programme to re-allocate all ships operating on U.S. domestic channels to International channels I6 and I7. After the presentation of this paper, it was agreed that the WMO be included with ESA, JMA and NOAA in notification of changes in the allocation of International DCP.

ACTION 20.4 : WMO to be placed on the International DCP allocation notification list.

F.2.1 JAPAN

Japan reported in its WP-7 that 117 ship DCPs (with 163 addresses) were registered as of 31 December 1991. A full list of all ship DCP was included in the Working Paper.

F.2.2 WMO

WMO noted that the ASAP project had been an operational part of the WWW for at least the past two years. At present, 13 ships on the North Atlantic and two on the North Pacific were equipped to take soundings using ASAP equipment.

In a series of performance studies of ASAP systems operating on the North Atlantic, the data were shown to be of the same quality as land-based radiosondes and showed an important impact on the analyses for rapidly developing storms (those forming in 12-36 hours).

An end-to-end monitoring of the reception of ASAP ship TEMP messages at WMO had been carried out during the period from July 1991 to September 1991. TEMP messages were received at the WMO via two routes, namely, from Meteosat through the its DCP Retransmission System (DRS) and via WMO GTS connection with Paris. An analysis of the monitoring results showed that the large (35-40%) data losses observed during the 1989-1990 end-to-end monitoring were not observed. Present data losses seemed to be more oriented toward individual ships, where either the equipment or the procedures in use were at fault. The WMO noted that Canada has agreed to examine the reception of ASAP data on a routine basis. A prototype monitoring activity had been established with the Atmospheric Environment Service at Vancouver.

The Vice-President of CBS expressed his gratitude to CGMS members for providing the infrastructure necessary for the ASAP. This extremely valuable data, frequently from data sparse areas, would not be available without services provided by the satellite operators.

F.3 ASDAR

Japan WP-8 presented a status report on ASDAR operations. JMA informed CGMS Members that the MSC would be ready to receive and disseminate ASDAR data from new "operational" ASDAR units using the AMDAR code format in February 1992. Japan stressed that early information on aircraft identifiers was essential so that it could be included in AMDAR data processing, and proposed a new application form for ASDAR admission. CGMS agreed to this proposal on a provisional basis.

ACTION 20.5 : **The Secretariat to include an ASDAR admission form, based on the proposal from Japan, as an additional Annex to the IDCS Users Guide.**

EUMETSAT commented that ESOC processing of AMDAR messages would be possible in a similar time frame.

WMO noted that ASDAR has reached the operational stage. Certification had been obtained from both the US and the UK for use of the ASDAR on Boeing 747 and DC-10 type aircraft. An ASDAR Centre has been established at the UK Met Office to monitor the operation of the ASDAR units, to identify problems, and to take action to notify the appropriate authorities. WMO recalled that from the beginning of 1 November 1991, the new AMDAR code had come into force.

The meeting noted that ASDAR data were now reported using this new code format and would carry the header designation "UDXX" rather than "UAXX". WMO noted the efforts by all satellite operators to complete the necessary programming changes for the

AMDAR code and that ESA and JMA were nearing completion of their changes.

ACTION 20.6 : **ESA and JMA to complete the necessary programming changes for the processing of AMDAR data as soon as practical and to enter data from within respective areas of responsibility onto the GTS in AMDAR code form.**

The Vice-president of CBS again expressed the gratitude of WMO Members to CGMS for providing services vital for the proper execution of the ASDAR Programme and requested that WMO be kept informed on the status of ASDAR admissions.

ACTION 20.7 : **All CGMS Members to note that WMO should be included in the notification list for ASDAR admissions.**

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

Japan reported in WP-9 the status of dissemination of DCP information within its Regional and International systems. Statistics on the collection and dissemination of data from both IDCPs and RDCPs during October 1991 were presented. CGMS noted that the number of the reports had increased by 28 % from the same period last year. About 79 % of the total collected (42,802 messages) were usable and disseminated to users. 27,038 messages were transmitted via the GTS.

The Vice-President of CBS expressed concern at the large loss of DCP data. He suggested that the satellite operators provide WMO with results of monitoring of DCP losses on a regular basis (e.g. quarterly). Based on these reports, CBS would be in a position to determine and arrange, with the help of the satellite operators, specific end-to-end monitoring exercises for individual components of the Global Observing System.

Japan supported WMO's proposal that a procedure to regularly monitor DCP data loss should be established, possibly via the mechanism of periodic end-to-end system evaluations.

ACTION 20.8 : **CGMS Members to forward to the WMO, on a quarterly basis, statistics of the loss of DCP messages which are normally distributed on the GTS.**

In its WP-13, USA provided a detailed description of the DCS Automated Processing System (DAPS). CGMS were informed that DAPS provided an economical system allowing users the possibility to retrieve their data in near real time via a Domestic Communications Satellite (DOMSAT).

F.5 Review of IDCS Users' Guide

CGMS noted the status of the preparations by the Secretariat for the latest issue of this document.

ACTION 20.9 : **The Secretariat to distribute a marked up draft text of the next updated issue of the IDCS Users Guide in a few weeks time.**

G. CO-ORDINATION OF DATA DISSEMINATION

G.1 Dissemination via Satellite

G.1.1 High resolution

Japan presented WP-10 and informed CGMS of a new mapping technique for GMS S-VISSR images, which could reduce MSC data processing time by 50 %.

EUMETSAT, in its WP-12 (METEOSAT Dissemination News No. 1/92) described changes to HR image dissemination during the last 12 months. Most changes related to the introduction of the ADC mission, which is described in Annex VIII.

G.1.2 Low resolution (WEFAX)

The USA presented WP-16, giving an overview of the Facsimile Transmission System (FXTS). It was noted that the FXTS transmits all of the GOES WEFAX images as well as other facsimile products for terrestrial distribution within the US. The system also has an automated scheduler that would facilitate changing the GOES WEFAX transmission window from 5 minutes to 4 minutes. Members agreed that a change from 5 min to 4 min windows would be beneficial and could be implemented unilaterally by NOAA. NOAA indicated it will continue to investigate and coordinate this change with its users.

The USA presented a working paper (WP-15) which provided a chronology of Configuration Change Management for the WEFAX transmission schedule.

A suggestion was made by EUMETSAT that the schedule should indicate which products were derived from METEOSAT-3 and METEOSAT-4 in the "No-GOES" schedule.

The USA pointed-out that, additionally, the schedule is likely to undergo revision as part of the Atlantic Data Coverage (ADC) effort.

The meeting noted that during 1991 several modifications were made to METEOSAT WEFAX Dissemination Schedules, mainly caused by the transmission of METEOSAT ADC WEFAX images, and which are described in detail in EUMETSAT WP-7. More general information on METEOSAT dissemination can be found in METEOSAT Dissemination News, No. 1/92, which can be obtained from EUMETSAT.

G.1.3 Digital WEFAX

EUMETSAT WP-13 presented a proposal for a Low Rate Image Transmission (LRIT) format. CGMS was invited to comment on the proposal, with a view to its adoption as a standard. A copy of the proposal can be found in Annex X.

CGMS strongly supported the proposal for the LRIT format presented by EUMETSAT. It also recommended that a net data rate of 64 Kb/s should become standard for this transmission scheme.

USA WP-17 noted that the LRPT format was very similar to the proposed LRIT format. Members were informed that NOAA was starting the Phase B studies for the new instruments which would be required to produce the new format and any changes made beyond approximately May 1992 would have potential cost and schedule impact.

CGMS commented that agreement on the ISO Open System Interconnection (OSI) first three levels was now urgently required in order that both LRIT and LRPT formats could be finalised with a common standard. The remaining four levels could be defined in due course for each of the LRPT and LRIT.

ACTION 20.10 : **CGMS Members to comment on the LRIT proposal by 1 May 1992, and in particular, the acceptance of the three OSI levels so far defined. If Members are unable to meet this deadline, then they should inform the Secretariat by 1 March 1992.**

ACTION 20.11 : **The Secretariat to mail a consolidated CGMS LRIT proposal, together with any further comments, to WMO/CBS by the end of July 1992.**

CGMS noted that there would be discussion of these formats by CBS at its next meeting in November 1992.

In response to a question from Japan concerning LRIT link budgets, EUMETSAT advised that these were dependent upon several parameters, including the performance (EIRP) of the various satellites. This would be one of several aspects of the proposal which would be studied in the near future.

The PRC informed the meeting that it supported the concept of digital WEFAX (LRIT and LRPT) and design ideas proposed by EUMETSAT. Concerning the bit rate of LIRT and LRPT, PRC expressed a preference for 64 Kb/S. PRC also stressed the point that the standard of LRIT and LRPT should be established as soon as possible, for example, within half or one year at the latest.

CGMS agreed that since the capability of a wide user community to receive LRIT and LRPT instead of APT/WEFAX would take a considerable time, especially in developing countries, it would be necessary for the standard of LRIT and LRPT to be established in the near future. There should also be an adequate time period for both broadcasts (analog WEFAX/APT and digital LRIT/LRPT) to be transmitted in parallel.

WMO stated that during CGMS-XIX, NOAA and EUMETSAT had discussed their intention to change the present APT and WEFAX analogue transmissions into a digital form commencing in 1997 with the morning polar-orbiting satellite and that it would be completed with the afternoon polar-orbiting satellite sometime after the year 2002. The WMO then discussed the results from an inquiry from its Members concerning the transition.

As a result of the enquiry, WMO had received a total of 46 replies, all of which supported the transition from analogue to digital transmissions from meteorological satellites. The responses covered a good cross section from all WMO Regional Associations and developed and developing countries. The WMO stated that the plans of the satellite operators to replace analogue APT and WEFAX services could be considered as generally acceptable by WMO Members. A concern expressed by WMO Members during the inquiry was the duration of the transition period, in that some Members felt that the proposed four year period may not be sufficient for a complete replacement of their equipment.

During the eleventh WMO Congress, appreciation was expressed for the early actions in the notification campaign towards assuring a smooth transition from the present analogue satellite services (APT and WEFAX) to digital services at the end of this decade. The WMO Congress felt that this initiative should be continued while keeping Members appropriately informed.

Following a recommendation made by the Vice-president of CBS, CGMS agreed to change the name of LRIT to "Low Rate Information Transmission".

G.1.4 Other Product Dissemination

Meteorological Data Distribution

A report on the current status of the METEOSAT Meteorological Data Distribution (MDD) mission was presented in EUMETSAT WP-14. Following a successful EUMETSAT/WMO sponsored demonstration phase in Africa, CGMS noted that several receiving stations were expected to be implemented in Africa and surrounding regions during 1992. Encryption of operational broadcasts from Bracknell (UK) and Rome (Italy) were expected to begin in March 1992. Details of the contents of MDD broadcasts can be found in Annex XI.

EUMETSAT noted a request from WMO who asked to be kept informed of licensed MDD stations.

EUMETSAT WP-15 described three cloud classification products derived from AVHRR IR imagery and produced by CMS Lannion which were regularly disseminated by METEOSAT on a test basis.

G.2 Dissemination via GTS or other Means

No papers were offered.

H. OTHER ITEMS OF MORE GENERAL INTEREST

H.1 International Space Year (ISY)

EUMETSAT WP-22 described the current planning of EUMETSAT activities and contributions to International Space Year (ISY) 1992.

The main contributions were image sequences for the Global Change Encyclopedia, image sequences for the Global Change Video and participation in major 1992 ISY conferences.

In parallel, a video had been prepared, based on METEOSAT imagery, of a cloud sequence producing severe weather similar to that experienced by Columbus during his crossing of the Atlantic 500 years ago.

In its WP-17 Japan reported on National ISY activities, in particular the Asia-Pacific ISY Conference that will be held in Tokyo during November 1992.

In USA WP-27, NOAA reported on its participation in International Space Year (ISY) activities. As a full member of the Space Agency Forum for the International Space Year (SAFISY) since May 1990, NOAA has supported ISY activities focusing on education, research, and outreach.

H.2 Other Meteorological Satellite Applications

CGMS were informed in EUMETSAT WP-23 that a first version of the EUMETSAT Directory of Satellite Applications has been published. Copies of the document had been distributed to Members of CGMS in November 1991.

ACTION 20.12 : **CGMS members are invited to submit proposals for a similar jointly produced publication focusing upon global applications and the benefits of meteorological satellite data.**

EUMETSAT WP-24 informed CGMS members on the current list of publications available from EUMETSAT.

In USA WP-28, NOAA informed CGMS about its use of satellites to detect and track volcanic ash clouds. Because of the danger these clouds pose to aircraft, NOAA uses satellite information and trajectory forecasts to provide operational support for the US Federal Aviation Administration's volcano hazard alerts. NOAA proposed that other CGMS members work with their aviation authorities to develop similar alert programmes in their respective regions of responsibility.

USA WP-29 reported on CoastWatch, a new system for monitoring the coastal ocean regions. The scientific theme of CoastWatch emphasizes applications of satellite data for coastal resource management (see Annex XII for details).

In WP-30, USA reported on its use of polar-orbiting satellites in the remote sensing of atmospheric aerosols. The paper described the NOAA/NESDIS aerosol optical thickness operational product derived from AVHRR data sets. CGMS members were invited to assist in various facets of the further development and validation of these products.

The WMO reported that since the last meeting of CGMS it had published the document Satellite Applications Technology - Annual Progress Report (SAT-8). The purpose of this publication is to make WMO Members aware of the state of developments in satellite applications, as well as the operational uses of satellite data, derived products and services within meteorological and hydrological services of different countries.

The WMO also reported that updated texts for document WMO 411 had been received from CIS, EUMETSAT, France, India and the USA. The finalized text is nearly ready for printing and distribution.

H.3 Search and Rescue (S & R)

In USA WP-31, NOAA presented an information paper which described US efforts to investigate, and potentially implement a 406 Mhz geostationary satellite S&R system, to assist in domestic and international S & R activities under the COSPAS-SARSAT Programme. CGMS members were invited to take note of USA efforts, and to participate in the extended worldwide 406 Mhz geostationary satellite system being carried out under the COSPAS-SARSAT Programme.

Japan informed the meeting that it was planning an experiment, using GMS-5, to verify the feasibility using 406 Mhz for S & R on geostationary satellite systems in 1994 and 1995.

H.4 Anomalies from Solar and Other Events

USA WP-32 provided information on solar activity and its effect upon environmental satellites (Annex XIII refers). USA reported that no floppy discs for updating previous distributions of the Anomaly database had been disseminated at the time of the meeting. WMO requested that USA distribute new updated files on solar activity to all members when the data becomes available.

ACTION 20.13 : **USA to distribute to CGMS members updated files on solar activity when the compiled data becomes available.**

I. REPORT FROM THE TELECOMMUNICATIONS WORKING GROUP

Working Group I elected Mr. R. Wolf as Chairman and Mr. L. Heacock as Secretary. A list of participants can be found in Annex XIX.

I/1 Co-ordination of Frequency Allocations
I/2 Preparation of the World Administrative Radio Conference (WARC 92)

The Working Group Members decided to cover items 1 and 2 on its agenda together since they were so closely related. Working papers EUM-17, Japan-WP-11 and 12, USA-WP-19 and 20 and WMO-WP-7 all dealt with preparations for the WARC-92. The Group were informed that all critical Meteorological Satellite (METSAT) frequency bands appeared to be safe as of the start of WARC-92, given the positions indicated by WMO Members, by SFCG participants, but particularly by CEPT Members in Europe.

The Group recalled that there always remained some concern for proposals which might surface at the WARC-92. Such proposals, not previously coordinated, could be a threat and it was essential that full representation be maintained at WARC-92 to immediately alert interest agencies, should such a threat materialize.

It was confirmed that CGMS would be represented at WARC-92 by delegates from WMO (part time) and EUMETSAT. Furthermore, support could be expected from SFCG members which also supported CGMS positions.

The Group noted that the USA representative to WARC-92 proposed to add the Mobile Satellite Service as primary in portions of the band 137-138 Mhz could pose problems for new polar satellites.

Wind profilers were now mostly regarded as radiolocation devices and, after consideration by the responsible ITU study group, a future WARC will probably be tasked to find a band for them.

Only the USA representative to WARC-92 would propose protection of some, but not all, bands for passive microwave sensing. Protection of these bands would, therefore, require further consideration at a future WARC.

The Working Group reaffirmed the breakdown of the 1670-1710 Mhz band adopted by CGMS XIX, and agreed, for the time being, to maintain coordination within CGMS and not seek formalization of a decision within e.g. ITU.

PRC-WP-4 (Annex XIV) described the solution developed by PRC and Japan which would avoid potential ranging interference between GMS-4 and FY-2. The Working Group were pleased to note that since the ranging schedules of the two satellite systems had now been coordinated, Action items 19.23 and 19.24 from CGMS XIX were now closed.

I/3 Progress with Electronic Bulletin Boards (EBB)

CGMS Electronic Bulletin Board

EUMETSAT presented WP-18 noting that the EUMETSAT Electronic Bulletin Board (EBB) had been created in order to provide up-to-date information about METEOSAT, other meteorological satellite systems and related activities. This EBB operates in complement with the EBB successfully developed by NOAA/NESDIS over recent years and there is a regular interchange of data-bases between the two bulletin boards. EUMETSAT noted that the WMO regularly accesses the EBB for the latest information concerning METEOSAT for inclusion in the WMO Monthly Newsletter. The EUMETSAT EBB is installed on a PC in EUMETSAT HQ and uses SERVONIC-MSN-MAILCONNECTION software.

Systems for the interchange of information between other space agencies and international organisations will also be established in the future in order that a wider range of information can be provided to users.

The WMO explained that CGMS Action item 19.33 had requested an investigation of the creation of a CGMS Electronic Bulletin Board similar to the NOAA.SAT EBB with access for CGMS Members to exchange operational messages, satellite status reports, and similar items. Also the Workshop on Wind Extraction from Operational Meteorological Satellite Data, 17-19 September, 1991 had recommended that an electronic bulletin board be established for the exchange of information concerning cloud track wind extraction. Since wind extraction from operational meteorological satellite data was of interest to Working Group II, CGMS agreed that they should discuss the possibility of including information related to cloud track winds on the bulletin board.

The WMO presented the results of its investigation into the necessary procedures for the establishment of such a board noting that NOAA/NESDIS would be willing to pay the "storage" fees. The WMO volunteered to act as the focal point for the establishment of the EBB and for posting, purging and administration of the EBB when required. It was understood by all CGMS Members that it will be the responsibility of each Member for establishing their own access to the OMNET service.

The Working Group recommended that CGMS set up an electronic bulletin board as described above and suggested that the board should have access limited to only CGMS Members. Each Member would only be able to read the board and only the administrator should be allowed to write to the board. The administrator would accept the responsibility for downloading designated files from e.g. EUMETSAT, NOAA and Japan and for placing those files on the CGMS Bulletin Board. The administrator would also keep only current files on the bulletin board.

ACTION 20.14 : **CGMS Members to provide WMO with their OMNET names in order that access to the CGMS EBB can be authorised**

I/4 Other Related Items of Interest

The Chairman raised the issue of the use of International DCS channels by Japan and USA to accommodate the USA Data Collection Platforms (DCP) affected by the possible eventual eastward drift of GOES-6 once all station keeping fuel has been exhausted. Channel I17 was initially proposed, since it was affected by interference in the European sector. JMA and NESDIS agreed that there would be a requirement for possibly three channels to cover approximately the forty DCP which may be affected. JMA and NESDIS agreed to initiate a bilateral agreement, in which the technical details, such as specific channels, will be determined. The Group were informed that the IDCS channels used for this purpose would become de-allocated upon the successful launch and commissioning of GOES-Next. The CGMS Secretariat would be kept informed of the discussions between Japan and the USA and EUMETSAT/ESA would be asked to provide, on an informal basis, any information on noisy International channels, other than channel I17, as an input to the Japan/USA talks.

ACTION 20.15 : **Each CGMS operator to experimentally monitor the unused IDCS channels for interference over the next 12 months, according to his own scheme, and prepare a report on results for CGMS XXI. If practical, dates of test and channels to be tested will be coordinated (perhaps via the CGMS EBB) near the end of the year in order to obtain information on possible world-wide phenomena.**

II. REPORT FROM THE SATELLITE PRODUCTS WORKING GROUP

Working Group II elected Dr. G. Szejwach as Chairman and Mr. T. Stryker as Secretary. A list of participants can be found in Annex XIX.

II/1 Satellite Data Calibration

In WP-13, Japan presented a normalization method, which significantly improved visible image quality from GMS-4. The image problem had appeared at the beginning of GMS-4 operations and has continued to date. Applying this method, the corruption of GMS visible images transmitted by S-VISSR and WEFAX will soon be rectified.

II/2 Meteorological and Other Parameter Extraction

Several papers from ESA, EUMETSAT, Japan and the WMO presented the results of satellite wind intercomparisons (ESA-WP-7, EUM-WP-16, 20 and 26, Japan WP-14, WMO-WP 4) and were discussed in detail.

Japan-WP-14 also informed WG Members that the height assignment tables for GMS cloud motion winds had been revised with effect from April 1990 and that significant improvements in the accuracy of the extracted winds had been observed. Japan further explained that manual correction to a part of the automatically assigned cloud heights, made in the process of manual quality control, also contributed to improved wind accuracy.

The Working Group noted in ESA-WP-7 that a major effort had been devoted to the production of water vapour winds and their automatic quality control. Operational water vapour winds were planned to be distributed via the GTS during 1992.

A proposal (WMO-WP-5) for the standardisation of winds derivation was forwarded by the WMO. The desirability for standardisation was recognised by the group, which also noted the difficulty of achieving true standardisation.

NOAA/NESDIS presented a paper on products extracted from polar-orbiting satellite imagery. This document was well received by the Group, which commented that it would welcome additional papers on this subject in the future.

Following a CGMS XIX action to convene a workshop to evaluate the input and methods of cloud motion winds derivation, a Workshop was held in 1991 in Washington DC. A presentation of the workshop results was given during the meeting (EUM-WP-19). During the workshop, a general improvement in the quality of cloud motion winds had been noted over recent years, especially those winds produced by Japan. Questions were raised with respect to the extension of SATOB codes in EUM WP-19. ESA had been asked to investigate and clarify the situation.

ACTION 20.16 : ESA to investigate changes in the SATOB code for winds.

A significant action from the workshop was the forwarding of a proposal to CGMS for the establishment of a working group to specifically address problems associated with the derivation of cloud motion winds.

The Working Group unanimously endorsed this proposal. Should such a group be formed, its tasks would include:

- evaluation of present and future methods for winds derivation
- improvement in formats to include quality flags, and identification of methodology utilised in the derivation
- aspects concerning standardisation.

The Group would also propose and establish means for the exchange of information between the data producers and user communities (e.g. workshops, exchange of publications, etc.)

The proposal to establish a Working Group of Satellite winds was welcomed by CGMS. It was further suggested that CGMS Members should nominate representatives for this Working Group, who could then meet on the occasion of the next COSPAR meeting Washington DC,in August 1992, to take care of actions from CGMS XX, to develop an agenda, to propose Terms of Reference for the Group, etc. It was also agreed that Dr G. Szejwach should be appointed coordinator for the Group and report to CGMS on a regular basis. CGMS noted an offer from NOAA/NESDIS to host this meeting.

After the success of the first Winds Workshop, in September 1991, participants recommended that a second Workshop should be held in the 1993 time frame. In view of the great interest shown by the Japanese participants, it was suggested that Japan might be an ideal location for the second Workshop.

In response, Mr. Kiriyama said that the JMA would be pleased to host the next Workshop on Satellite Winds in Tokyo. He noted the important uses of satellite wind vectors in both operational and research meteorology, the need to improve their accuracy and recalled that the previous workshop had provided an excellent forum for discussion of the improvement of extraction techniques and the assimilation of data by the numerical models.

CGMS noted that the date of the Workshop and other related matters would be finalized in consultation with Working Group Members and the CGMS Secretariat.

The point raised by the WMO during the Plenary session of CGMS concerning INSAT data tapes was then discussed by the Working Group. It was decided that the WMO should forward these data tapes to the CGMS Secretariat for the coordination of circulation to other satellite operators. Each satellite operator could then decide upon the proper handling of the data with regard to outside researchers or other interested user groups.

ACTION 20.17 : **WMO to send the INSAT data set to the Secretariat for coordination of circulation.**

NOAA/NESDIS informed the Group that there had been a rather irregular distribution of monthly GOES winds statistics. The group confirmed its interest in receiving regular statistics.

ACTION 20.18 : **USA to ensure distribution of GOES monthly wind statistics.**

II/3 New Products and their use in Numerical Weather Prediction

After a short presentation (EUM-WP-21) on the AVHRR Data Users Conference by EUMETSAT, WMO requested from the Group comments on the "short" list of satellite data requirements, which were presented in EUM-WP-27. This action is to be carried out in preparation for the March 1992 WMO Executive Council Panel of Experts.

ACTION 20.19 : **All CGMS members to provide comments on the "short" list of satellite data requirements listed in EUM WP-27 to WMO in advance of the March 1992 meeting of the WMO Executive Council Panel of Experts.**

In its WP-16 (see Annex XV), Japan summarised planned new products which would be derived from processed GMS-5 VISSR data and which will augment its support to weather observation and prediction. Japan also stated that it had a plan to replace the data processing computers at MSC for the production of more and upgraded products in time for the launch and operation of GMS-5.

The USA presented a paper (USA-WP-23) which reviewed progress on CO_2 height assignments, and reported on the new auto-editing technique currently being developed. The USA agreed to provide satellite operators with an information paper on the auto-editing procedure.

ACTION 20.20 : **USA to provide CGMS Members with an information paper on the auto-editing procedure.**

In response to a WMO request, the USA reported on NOAA/NESDIS preparations for producing satellite winds with METEOSAT-3 at 50° West. This is being done in support of long-term intercomparison campaigns.

The USA also informed the Working Group of a new experimental technique using SSM-I for snow cover evaluation. Working Group Members, Japan in particular, expressed strong interest in obtaining more information on this topic.

WMO introduced the idea of establishing a dedicated bulletin board for CGMS members, which could include a section for the wind working group, should it be established.

II/4 Archiving and Retrieval of Satellite Data

In response to a CGMS request, ESA reported on recent developments with the archiving and retrieval system at ESOC (ESA-WP-8). The Group expressed an interest in the potential for a fully robot operated system for archiving and retrieval, and requested ESA to provide additional information when available.

ACTION 20.21 :	**ESA to provide CGMS Members with additional information on its robot operated archive and retrieval system.**

The USA provided information on the development of the PATHFINDER programme for storage and retrieval of Earth Observation System (EOS) data.

An action was given to all participants to inform CGMS members on progress involving archival and retrieving system.

ACTION 20.22 :	**CGMS members to provide each other with information on their progress in the further development of archiving and retrieving systems.**

J. SENIOR OFFICIALS MEETING

The CGMS XX Senior Officials meeting convened at 09h30 on 31 January 1992. Mr J Morgan (EUMETSAT) was elected Chairman.

J.1 Draft Final Report

The Senior Officials (Heads of Delegations) reviewed a draft of the Final Report of the meeting. Having identified some modifications and corrections, the draft and the list of Actions were approved. The Secretariat agreed to include all the amendments into a revised draft which would be distributed to Members, together with a proposal for the list of Appendices, within a few weeks for final approval prior to publication.

The meeting expressed satisfaction over the adoption of the CGMS Charter and commented that this was a major milestone in the 20 year history of the Group.

Concerning the setting up of a Working Group on Global Contingency Planning matters, the Senior Officials strongly supported the proposal and commented that this Group would address many wide ranging and somewhat political subjects. Members would have to carefully define its Terms of Reference, discussion subject headings (Agenda) and longer term issues. It would also have to be decided if discussions should be held within the normal plenary sessions of CGMS or separately.

In the meantime it was proposed that a first planning meeting of this Group should take place in the October 1992 time-frame. This meeting would address, in particular, such matters as Terms of Reference, Agenda and a future work plan.

Satellite operators were already requested to consider options for long term contingency planning which might be discussed at the October 1992 planning meeting.

The USA offered to host the planning meeting at a venue to be decided in due course.

ACTION 20.23 : **The Secretariat to arrange a planning meeting establishing a Working Group on Global Contingency Planning in the USA during October 1992, and to inform CGMS Members accordingly.**

ACTION 20.24 : **Satellite operators to consider options for long term contingency planning in time for preliminary discussion on this item at the initial meeting of the Working Group on Global contingency Planning, scheduled for October 1992.**

J.2 Reports from the Satellite Products and Telecommunications Working Groups

The Senior Officials took note of the Reports of the Satellite products and Telecommunications Working Groups and endorsed proposals and recommendations therein.

J.3 Any Other Business.

The meeting noted that the Reports from the 1992 sessions of the Working Group on Satellite Winds and Working Group on Global Contingency Planning would be discussed in the relevant Agenda Items in future meetings of CGMS.

J.4 Date and Place of next Meeting

CGMS was pleased to accept an offer made by the PRC to host CGMS XXI in Beijing, People's Republic of China, in April 1993. The date of this meeting would be notified to all CGMS Members by the Secretariat in due course. PRC informed the meeting that it would be please to invite CGMS participants to inspect the meteorological satellite launch facility in the southwest of the PRC, either immediately before or after CGMS XXI. A visit to the FY-2 spacecraft manufacturing site in Shanghai might also be considered if time permitted.

An offer by the USA, to host CGMS XXII, near Washington DC, possibly in Annapolis, in 1994 was noted.

K. SUMMARY LIST OF ACTIONS FROM CGMS XX

ACTION 20.1 :	**NOAA and EUMETSAT to provide CGMS members with technical details of the ADC extension.**
ACTION 20.2 :	**CGMS Secretariat to forward a report of discussions in EC Panel of Experts/CBS Working Group on Satellites to CGMS members.**
ACTION 20.3 :	**The Secretariat to include "request for nomination of CGMS representatives at WMO and other meetings" on the Agenda of future CGMS Meetings.**
ACTION 20.4 :	**WMO to be placed on the International DCP allocation notification list.**
ACTION 20.5 :	**The Secretariat to include an ASDAR admission form, based on the proposal from Japan, as an additional Annex to the IDCS Users Guide.**
ACTION 20.6 :	**ESA and JMA to complete the necessary programming changes for the processing of AMDAR data as soon as practical and to enter data from within respective areas of responsibility onto the GTS in AMDAR code form.**
ACTION 20.7 :	**All CGMS Members to note that WMO should be included in the notification list for ASDAR admissions.**
ACTION 20.8 :	**CGMS Members to forward to the WMO, on a quarterly basis, statistics of the loss of DCP messages which are normally distributed on the GTS.**
ACTION 20.9 :	**The Secretariat to distribute a marked up draft text of the next updated issue of the IDCS Users Guide in a few weeks time.**
ACTION 20.10 :	**CGMS Members to comment on the LRIT proposal by 1 May 1992, and in particular, the acceptance of the three OSI levels so far defined. If Members are unable to meet this deadline, then they should inform the Secretariat by 1 March 1992.**

ACTION 20.11 : The Secretariat to mail a consolidated CGMS LRIT proposal, together with any further comments, to WMO/CBS by the end of July 1992.

ACTION 20.12 : CGMS members are invited to submit proposals for a similar jointly produced publication focusing upon global applications and the benefits of meteorological satellite data.

ACTION 20.13 : USA to distribute to CGMS members updated files on solar activity when the compiled data becomes available.

ACTION 20.14 : CGMS Members to provide WMO with their OMNET names in order that access to the CGMS EBB can be authorised

ACTION 20.15 : Each CGMS operator to experimentally monitor the unused IDCS channels for interference over the next 12 months, according to his own scheme, and prepare a report on results for CGMS XXI. If practical, dates of test and channels to be tested will be coordinated (perhaps via the CGMS EBB) near the end of the year in order to obtain information on possible world-wide phenomena.

ACTION 20.16 : ESA to investigate changes in the SATOB code for winds.

ACTION 20.17 : WMO to send the INSAT data set to the Secretariat for coordination of circulation.

ACTION 20.18 : USA to ensure distribution of GOES monthly wind statistics.

ACTION 20.19 : All CGMS members to provide comments on the "short" list of satellite data requirements listed in EUM WP-27 to WMO in advance of the March 1992 meeting of the WMO Executive Council Panel of Experts.

ACTION 20.20 : USA to provide CGMS Members with an information paper on the auto-editing procedure.

ACTION 20.21 : ESA to provide CGMS Members with additional information on its robot operated archive and retrieval system.

ACTION 20.22 : **CGMS members to provide each other with information on their progress in the further development of archiving and retrieving systems.**

ACTION 20.23 : **The Secretariat to arrange a planning meeting establishing a Working Group on Global Contingency Planning in the USA during October 1992, and to inform CGMS Members accordingly.**

ACTION 20.24 : **Satellite operators to consider options for long term contingency planning in time for preliminary discussion on this item at the initial meeting of the Working Group on Global contingency Planning, scheduled for October 1992.**

ANNEXES TO THE FINAL REPORT OF CGMS XX

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
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
CEOS	Committee on Earth Observations Satellites
CEPT	Conference European des Postes et Telecommunications
CGMS	Coordination of Group for Meteorological Satellites
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
DRS	DCP Retransmission System (Meteosat)
DRT	Data Relay Transponder (INSAT)
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
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
EVIRI	Enhanced VIS and IR imager (MSG)
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)
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 (CIS)
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)
IDCS	International Data Collection System
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
JMA	Japanese Meteorological Agency

LR	Low Resolution
LRIT	Low Rate Information Transmission
LRPT	Low Rate Picture Transmission
LST	Local Solar Time
MCP	Meteorological Communications Package
MDD	Meteorological Data Distribution (Meteosat)
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)
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)
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)
PTT	National Post and Telecommunications Authority
RDCP	Regional DCP (Japan)
RMS	Root Mean Square
RSMC	Regional Specialised Meteorological Centre

S&R	Search and Rescue mission
SAM	Satellite Anomaly Manager
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
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

AGENDA FOR CGMS XX, TOKYO, JAPAN, 27-31 JANUARY 1992

A. PRELIMINARIES

A.1 Introduction
A.2 Election of Chairman
A.3 Arrangements for the Drafting Committee
A.4 Adoption of Agenda and Work plan of W/G Sessions
A.5 Review of Action Items from Previous CGMS Meetings
A.6 CGMS Charter

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

D. OPERATIONAL CONTINUITY AND RELIABILITY

D.1 Inter-regional planning
D.2 Global planning

E. METEOROLOGICAL SATELLITES AS PART OF WMO PROGRAMS

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)
F.5 Review of IDCS User's Guide

G. COORDINATION OF DATA DISSEMINATION

G.1 Dissemination via Satellite

- G.1.1 High Resolution
- G.1.2 Low Resolution (WEFAX)
- G.1.3 LRIT
- G.1.4 Other product Dissemination

G.2 Dissemination via GTS or other means

PARALLEL WORKING GROUP SESSIONS

WORKING GROUP I - TELECOMMUNICATIONS

- I/1 Coordination of Frequency Allocations
- I/2 Preparation of WARC-92
- I/3 Progress with Electronic Bulletin Boards (EBB)

WORKING GROUP II - SATELLITE PRODUCTS

- II/1 Satellite Data Calibration
- II/2 Meteorological & Other Parameter Extraction
- II/3 New Products & Their Use in Numerical Weather Prediction
- II/4 Archive and Retrieval of Satellite Data

H. OTHER ITEMS OF MORE GENERAL INTEREST

- H.1 International Space Year Activities
- H.2 Applications of Meteorological Satellite Data in the Fields of Earth Environment Monitoring
- H.3 Search and Rescue (S&R)
- H.4 Anomalies from Solar and Other Events
- H.5 EUMETSAT representation at WMO and other meetings

J. SENIOR OFFICIALS MEETING & REVIEW OF WORKING GROUP REPORTS

- J.1 Approval of Draft Final Report
- J.2 Reports from the Working Groups
- J.3 Any Other Business
- J.4 Date and Place of Next Meeting

WORKING PAPERS SUBMITTED TO CGMS XX

(Summary titles - agenda item in brackets)

CIS

No Working Papers were submitted

ESA

ESA-WP-1	Status of Current METEOSAT Satellites (B.2)
ESA-WP-2	Re-Orbiting of METEOSAT-2 (B.2)
ESA-WP-3	Proposal for an Extended Operation of ADC (D.1)
ESA-WP-4	METEOSAT Support to WMO Programmes (E.2)
ESA-WP-5	Status of Interference Monitoring on DCP Channels (F.1)
ESA-WP-6	The stand alone Data Collection System (F.1)
ESA-WP-7	Cloud Motion Wind Retrieval from METEOSAT Images (II.2)
ESA-WP-8	Archiving of METEOSAT Image Data (II.4)

EUMETSAT

EUM-WP-1	Review of Action Items (A.5)
EUM-WP-2	CGMS Charter (A.6)
EUM-WP-3	Status of the MOP (B.2)
EUM-WP-4	Status of the EUMETSAT Polar System (C.1)

ANNEX III

(EUMETSAT cont.)

EUM-WP-5	Status of the Meteosat Transition Programme (C.2)
EUM-WP-6	Status of Meteosat Second Generation (C.2)
EUM-WP-7	Atlantic Data Coverage (ADC), (D.1)
EUM-WP-8	Proposal for an extended Operation of ADC (D.1)
EUM-WP-9	Status and Problems of the IDCS (F.1)
EUM-WP-10	Coordination of IDCS Data Bases (F.1)
EUM-WP-11	Draft IDCS Users Guide, New Issue (F.5)
EUM-WP-12	Meteosat HR and WEFAX Disseminations (G.1.1/2)
EUM-WP-13	Low Rate Image Transmission (G.1.3)
EUM-WP-14	METEOSAT MDD Mission (G.1.4)
EUM-WP-15	AVHRR Products for METEOSAT Dissemination (G1.4)
EUM-WP-16	Results of the August 1990 METEOSAT-GOES Wind Comparison Campaign (II.2)
EUM-WP-17	Preparations for World Administrative Conference (I/2)
EUM-WP-18	EUMETSAT Electronic Bulletin Board (I/3)
EUM-WP-19	Report on the 1991 Winds Workshop (II/2)
EUM-WP-20	CMV Statistics from Meteosat and other Met Sats (II/2)
EUM-WP-21	AVHRR Data Users Conference (II/3)
EUM-WP-22	International Space Year 1992 - Update (H)
EUM-WP-23	Directory of Meteorological Satellite Applications (H)
EUM-WP-24	EUMETSAT Publications (H)
EUM-WP-25	CGMS Representation at WMO and other Meetings (H)

EUM-WP-26	The Derivation of Satellite Winds from Satellite Imagery (II.2)
EUM-WP-27	WMO Consolidated List of Satellite Data Requirements (II.3)

INDIA

INDIA-WP-1	Report on the Status of INSAT-1 (B.2)
INDIA-WP-2	Report on the Future Satellite System (C.2)

JAPAN

JAPAN-WP-1	Review of Action Items from previous Meetings (A.5)
JAPAN-WP-2	Status of GMS-4 (B.2)
JAPAN-WP-3	Report on Status of Satellite Systems - GMS (B.2)
JAPAN-WP-4	GMS-5 (C.2)
JAPAN-WP-5	Status and Problems of IDCS (F.1)
JAPAN-WP-6	Interference Monitoring of IDCS Channels (F.1)
JAPAN-WP-7	Status of Ship IDCP including ASAP (F.2)
JAPAN-WP-8	Status of ASDAR (F.3)
JAPAN-WP-9	Dissemination of DCP Messages (F.4)
JAPAN-WP-10	Mapping Method for VISSR Data (G.1)
JAPAN-WP-11	Separation of 1670 to 1710 MHz Band (I.1)
JAPAN-WP-12	Protection of Frequency Bands 400 MHz and 2 GHz (I.1)
JAPAN-WP-13	Normalization Method of GMS-4 visible Channels (II.1)

(JAPAN cont.)

JAPAN-WP-14	Current Status of GMS Wind Derivation (II.2)
JAPAN-WP-15	GMS Support to WMO Programmes (E.2)
JAPAN-WP-16	Products for Geostationary Meteorological Satellite-5 (GMS-5) (II/3)
JAPAN-WP-17	Japanese ISY Activities coordinated by STA and NASDA (H.1)

PEOPLES REPUBLIC OF CHINA

PRC-WP-1	Status of FY-1B Satellites (B.1)
PRC-WP-2	Future Plans for FY-1 Satellites (C.1)
PRC-WP-3	FY-2 Satellite Systems (C.2)
PRC-WP-4	FY-2 Satellite Operational Schedule (I)
PRC-WP-5	Comments of LRIT and LRPT (G.1)

USA

USA-WP-1	(cancelled)
USA-WP-2	The CGMS Charter (A.6)
USA-WP-3	Status of NOAA Polar-Orbiting Satellites (B.1)
USA-WP-4	Status of Geostationary Operational Environmental Satellites (GOES) - (B.2)
USA-WP-5	Polar Orbiting Meteorological Satellite Systems (C.1)
USA-WP-6	GOES-N (C.2)

(USA cont.)

USA-WP-7	Future Satellite Systems, GOES I-M (C.2)
USA-WP-8	Inter-Regional Planning: The Example of Meteosat-3 (D.1)
USA-WP-9	(cancelled)
USA-WP-10	Interference Checks on IDCS Channels (F.1)
USA-WP-11	Ships including ASAP (F.2)
USA-WP-12	ASDAR Update (F.3)
USA-WP-13	Dissemination of DCP Messages by DOMSAT (F.4)
USA-WP-14	(cancelled)
USA-WP-15	WEFAX Transmission Schedule (G.1.2)
USA-WP-16	FXTS Operational Capabilities : Current and Planned (G.1.2)
USA-WP-17	LRPT and HRPT for NOAA O, P, Q (G)
USA-WP-18	NOAAPORT (G.1.4)
USA-WP-19	Coordination of Frequency Allocations (I/1)
USA-WP-20	Preparation of WARC-92 (I/2)
USA-WP-21	NOAA/NESDIS Electronic Bulletin Board (I/3)
USA-WP-22	Generation and Distribution of Polar Sounding Data (II/2)
USA-WP-23	Progress in using CO2 Height Assignments in NESDIS GOES-7 Satellite Winds (II/3)
USA-WP-24	Preparations for Satellite Winds from Meteosat-3 at 50W (II/3)
USA-WP-25	Microwave Snow Cover Evaluation (II/3)
USA-WP-26	The Pathfinder Programme (II/4)

(USA cont.)

USA-WP-27	NOAA Participation in ISY Activities (H.1)
USA-WP-28	Detection and Tracking of Volcanic Ash Clouds by Satellites (H.2)
USA-WP-29	COASTWATCH (H.2)
USA-WP-30	Remote Sensing of Atmospheric Aerosols by Polar Satellites (H.)
USA-WP-31	Geostationary Satellite System for Search & Rescue (H.3)
USA-WP-32	Solar Activity (H.4)

WMO

WMO-WP-1	Review of Actions from previous CGMS Meetings (A.5)
WMO-WP-2	Conversion of Analogue APT/WEFAX to Digital (G.1)
WMO-WP-3	CGMS Participation in EC Panel of Experts and CBS (E.1)
WMO-WP-4	Standardization of Cloud Track Wind Algorithms (II/2)
WMO-WP-5	CGMS Electronic Bulletin Board (I.3)
WMO-WP-6	ASAP and ASDAR Status Report (F.2/F.3)
WMO-WP-7	Radio Frequency Matters (I/1)
WMO-WP-8	Contingency Planning for the Space-based Sub-system of the Global Observing System (E.1)

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, ANNEX IV

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:

<u>OBJECTIVES</u>

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.

<u>MEMBERSHIP</u>

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 Appendix A.

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 meetings will 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 of CGMS 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 CIS	-	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*)

REPORT ON STATUS OF INSAT-I SYSTEM

* * *

1. Status of INSAT-IB

i) INSAT-IB launched on 30th August 1983 was fully operationalized on 15th October 1983 and it has sucessfully performed during its mission life of seven years except for a brief loss of earth lock in August 1984, resulting in temporary disruption of services for about 36 hours. The satellite maintained its designated orbital position. (74degres East $\pm$ 0.1 degree)

ii) Again on 17-10-89 and 20-10-89, there were two occasions of loss of earth lock. Immediately after these events the satellite was put on safe sun acquisition mode and subsequently manoevered to reaquire earth lock and operationalise the spacecraft in the normal mode.

iii) On 17th July 1990, operations from INSAT-IB were shifted to the new satellite of the series, INSAT-ID .

iv) The Satellite is now in an inclined orbit and it is available for use in case of any contingency.

2. STATUS OF INSAT-IC

INSAT-IC the on orbit spare of INSAT-IB,was launched by ARIANE-3 launch vehicle on 22nd July 1988. On 22nd Nov. 1989 INSAT-IC experienced a loss of earth lock and since then it is not available for operational use.

3. STATUS OF INSAT-ID

INSAT-ID,the last satellite in the present INSAT-I series of satellites,was launched sucessfully on 12th June 1990 from Cape Kennedy, USA and declared operational on 17th July 1990. This had been placed at 83 Degrees East position and functioning as replacement of the previously operational INSAT-IB satellite at 74 degrees East. All operations of earth imaging have, therefore, been shifted from INSAT-IB to INSAT-ID and at present it is the main operational satellite of INSAT-I series.

4. OPERATIONAL USE OF INSAT-ID FOR METEOROLOGICAL APPLICATIONS:

INSAT-ID Meteorological satellite data are being processed on operational basis at Meteorological Data Utilisation Centre(MDUC) located in IMD, New Delhi. The Very High Resolution

Radiometer (VHRR) data are processed at MDUC to provide the following products:

a) EARTH CLOUD COVER IMAGERIES IN THE VISIBLE AND INFRARED BANDS:

Normally 11 full earth disc scans are obtained daily as a routine. Additional ingests are also commanded during important weather situations. Based on the analysis of these cloud pictures regular bulletins are sent to the users.

b) CLOUD MOTION VECTORS (CMVs):

Cloud Motion Vectors giving a measure of winds in the upper levels of the atmosphere are being derived at Ø3 and Ø6UTC using cloud pictures taken in VIS band at successive half hourly intervals.Winds are being derived over Arabian Sea ,Bay of Bengal and Indian Oceans areas data are being transmitted over National Meteorological Telecommunication Network for utilisation within India and over the GTS of WMO for international utilisation once a day based on winds derived at Ø6 UTC.

c) SEA SURFACE TEMPERATURE (SST)

The data obtained from VHRR are being used for derivation of Sea Surface Temperature (SST) for Bay of Bengal, Arabian Sea and part of the Indian Ocean on an experimental basis.

d) ESTIMATION OF PRECIPITATION AND OUTGOING LONG WAVE RADIATION:

Estimation of Quantitative Precipitation Index is made using 3 hourly INSAT-ID data. Such precipitation estimates are averaged over large areas (2.5 degrees square Lat/Long.) over a week of month. Similarly outgoing Longwave Radiation (OLR) weekly and monthly avarage are being computed over 2.5 degrees (Lat./ Long.) square areas.

e) The cloud imagery data obtained from INSAT-ID are being transmitted every three hours in analog facsimile mode to the 20 Secondary Data Utilisation Centres (SDUCs) located at various important forecasting offices of the Department in the country through dedicated communication links.

4. INSAT-ID ALSO PROVIDES THE FOLLOWING TWO COMMUNICATION SERVICES FOR METEOROLOGICAL PURPOSE:-

i) A scheme for dissemination of Cyclone warning called Disaster Warning System (DWS) directly to the coastal areas likely to be affected is in operation since January 1986. The performance of this scheme has been found to be very effective and satisfactory when the cyclonic storms affected the coastal areas on several occassions from 1987 to 1991.Under the scheme 50 more DWS receivers will be deployed in near future in addition to the existing 100 DWS receivers, the reception of cyclone warnings through INSAT.Thus total number of 150 DWS receivers will cover the entire coastal region of Indian sub-continent.

In this scheme cyclone warning messages originating from the Area Cyclone Warning Centre,are transmitted to INSAT from the nearest Earth Station.The S- band transponder of INSAT receives and relays back these signals over the Indian Territory for direct reception by DWS receivers. In this scheme the transmitted signals selectively address only those specific set of DWS receivers.for which the cyclone warnings are meant.

ii) Scheme for Meteorological Data Dessemination (MDD) through INSAT-satellite,using Television broadcast capability of INSAT-ID is under implementation. With this scheme it will be possible to receive processed meteorological data at secondary location directly from satellite. Under this scheme 23 stations will be installed in India. Out of 23 stations , 10 stations have been commissioned so far.

REPORT ON THE FUTURE SATELLITE SYSTEM

INSAT-II SYSTEM:

INSAT programme will be continued through the 1990s by lunching rhe 2nd generation INSAT Satellites (INSAT-II). First satellite of INSAT II series will be launched in the last week of March 1972 on Ariane Launch vehicle of ESA. The first two satellites of INSAT-II series are being fabricated indigenously by the Indian Space Research Orgination (ISRO) satellite centre, Bangalore to meet the requirements of various user agencies. INSAT-II satellites will replace the currently operational INSAT-I satellite series in a phased manner. Critical Design Review (CDR) of INSAT-II satellite has been completed and the first satellite of the programme (INSAT-IIA) is now in an advanced stage of testing before its shipment to launch site in early 1992.Like INSAT-I,INSAT-II is also a multipurpose,three axis stabilised geostationary satellite system to provide services for Meteorology, Telecommunications and T.V. and consists of the following meteorological payloads:

(a) Very High Resolution Radiometer (VHRR)
(b) Data Relay Transponder (DRT)

(a) The function of Very High Resolution Radiometer is to image the earth's cloud cover in visible and IR channels . The resolution at sub-satellite point will be 2.0 Kms (visible) and 8 Kms (IR). The VHRR will image the earth's cloud cover over Indian and adjoining land and sea areas.The scan mechanism will have the capability for full earth scan with 20 Degrees (N-S)x20 Degrees (E-W) and sector scan will have 20 Degrees (E-W) x 4.5 Degrees (N-S).Normally VHRR will scan 14 degrees (N-S) x20 degrees (E-W) field of view for most of the day to day operations.

(b)The Data Relay Transponder (DRT)on INSAT-II will be like that on INSAT-I, for collection of Meteorological data from Data Collection Platforms (DCPs) located over remote and inaccessible areas.

INSAT-II METEOROLOGICAL GROUND SEGMENT

For utilisation of meteorological capability of INSAT-II satellite a suitable ground segment is being established in the premises of Meteorological Department, Lodi Raod, New Delhi for direct reception of INSAT-II meteorological data. A new INSAT-II Meteorological Data Processing system (IMDPS) with improved capabilities for processing of satellite meteorological data and derivation of products is being comissioned shortly. It will consist of eight VAX-3400 series of computers and will also have capabilities of ingesting conventional meteorological data and processing of TOVS data from US polar orbiting satellites.

MSG - SEVIRI INSTRUMENT PROPOSAL

1 INTRODUCTION

This Working Paper summarizes the output of the Phase A study for the Meteosat Second Generation imager and also describes the support activities to the MSG imager development initiated by EUMETSAT running in parallel to the SEVIRI industrial study. They include further work on the spectral channels definition, and the status of the SEVIRI simulator development. The long term objectives of these support activities are to ensure the definition of an instrument responding to the needs of the user community and to prepare for the exploitation of the potential of the SEVIRI measurements.

2 RESULTS OF THE INDUSTRIAL PHASE-A STUDY

2.1 Objectives and Study Organization

The study on the SEVIRI was carried out over the period June 1991 to March 92 with the following objectives:

a) design of the imager based on the mission requirements
b) performance assessment
c) proposals/plans for technology development prior to phase B
d) planning/cost estimates for phases B/C/D

A summary of the SEVIRI channels is given in table 1

Channel	8 cooled channels baseline	10 cooled channels option
VIS 0.6	X	X
VIS 0.8	X	X
IR 1.6	X	X
IR 3.8	X	X
IR 8.7	X	X
IR 10.8	X	X
IR 12.0	X	X
WV 6.2	X	X
WV 7.3	X	X*
IR 9.7		X*

Channel	8 cooled channels baseline	10 cooled channels option
VIS 0.6	X	X
IR 13.4	X	X
IR 14.0	X	X*
IR 4.5	X	X*
HRV	X	X

* : Gaps allowed (2 detectors missing out of 3)

TABLE 1 - SEVIRI Phase A Channels Options

2.2 Instrument Design

The overall instrument concept resulting from the study is presented in figure 1. It is based on a conventional spin scan configuration with a scan mirror with a 500mm aperture telescope, separate visible and IR focal plane assemblies and a passive cooler. The major dimensions of the instrument are 2110 mm in length, 4473 mm telescope focal length, a diameter of 1000 mm and a mass of 135.8 kg.

The repeat cycle and sampling distance requirements can be met at 100 rpm spin rate by scanning three lines in parallel for each channel. There are three active detectors per channel except for the HRV which has 9. The telescope line of sight is moved by 9 km between each Earth scan. The baseline instrument includes 12 channels, 8 of them being cooled to 100K.

Most of the analysis in this study has been performed for the baseline, but an upgraded option including 14 channels, 10 of them being cooled to 105K, has also been considered. For the baseline a convenient separation lay out has been established for the 8 cold channels combining in field separation prisms and dichroic separation, with a symmetrical four arms beam geometry. For 10 channels the separation geometry becomes significantly more complex in terms of mechanical construction, alignment procedures.

2.3 Instrument Performance

a) Radiometry

The study has demonstrated that the noise performance requirements (0.25K including averaging) are met except for channels IR12, IR13.4 and IR 14. The absolute accuracy of 0.5 K for the IR channels is achievable and based on an internal full pupil calibration approach. The absolute accuracy (1.66%) of the VNIR channels cannot be met due to the difficulty of implementation and characterization of a visible calibration reference source, even in laboratory conditions.

b) Geometry

The current MTF requirements are essentially met for all channels by appropriate selection of the detector shape and size and the stiffening of the scanning mirror. Current interchannel MTF requirements are also met (except for the IR 3.8) with a significant margin. However, the stringent co-registration requirement to be achieved through "hardware" channel alignment cannot be met. A different approach to the MTF requirements might allow to bypass this problem as it is being investigated within the ongoing EUMETSAT MTF studies (chapter 3).

c) Geometry correction accuracy

The current image quality requirements are met on the basis of a preliminary spacecraft instrument apportionment budgets. The most stringent requirements are the spacecraft attitude and attitude restitution. This is important especially for the HRV channels for which there are no specific requirements on attitude. The selection of the detector size in combination with the expected scan accuracy guarantees that each area on the earth is correctly sampled.

2.4 Technology Development

Crucial aspects of the SEVIRI design requiring further development are the following:

- the IR detection chain which is the driver of the instrument radiometric and to a certain extent, geometric performance

- the lightweight scan mirror, as the optical quality of the scan mirror is a driver with respect to the MTF requirement of the HRV channel

- scan mechanism and associated control electronics which is the driver of the raw image quality

2.5 Recommendations from Industry

Industry has proposed an instrument characterized by a very good overall performance with regard to the current "enhanced imaging mission requirements". Two negative issues are the radiometric performance of long wavelength IR channels and the channels co registration. The final recommendations are:

- to initiate technology development as soon as possible to confirm the analysis performed during the Phase A and to consolidate the performance budgets

- to consider only the baseline instrument with 8 cold channels in order to limit the development risks and the overall program cost

2.6 Crucial Items for the Users

a) Upgrade to 10 Channels

Industry has made it clear that the upgrade of the instrument to 10 cold channels represented a major difficulty as it would require a different design of the cold part of the focal plane. The Phase A study also indicated that there is no real advantage in allowing gaps within some channels, as previously suggested for the 10 channel option.

The feasibility of adding two more channels is driven by the resulting total number of cold IR channels which has a direct impact on the opto-mechanical complexity of the focal plane. The recommendation by industry not to pursue the option of 10 channels needs to be carefully considered in relationship to the SEVIRI mission objectives

b) Co-registration Requirements

A simulation of the instrument optics stability has shown that the registration requirements are met for channels VIS 0.6 VIS0.8 and IR1.6, but not for the IR channels. The simulations have also shown that the current requirements impose very high stability requirements on the IR FPA optics (between 0.5 and 2 um) and that it is not possible to guarantee that such tolerances can be achieved or maintained as they mean in practice that the optics should not move at all. The implication of the study is that the only feasible requirement is the "knowledge" of the co-registration .The consequences of relying on the onground processing to co-register the channels needs now to be carefully assessed.

c) VNIR absolute Calibration

The Phase A study has shown that the visible and NIR calibration cannot be achieved on board. The current baseline option consists of a calibration follow up based on typical ground scene analysis. The proposed scenario envisages a precise pre-launch calibration of the imager and leaves open the necessity for setting up a strategy for the VISible calibration campaigns to be carried out on a regular basis during the operational phases of MSG.

3. REVISION OF THE MTF REQUIREMENTS

3.1 Need for further Analysis

From the beginning of the SEVIRI Phase A study it was felt that in spite of the long term effort to translate the meteorological requirements into engineering parameters, further clarification was necessary for the MTF requirements, especially in view of their foreseen impact on the HRVIS channel. The higher spatial resolution of HRVIS means that this channel is likely to be a design driver. EUMETSAT has therefore initiated two studies to check the consistency of the requirements and to assess the impact of possible relaxations resulting from the industrial Phase-A outputs. One study is being performed with the objective of reviewing the MTF requirements. Such revision will be broadly applicable to both HRVIS and the core channels, and particular attention will be paid to the current requirements for physical interchannel MTF or interchannel spatial registrations. The second study will emphasize the HRVIS channel requirements and it makes use of the LANDSAT imagery to visualize the impact of different MTF.

3.2 HRV Channel

As noted above the industrial study has been able to demonstrate compliance with the current HRVIS MTF requirements, although the fact that HRVIS is the highest spatial resolution channel has made it the design driver in the specifications of the scan mirror stiffness, optical quality of the telescope mirrors and the telescope alignment stability. As the current specifications are met by the proposed design the moment no relaxation of the HRVIS MTF has been recommended by industry. However, in case of difficulties with the scan mirror technology a relaxation strategy will have to be considered on the basis of the output of the two studies.

4. FURTHER WORK ON SPECTRAL CHANNELS DEFINITION

4.1 "Cold Detector" Channels

In parallel with the industrial Phase A study work has continued in EUMETSAT to evaluate the capability of SEVIRI for instability monitoring on the basis of the foreseen technological limitation to the 8 cold IR channels and of the recommendation of STG to include the Ozone channel. Some computations are currently performed to assess the capability of the SEVIRI instrument to detect the horizontal gradients of temperature and moisture in the lower atmospheric level. Further analysis is also ongoing with regards to the SEVIRI contribution functions to assess the channels sensitivity to vertical structure variances and first guess errors. Also, the 8-channel SEVIRI option will be analyzed in terms of the retrieval quality of several stability indices, on the basis of at least two retrieving methods of statistical nature, using or not using forecasts as "first guess". Realistic situations where statistical methods are applied with the available forecasts or even forecasts interpolated to the time of observation, will be simulated for an area large enough to be comparable with the grid point spacing of soundings.

4.2 Airmass analysis

As mentioned in the previous paragraph, the work underway is focused on the analysis of the 8 channel SEVIRI version to estimate stability indices, layer mean temperatures and moisture parameters. It is suggested at this stage that the retrieval of parameters for the instability monitoring mission will probably be performed with less confidence if it is not possible to estimate in real time any parameter representative of the lower tropospheric thermal instability (even with the support of temperature forecast fields providing information in substitution of the mid tropospheric CO2 channel at 14.0 μm) However, in the final analysis, careful consideration will be given to the broad interpretation of the instability mission. This implies that the "split water vapour channels can also support the instability monitoring mission with updated wind fields within two layers, in parallel with their NWP applications. The ozone channel can also provide some information on the upper tropospheric potential vorticity, although its direct application in instability monitoring might have some relevance only in situations with particularly very strong advection of potential vorticity at the upper levels.

4.3 Visible Channels

A study has also been initiated in order to refine the SEVIRI shortwave channels now defined as VIS 0.6 VIS 0.8 and IR1.6 on the basis of the mission requirements. The study is based on simulations of the radiances from different earth scenarios. Different aerosol types, water and ice clouds and four ground types will be used in the study. Determination of cloudiness, water clouds from ice clouds and snow, discrimination of clouds over land and aerosol observation are considered as the target mission objectives. The channel definitions will also determine whether the requirements on the shortwave channels as currently defined are complete enough to ensure achievement of the mission objectives. The SEVIRI channels will be compared to the corresponding AVHRR 4 channels to check the desirable consistency of spectral observations from the two imagers.

5 SEVIRI SIMULATOR

5.1 Objectives and Study Organization

The SEVIRI simulator software has been defined as a tool for the end users for specifications refinement, performance assessment and products definition. The project has been organized in different phases, the first one being devoted to the detailed specifications to be used in the second phase of implementation of the system. Two parallel studies are ongoing for the first phase of the project, the output being a set of specifications for the implementation of the system.

5.2 Status of the Project

The SEVIRI simulator studies are focused at this stage on the definition of the Environmental Data Base (EDB) and of the Radiative Transfer Model (RTM). The problem of generating data as representative as possible of the future operational MSG data to help the end users to assess the image quality performance of the instrument and to develop algorithms for products extraction makes the initial phase of the study very demanding. The EDB and the RTM must simulate the MSG radiances taking into account the fields of view, the spectral filter of each channel and the geophysical parameters describing the atmospheric profile. The EDB requires to collect and merge as much possible information from numerical model prediction outputs, meteorological satellite data, and possibly specific parameters acquired during relevant campaigns. The meteorological situations selected for the EDB will be of interest for the SEVIRI applications. It is envisaged that the simulator will simulate SEVIRI images at intervals of 15 minutes for a long periods (i.e. one day) for subsectors of the European area and at lower resolution for the whole globe.

6 CONCLUSIONS

a) The SEVIRI Phase A study has demonstrated the feasibility of the instrument with the 8 cold IR channels. Radiometric requirements for the long wavelength channels, and co-registration requirements are not met by the proposed design.

b) Support activities to the SEVIRI development are ongoing. Further work is being performed on channels definition and two studies are being performed on the MTF requirements, to be completed in May. The first phase of the Simulator is also ongoing, and the specifications for the implementation phase will be available in May.

GOES-N

In order to obtain requirements for a GOES series of satellites post 2000, a NESDIS-sponsored workshop was conducted in Clinton, Maryland on January 10-11, 1989. The purpose of the workshop was threefold: 1) assure that planning for the GOES-N series of satellites was part of a deliberate process instead of the more hasty procurement method used for GOES I-M, 2) re-examine the GOES I-M baseline and proposed needed changes and 3) review requirements and submit upgraded or new requirements, if needed.

Over eighty (80) personnel attended including representatives from all five NOAA line offices, the Department of Defense (Office of the Secretary of Defense, U.S. Air Force, U.S. Navy, and U.S. Army Corps of Engineers), NASA (Headquarters, Goddard Space Flight Center, Marshall Space Flight Center, and the Johnson Space Center), the Department of the Interior (U.S. Geological Survey), the Department of Agriculture (Agricultural Research Service), the Department of Transportation (Federal Aviation Administration and U.S. Coast Guard), and consultants from the Universities of Wisconsin, Colorado, and Oklahoma.

The workshop participants were broken down into six requirements teams to address the following areas: imaging, sounding, space environment monitoring, data communications services (DCS/WEFAX), search and rescue, and spacecraft systems. The imaging and sounding requirements teams were chaired by National Weather Service personnel, the space environment monitoring team by NOAA Space Environment Laboratory personnel, with the remaining areas chaired by NESDIS personnel. The NASA/GSFC metsat project office provided technical consultant support to all six teams.

The six teams were told that their ground rules for arriving at requirements were 1) their work would not be allowed to impact the GOES I-M system already under procurement, 2) their work should focus on observation and service requirements, not hardware, 3) requirements would only be accepted if they supported a NOAA operational service, and 4) requirements that resulted in the need for systems beyond the state-of-the-art (e.g. a geostationary microwave sounder) would be disallowed and left for NASA to pursue as part of its proposed "Mission to Planet Earth" Geoplatform series.

Requirements from the six teams were submitted to NESDIS in early April 1989 and combined to form a Statement of Guidelines and Requirements for a GOES-N Phase-A Study to be performed by the NASA/GSFC Advanced Missions Analysis Office (AMAO). As part of the Phase-A study, AMAO first undertook the task of converting the proposed GOES-N observations and services to instrument and system engineering requirements. AMAO was further directed to determine the cost, feasibility, and risk of the following five options: 1) replicating the GOES G/H design in the post 2000 time frame, 2) replicating the GOES I-M design in the post 2000 time frame 3) changing the GOES I-M design to improve efficiency or reduce costs, 4) changing the GOES I-M design to satisfy National Weather Service 1983 requirements not currently being met on GOES I-M, and 5) changing the GOES I-M design to satisfy the NOAA 1989 requirements generated as a result of the post 2000 GOES requirements workshop. Details on the various options studied are included in the attached tables.

The Phase A study was completed by AMAO in late 1991. Data derived from the study are being be used to form the basis of NOAA's planning for the post 2000 series of GOES satellites.

GOES-N REQUIREMENTS COMPARISON

SAMPLE COMPARISONS OF GOES I-M EXPECTED PERFORMANCE AND GOES-N REQUIREMENTS

SENSING/ELEMENT AREA	GOES I-M	GOES-N+
VISIBLE & INFRARED IMAGING	SINGLE IMAGER - 5 CHANNELS - 1KM VIS RESOLUTION - 4-8KM IR RESOLUTION - SECTORS & FULL DISK OPS	POSSIBILITY OF TWO IMAGERS - ORIGINAL IMAGER - REGIONAL FOCUS - ~ 10 CHANNELS -0.5-1KM VIS RESOLUTION - 2-4KM IR RESOLUTION - GREATER SENSITIVITY - SECOND IMAGER - FULL DISK FOCUS - GLOBAL WINDS - BACK-UP
IR PROFILING	MODERATE SPECTRAL RESOLUTION PROVIDES - 2K TEMP. ACCURACY - 20-25% RH ACCURACY 8KM RESOLUTION	HIGH SPECTRAL RESOLUTION PROVIDES - 1-1.5K TEMP ACCURACY - 15% RH ACCURACY 4-8KM RESOLUTION CLOUD DETECTION ARRAY
SEM	3-4 SENSORS FOR SOLAR & SPACE ENVIRONMENT MONITORING	UP TO 9 SENSORS FOR SOLAR & SPACE ENVIRONMENT MONITORING

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GOES-N REQUIREMENTS COMPARISON

(CONTINUED)

SAMPLE COMPARISONS OF GOES I-M EXPECTED PERFORMANCE AND GOES-N REQUIREMENTS

SENSING/ELEMENT AREA	GOES I-M	GOES-N+
SEARCH & RESCUE	DETECTION OF EMERGENCY BEACONS	DETECTION & LOCATION OF EMERGENCY BEACONS
DCS/WEFAX	100 BAUD TRANSMISSION NO EARTH LOCATION OF TRANSMISSION. 1 WEFAX CHANNEL	INCREASED TRANSMISSION RATES OF 300 & 1200 BAUD. EARTH LOCATION OF TRANSMISSION. 4 WEFAX CHANNELS
EARTH LOCATION	4-6KM (3σ)	2KM (3σ) AT 45^{o} LAT.
IMAGE TO IMAGE REGISTRATION (3σ)	$\pm$ 42µRAD IN 15 MIN. $\pm$ 84µRAD IN 90 MIN.	$\pm$ 28µRAD IN 15 MIN. $\pm$ 42µRAD IN 90 MIN.
CHANNEL TO CHANNEL REGISTRATION (3σ)	$\pm$ 28µRAD (IMAGER) $\pm$ 22µRAD (SOUNDER)	$\pm$ 14µRAD (IMAGER) $\pm$ 10µRAD (SOUNDER)

GSFC
ADVANCED MISSIONS ANALYSIS OFFICE

CGMS-XX EUM-WP-7
Prepared by EUMETSAT
Agenda Item: D.1

ATLANTIC DATA COVERAGE

1 INTRODUCTION

EUMETSAT has agreed that the METEOSAT-3 satellite will be used in support of the Atlantic Data Coverage (ADC) mission. The primary purpose of this mission is to provide users in North and South America with additional image information whilst there is only one GOES satellite operated by NOAA. The ADC satellite is currently located at 50 degrees West in order that it can still be controlled directly from ESOC in Germany. In the event that GOES might fail then plans are being developed for the operation of METEOSAT-3 at around 100° West. Control of the satellite would still be performed from Germany, however, satellite telecommunications and image data would flow via a trans Atlantic data link and an uplink/downlink station at Wallops Island on the east coast of the USA.

2 ADC DATA FLOW

Raw image data from METEOSAT-3 is received by both ESOC and CMS Lannion, France, and processed for the ADC schedule. ESOC processing is confined to the production of digital image formats using an equipment chain set up specifically for ADC. In the case of CMS Lannion the data are rectified in the station computer and then transferred to the GMR computer for re-formatting to the METEOSAT analogue WEFAX standard and finally uplinked to METEOSAT-3 using a dedicated antenna.

The ADC schedule provides up to 48 METEOSAT-3 high resolution images per day and up to 24 WEFAX images per day in available spectral bands, covering several different areas.

3 IMPACT UPON GOES-METEOSAT-RELAY (GMR) OPERATIONS

For the time being METEOSAT-ADC satellite images have replaced the GOES imagery usually disseminated via METEOSAT-4 Channel A2.

Since there is only one antenna available in Lannion to support ADC and GMR uplink operations it is necessary to repoint it between METEOSAT-3 and METEOSAT-4 every three hours. This has resulted in the grouping together of all GMR image transmissions. The METEOSAT-4 dissemination schedule showing the revisions caused by GMR image grouping is shown on page 5.

4 ADC SATELLITE RANGING

A satellite in geostationary orbit requires regular ranging to accurately determine its position in the orbit and to allow the prediction of future movement. For METEOSAT-ADC ranging operations are carried out by ESOC and, because of a partial installation of additional ranging equipment in the main ground station at the start of ADC operations, there were frequent losses of WEFAX formats for periods of up to 48 hours every seven days in the first three months of ADC operations. Following the completion of the ground station installation by the end of November 1991 it was possible to perform normal satellite ranging, i.e. 12 minutes of ranging every three hours (as indicated by the letter "R" in the schedule shown on page 4).

5 ADC Analogue (WEFAX) image dissemination from CMS Lannion

6 WEFAX IR formats (LnD - see Figure 2, page 6), centered at 50° West provide adequate coverage to SDUS users since remaining areas in the ADC satellite field of view are already covered by imagery from METEOSAT-4 and GOES-Central. Visible WEFAX image formats are transmitted during daytime at IR resolution and using the same format as for IR (LnC) because of limited time within the dissemination schedule.

It will also be noted that at some hours it is not possible to transmit all 6 IR and Visible image formats. Details of the ADC image dissemination schedule are shown on page 4. Some further modification of the ADC schedule has to be expected in the light of user experience.

6 ADC Digital image dissemination from ESOC

The following METEOSAT-ADC digital images formats are disseminated :

- T - full disk, similar to the standard METEOSAT "A" format, current options are : TIW (Infra-red and Water Vapour), TIVH (Infrared plus half resolution Visible data, and some TW (Water Vapour - to complement TIVH formats). These formats are generally transmitted every hour, but half hourly between 03 & 06, 09 & 12, 15 & 18 and 21 & 00 where they are used for cloud motion wind extraction in the USA.

- S - "B" type format, centered at 20 deg. North, 50 deg. West and transmitted from 1 June to 31 October, approx. every hour.

- W - "B" type format, centered at 40 deg. North, 55 deg. West and transmitted from 1 November to 31 May, approx. every hour.

Examples of the T, S and W formats are shown in Figure 1, page 6.

In order to minimize the impact of these additional formats upon existing PDUS operators the "A" and "B" format identification in the ID-word of each data frame has been retained (i.e. all T formats are called "A" formats, and the S and W formats are called "B" formats.

In order to differentiate between the T and the real "A" format and the S and W and the real "B" formats, the following additional identifiers have been be introduced :

- **the sub-satellite point (0 deg.longitude for METEOSAT-nominal and 50 deg. West for METEOSAT-ADC,**

- **the offset of the lower right hand corner of the B, S, W format window within a standard 2500 line by 2500 column reference frame.**

These additional identifiers are located in the identification field of the Heading and Conclusion subframes (see page 21 of the document "METEOSAT High Resolution Image Dissemination", dated October 1989). Bytes 21 - 32 of the identification field will contain these additional identifiers :

- Bytes 21 - 22 contain the column offset
- Bytes 23 - 24 contain the line offset
- Bytes 25 - 26 contain the sub-satellite longitude (nominally 0 or -50)

For consistency the standard "B" format will contain the column offset value of 625 in Bytes 21 and 22, and the line offset 1809 in Bytes 23 and 24.

FORMAT	COLUMNS	LINES	Lower right corner	
			Column	Line
S	626 - 1875	1414 - 2038	625	1413
W	717 - 1988	1805 - 2429	716	1804

7 DEFINITION OF IMAGE FORMATS PROVIDED BY LANNION

FORMAT	CHANNEL	RESOLN (KM)	SIZE (Lines x pixels)	POSITION IN WHOLE EARTH DISK (2500x2500)			
				first line	last line	first pixel	last pixel
L1D L1C L1E	IR VIS WV	5	800 x 800	1540	2339	1470	2269
L2D L2C L2E	IR VIS WV	5	800 x 800	1540	2339	670	1469
L3D L3C L3E	IR VIS WV	5	800 x 800	850	1649	1470	2269
L4D L4C L4E	IR VIS WV	5	800 x 800	850	1649	670	1469
L5D L5C L5E	IR VIS WV	5	800 x 800	50	849	1470	2269
L6D L6C L6E	IR VIS WV	5	800 x 800	50	849	670	1469

8 ADC ANALOGUE WEFAX FORMATS DISSEMINATED TO METEOSAT-4

FORMAT	CHANNEL	RESOLN (KM)	SIZE (Lines x pixels)	POSITION IN WHOLE EARTH DISK (2500x2500)			
				first line	last line	first pixel	last pixel
LY	IR	8	800 x 800	1150	2449	900	2199
LR	IR	8	800 x 800	150	1449	750	2049
LZ	VIS	5	800 x 800	1650	2449	1100	1899

9 ADC DIGITAL HIGH RESOLUTION FORMATS DISSEMINATED TO METEOSAT-4

For the time being full disk LXI and LXIVH formats will be disseminated. Full disk LXIV formats will be disseminated in due course following completion of equipment upgrade in CMS Lannion (See Figure 3, page 6 for image formats).

FORMAT	CHANNEL	RESOLN (KM)	SIZE	Transmission time
LXIVH	IR & VIS	10	1250 x 1250	Approx 3 Minutes (i.e. one slot)
LXIV	IR & VIS	10 IR 5 VIS	1250 x 1250IR 2500 x 2500 VIS	Approx 7.4 Minutes (i.e. two slots)

Figure 1. HR DIGITAL ADC FORMATS
(Uplinked by ESOC)

S = Summer format, W = Winter format

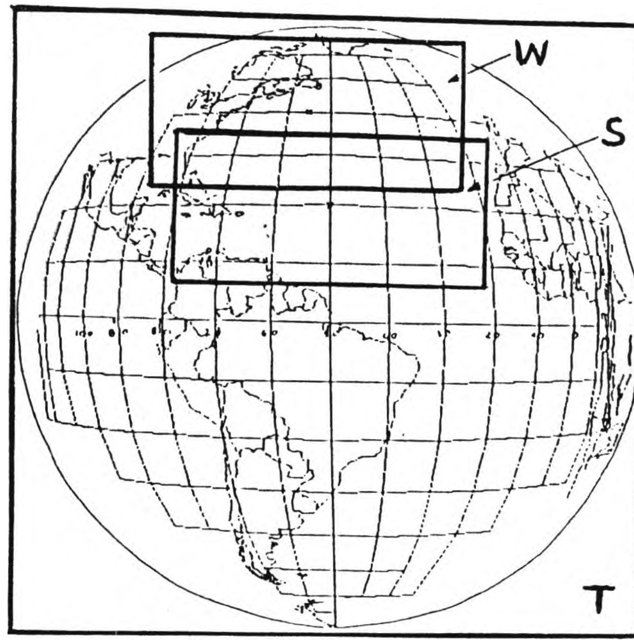
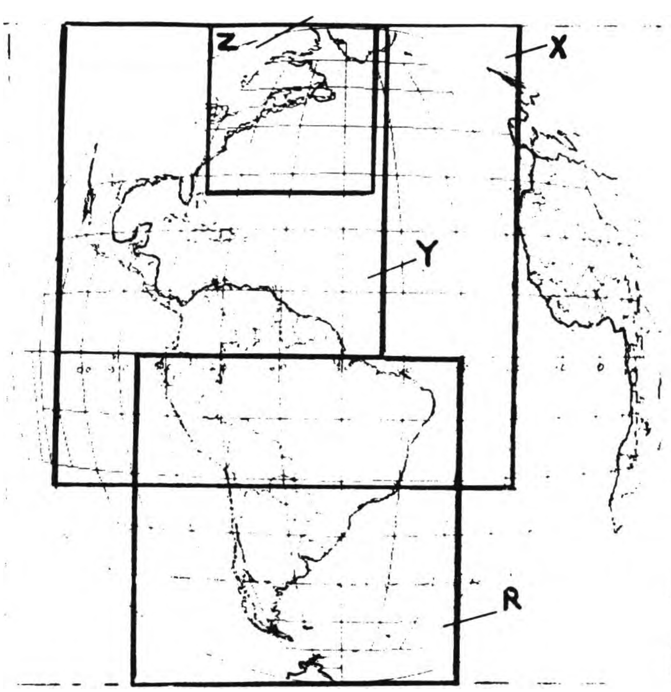


Figure 2. WEFAX ADC FORMATS
(Uplinked by CMS Lannion to METEOSAT-3



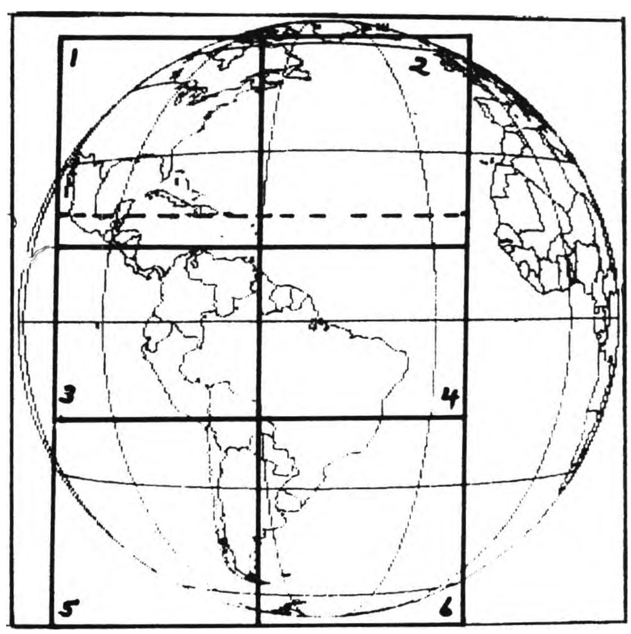


Figure 3. HR & WEFAX ADC FORMATS

(Uplinked by CMS to METEOSAT-4)

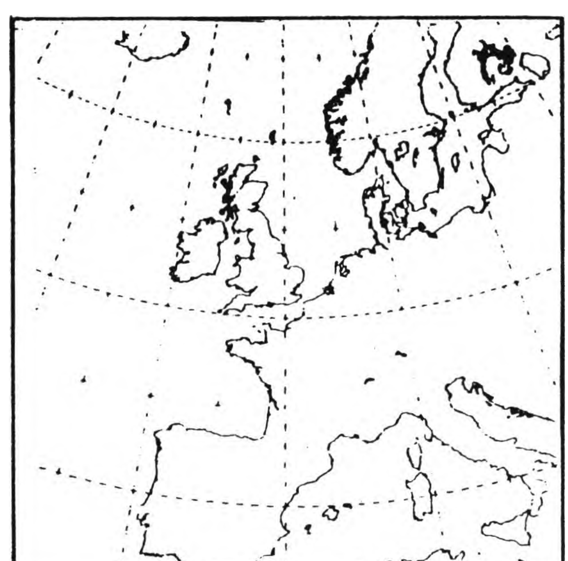


Figure 4. EXPERIMENTAL AVHRR PRODUCT

(Uplinked by CMS Lannion to METEOSAT-4)

CGMS-XX EUM-WP-8
Prepared by EUMETSAT
Agenda Item: D.1

EXTENDED OPERATIONS OF ATLANTIC DATA COVERAGE

1 INTRODUCTION

EUMETSAT has agreed that METEOSAT-3 will be operated at 50° West to provide Atlantic Data Coverage (ADC) until at least October 1992. This position was chosen since it is close to that occupied by the GOES-East satellite and at the same time the satellite can be controlled from ESOC.

The National Oceanic and Atmospheric Administration (NOAA) has stated that its meteorological geostationary satellite GOES-West (GOES 7) is close to its end of lifetime and could possibly fail within one or two years. A replacement satellite is not foreseen before 1994. As a consequence, NOAA has asked EUMETSAT to consider moving Meteosat-3 to a position near 100° West, in order to be available as a back-up should GOES 7 fail. A positive response to this request was received from the EUMETSAT Council in August 1991.

2 TECHNICAL SOLUTION

ESA will install the necessary up and downlink equipment at Wallops Island in the US and operate the satellite. Following discussions between EUMETSAT, NOAA and ESA, the necessary legal arrangement will be made through an exchange of letters and a contract will be signed by all parties. The texts are currently being finalised. Setting up the operational facilities will take about 16 months, so that the move of the satellite is not expected before early 1993.

The main components to be installed in Wallops Island will be :

- the uplink divider
- the downlink divider
- housekeeping data reception chain
- raw image reception chain
- telecommand equipment
- WEFAX and HR image receivers and format check units
- METEOSAT ranging system
- communications subsystems
- monitoring and control systems
- frequency and timing distribution systems

A back-up system will also be installed in Wallops which will be used to place the satellite in a safe state in the event of a major failure of the primary Wallops station. Only the capabilities to send spacecraft commands and receive housekeeping telemetry would comprise the back-up system.

Additional equipment will be installed in Kourou (for ranging) and ESOC to support the operation of a METEOSAT satellite at around 100° West. The facilities for adjusting, calibrating, navigation and processing of image data will be housed at ESOC. ESOC will receive raw image data from Wallops and return processed image data for dissemination via Wallops and the satellite.

3 CONDITIONS OF THE LEASE

Meteosat-3 is currently carrying enough station keeping fuel to last until 1994. The satellite will remain under EUMETSAT/ESA control and could be moved back at any time. However, since METEOSATs 4 and 5 are operational satellites in orbit, it seems unlikely that METEOSAT-3 would have to be returned to Europe for nominal operations.

As part of the Agreement, NOAA will undertake to provide METEOSAT-ADC EXT raw data and GMS data for dissemination by METEOSAT-nominal. The final location of Meteosat-3 will be determined by EUMETSAT and NOAA jointly, taking into account the availability of US satellites.

CGMS-XX WP-06
Prepared by Japan
Agenda Item: F.1

IDCS Interference Monitoring System

An IDCS interference monitoring system was developed to monitor spectrum condition of IDCS channels. The spectra of IDCS channels are automatically measured and stored in a personal computer of the monitoring system for necessary analysis.

1. Monitoring system

1.1 Outline of the monitoring system

IDCS RF signals relayed by GMS-4 are fed into the spectrum analyzer through antenna, receiver and IF conversion unit. The spectrum analyzer is controlled by personal computer with GP-IB. Schematic diagram of the system is shown in Figure 1.

1.2 Equipment specifications

The monitoring system consists of spectrum analyzer, personal computer and some peripheral equipments. Equipments specifications of the system are as follows:

a. Personal computer
NEC/PC9801 with 16 bit micro-processor (80286)

b. Spectrum analyzer (HP8568A):

frequency range	:	100 Hz to 1.5 GHz
amplitude range	:	-135 dBm to +30 dBm
frequency stability	:	1 x 10^{-9} /day
resolution band width	:	> 10 Hz

c. Hard disk unit

storage capacity	:	20 Mega bytes

d. CRT display	:	14 inch color display
e. Printer	:	132 CPL color dot impact printer

1.3. Monitoring software

Spectrum measurement and analyzing are carried out independently. The monitoring software consists of two major packages, such as GP-IB control program and analyzing program. The processing flow chart of the programs is shown in Figure 2.

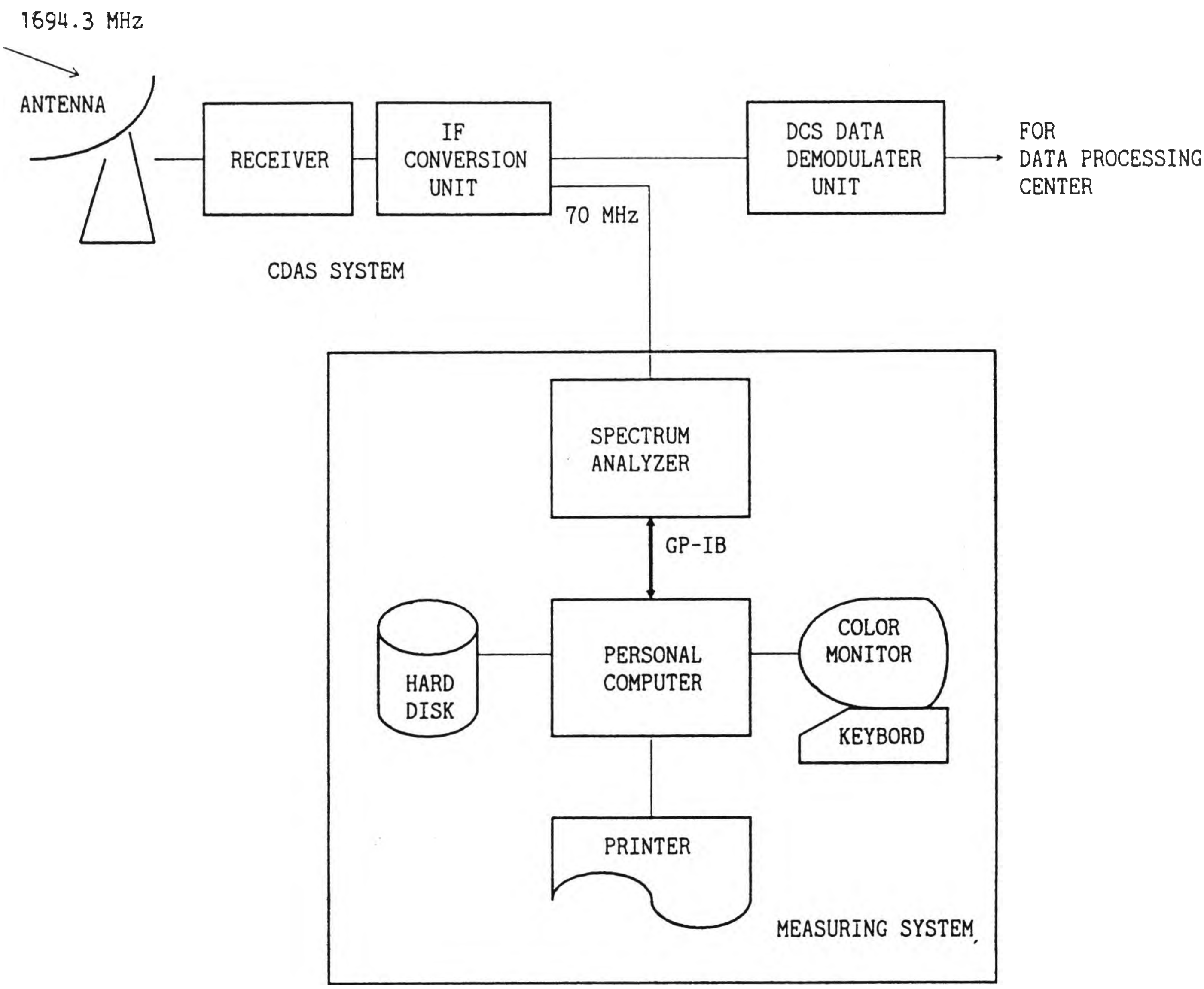
The spectrum monitoring is performed through the following procedure.

a. GP-IB control program

- Initialization of personal computer;
- Calibration and parameter setup of spectrum analyzer;
- Frequency sweep and signal level measuring;
- Data save;

b. Analyzing program

- Stored data read;
- Data analyzing;
- Spectrum chart display on CRT;
- Hard copy.



RF signal characteristics

a. input frequency	:	1694.3	MHz
b. reception bandwidth	:	100	KHz
c. IF	:	70	MHz band
d. DCS signal level	:	-40	dBm

(nominal, at spectrum analyzer input)

Figure 1 Schematic diagram of monitoring system

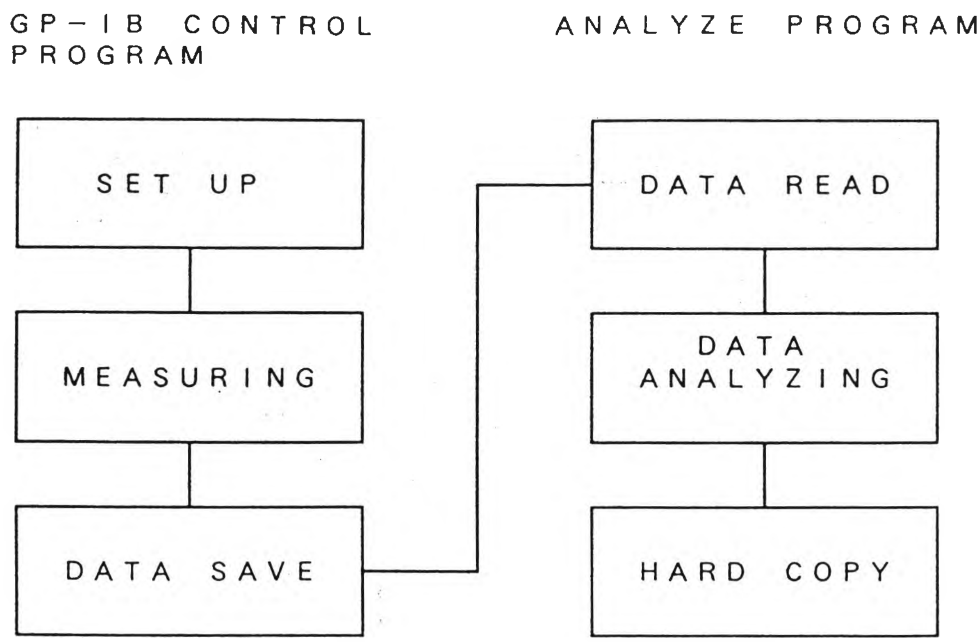


Figure 2 Processing flow chart of the spectrum monitoring system

ANNEX X

CGMS-XX EUM-WP-13
Prepared by EUMETSAT
Agenda Item: G.1.3

DEFINITION OF A

LOW RATE IMAGE TRANSMISSION FORMAT

1 INTRODUCTION

During previous sessions of CGMS discussions have taken place in order to define future transmission systems which could replace the present APT and WEFAX direct broadcast systems operated on polar orbiting and geostationary meteorological satellites. NOAA took an action to define the Low Rate Picture Transmissions (LRPT) format which will replace APT, and EUMETSAT was entrusted with the definition of an equivalent Low Rate Image Transmission (LRIT) format to replace the WEFAX service.

The presently operated WEFAX standard, based an analogue transmission technique, is to be replaced by a new digital standard. Due to the fact that the WEFAX standard is the most common standard for the distribution of meteorological data and is operated internationally it is necessary to carefully coordinate the new standard.

The attached document "Low Resolution Image Transmission (LRIT) Format - Specification" - Revision 1, November 1991 is the first draft of such a format pecification, and contains details of basic format structure and makes a provision for any further necessary enhancements.

2 BASIC CONSIDERATIONS

Before the format proposal can be discussed in detail, the basic considerations presented and agreed during previous CGMS should be recalled:

- LRPT and LRIT should become an international standard,

- LRPT will be used for data transmission systems on polar orbiting satellite systems, LRIT will be its equivalent and used for data transmissions from geostationary satellite systems,

- The standard should make use of existing international standards in telecommunications and data processing wherever possible,

- The standard should allow the use of low cost user stations,

- The antenna size of user stations should not exceed a diameter of 2 m (preferable would be antenna sizes between 1 and 1.5 m); omnidirectional antennae shall be used for polar systems,

- Packetized transmission techniques should be applied to allow the sequential transmission of data of various origins,

- Forward error connection algorithms should be considered to improve the link quality,

- Data compression methods could be considered (optional).

All above requirements can be achieved using the format specification provided in the attached document.

2.1 International standards

The format structure is based on CCSDS Advanced Orbital Systems recommendations. This is a standard suitable for packetized transmissions.

The transmission concept follows the CCITT OSI model. The attached document has to be considered as a growing document. Some higher layers of the OSI structure require further discussions and agreement between future operators.

2.2 Low cost user station

Although the definition of the physical layer of LRIT is not finally specified and depends upon the performance figures of the spacecraft, it can be expected that LRIT user stations would require performance figures of 1 db/K only (compared to 2.5 dB/K on present WEFAX reception stations). This would allow antenna sizes of approximately 1m and could allow application of cheap yagi type antenna, achievable by application of Reed Solomon Forward Error Correction methods.

During the definition of LRIT format the results from LRPT definition work which was performed simultaneously were taken into account and were integrated wherever possible.

3 DATA TO BE TRANSMITTED

It may be recalled that the following data can be transmitted via LRIT :

- Image Data from various spacecraft,
- Alphanumeric Data (DCP, calibration figures, atmospheric soundings, cloud track winds, sea surface temperatures, selected GTS products, etc.),
- Grid and Coastline Information,
- Graphical information (weather charts, products).

3.1 Image Data

Image data from the spacecraft used for transmission as well as those from other spacecraft systems together with derived products in pictorial form shall be transmitted using identical format and frame structures.

All image formats will contain header information describing the content of the format, i.e. information on the geographical sector, pixel resolution, spectral band indication, etc. The header preprocessor will thus only handle frames which contain particular information required by the user.

CCSDS format structures cater for such header information.

3.2 Alphanumeric and Binary Data

Alphanumeric data frames can contain meteorological data (selected SYNOP, TEMPS etc), DCP data, calibration figures, administrative messages, atmospheric soundings, cloud track winds, sea surface temperatures etc. Binary codes such as GRIB and BUFR will have to be supported.

3.3 Graphical Information

This will include weather charts and meteorological products in graphical form similar to the information transmitted via EUMETSAT's MDD mission. The graphical information shall be encoded in an internationally agreed code such as CCITT T.4.

3.4 Grid and Coastline Information

Grid and Coastline information will be transmitted separately from image information. This will enable the user to select only information of his interest and allow the replacement of this information by the users own coastline and gridding information. The structure of such information will have to be defined.

In the case of transmissions containing rectified image data, it is assumed that it would not be necessary to transmit this information on a regular basis.

4 DATA RATE

The recommended net data rate is 64 kbit/sec for both LRPT and LRIT. Due to overhead information this implies an actual transmission data rate of approximately 72 kbit/sec, including forward error correction.

64 kbit/sec is a standard transmission rate and would allow the use of commercial equipment. The use of 128 kbit/sec should also be considered as an option.

5 FUTURE DEVELOPMENTS

Further studies are necessary to define the content of all layers of the OSI model. It will be necessary to coordinate the future definition work very carefully in order to obtain one common standard for all direct readout transmissions from meteorological satellites. Ideally this should include LRIT, LRPT, HRPT and other digital transmission formats for high speed data transmissions.

CGMS should discuss the framework for future coordinated studies and implement a plan for close cooperation during the definition phase of this standard.

After agreement on the standard it will be necessary to further develop standardisation of user station modules in such a way that both stand alone low cost user stations and combined user stations could be produced for various applications.

Appendix to ANNEX X

Low Resolution Image Transmission Format (LRIT)

Specification

Revision 1.0
November 1991

EUMETSAT Ground Segment Support Division
Am Elfengrund 45
D-6100 Darmstadt-Eberstadt
Federal Republic of Germany

Table of Contents

List of Figures

1. Document Change Record

Revision Number and Date	Sections Affected	Status / Remarks
Rev. 1.0 12-Nov-1991	all	initial draft release

2. References

2.1 Applicable Documents

[1] CCSDS: "Advanced orbiting systems, networks and data links: architectural specification", CCSDS recommendation 701.0-B-1, October 1989

[2] ISO: "Information processing systems - open systems interconnection - basic reference model", ISO standard 7498, February 1982

[3] ESA: "Radio frequency and modulation standard", ESA PSS-04-105 Issue 1, December 1989

[4] CCSDS: "Time code formats", CCSDS recommendation 301.0-B-1, January 1987

[5] CCSDS: "Telemetry channel coding", CCSDS recommendation 101.0-B-2, January 1987

2.2 Related Documents

[R1] CCSDS: "Advanced orbiting systems, networks and data links: summary of concept, rationale and performance", CCSDS report 700.0-G-2, October 1989

[R2] ESA: "Packet telemetry standard", ESA PSS-04-106 Issue 1, January 1988

[R3] CCSDS: "Radio frequency and modulation systems, part-1: earth stations and spacecraft", CCSDS red book issue -1,-2, May 1989

[R4] ESA: "Telemetry channel coding standard", ESA PSS-04-103 Issue 1, September 1989

[R5] ESOC: "Meteosat WEFAX Transmissions", published by Meteosat Exploitation Project, March 1990

3. Introduction

3.1 Purpose of the mission

The intention of LRIT is to define a standard for dissemination of data from geostationary spacecrafts towards LRIT user stations.
The (digital) LRIT mission shall replace the (analogue) WEFAX mission.
For Meteosat WEFAX dissemination the LRIT user station shall substitute the present Secondary Data User Stations.
The main approach of LRIT is to disseminate rasterized image data mapped to the surface of the earth, preferably those generated by or deducted from satellite remote sensing data. Additionally, LRIT shall provide means to forward other types of graphical information, alphanumeric data or binary data.
The LRIT mission supports low cost user stations by means of adopting international standards and by taking advantage from modern coding techniques.

3.2 Purpose of this document

This document provides an architectural specification of the LRIT mission from a telecommunications point of view. Thus it does neither define meteorological or other applications nor it specifies a user station for LRIT.
With help of this documents all data structures, protocols, and services are defined completely. Also the physical space link is specified in detail.

3.3 Scope of this document

Since the LRIT dissemination mission is understood as a communication between "open systems", the architecture is strictly aligned to ISO standard 7498 (describing the OSI reference model). Network and data link layer are specified in conformance with the AOS recommendation, which is the cleanest and most modern adoption of the OSI model for space communications.
In section 4 an overview of the communication system is provided. Each layer of the communication model is specified in detail in the subsequent sections. Refer to appendix A for explanations of the acronyms used in this document.

3.4 Conventions

Within this document the terminology defined in ISO standard 7498 (OSI reference model) is used assuming the definitions given therein. As an extension, the terminology of CCSDS 701.0 (AOS architecture) is used for network and data link layers, without repeating the definitions and explanations given therein, too.
The CCSDS bit numbering convention is adopted for the entire specification herein. Be aware that bit streams are counted from the MSB onwards, beginning with 0. Groups of eight bits are denoted as "octets".

4. System Overview

4.1 Communication Model

In order to specify the LRIT format ISO standard 7498 (OSI reference model) is used. LRIT is mapped onto the seven layers of the communication reference model. Figure 4-1 visualizes how the reference model is applied for LRIT.

Due to the fact that LRIT is a dissemination mission there is a unidirectional flow of information from a transmission system (denoted as TX) to a reception system (denoted as RX). In the physical representation the transmission system is the central LRIT uplink station and the reception system is one LRIT user station.

There are seven layers specified for the communication process, with increasing level of abstraction, beginning with the physical layer at the bottom of the stack, ending up with the application layer at its top. Below the communication system there is the communications media, which is the space path from the uplink station towards the user station including the transponder functionality of the spacecraft.

For each of the communications layers a service data unit (SDU) can be defined, which is the data structure appearing at the top of that layer. Additionally, for each layer there is a set of services to be named. In this special application, the TX services for one layer receive the related SDU as input, and the RX services generate the related SDU as output.

In the subsequent sections (4.2 - 4.8) there is an outline of the communication layers. In sections 5 through 11 each communication layer is specified in detail then.

TX (uplink station) Layers	Services	Service Data Unit	Services	RX (user station) Layers
Application	Generation of User Data	——	Processing of User Data	Application
Presentation	Insertion of User Data into File	User data	Retrieval of User Data from Files	Presentation
Session	Compression Encryption	LRIT file	Decompression Decryption	Session
Transport	Segmentation	LRIT file	File Assembly	Transport
Network	Path Selection	CCSDS version-1 packet	(none)	Network
Data Link	Multiplexing Commutation Serialization	CCSDS version-1 packet	Demultiplexing Decommutation VCDU Acquisition	Data Link
Physical	Modulation Transmission	NRZ-L serial bitstream	Demodulation Reception	Physical

→ Communications media: space path →

LRIT	Communication Model	Fig. 4-1

VCS Nachrichtentechnik GmbH
j:\ecad\ck\km\lrit\commodel.fcd

4.2 Application Layer

The application layer describes the information interchange between application entities.

Examples for application entities on the TX side could be

- a process generating image products from remote sensing data
- a spacecraft operator issuing an administrative message
- a process generating meteorological bulletins.

On the RX side one could find possible application entities in

- a process visualizing image loops
- a user station operator reading an administrative message
- an application program processing meteorological bulletins.

There is no service data unit for the application layer.

4.3 Presentation Layer

The service data unit for the presentation layer is the user data (e.g. image product, administrative message, meteorological bulletin), which it is receiving from or sending to the application layer. Within the presentation layer the information is transformed from a form suitable for presentation (i.e. user data) to a form suitable for issuing a communications session (i.e. a file containing LRIT data) or vice versa.
Consequently, from the presentation layer point of view, the underlying communication is a transfer of LRIT files from the transmission system to the reception system, each of them represented by its session layer.
Within the presentation layer the detailed structure of LRIT files is specified, but neither the possible usage of the data therein (this belongs to the application layer) nor the method of sending it from the TX presentation layer towards the RX presentation layer (this belongs to the session layer).

4.4 Session Layer

The session layer describes how an LRIT file (the session SDU) is send from the TX system to the RX system, without uncovering the transport mechanism. For LRIT dissemination, there are two pairs of complementary services to be performed:

- compression and decompression of data, if required

- encryption and decryption of data, if required.

From the session layer point of view, the underlying communication can be described as the transportation of an LRIT file (prepared for shipping) from TX transport layer to RX transport layer.

4.5 Transport Layer

The transport layer provides means for transferring a file through the packet multiplexing network.
On the TX side a suitable packet channel is selected and the file is partitioned into one or more segments, each of them packed into a CCSDS conforming source data packet.
On the RX side the file segments are retrieved from incoming packets and the segments are reassembled to LRIT files.
Thus, the transport layer does not know anything about structure and contents of the LRIT files it is transporting nor it is involved in how source packets are forwarded from the TX system to the RX system.

4.6 Network Layer

The network layer is responsible for controlling the path on which a source is transferred through the communication system. For LRIT, the only activity required is to select the path (i.e. the virtual channel) upon transmitting a source packet. On the reception side there is no network layer activity.

4.7 Data Link Layer

The data link layer performs the transfer of a CCSDS source packet on a predefined path through the data link.
The underlying communication system is capable of forwarding a serial bitstream from the transmission system to the reception system, both represented by its physical layers.
While multiple communication tasks may run on the higher layers simultaneously, the underlying physical layer is capable of transferring a single bitstream only. Consequently, incoming source packets must be multiplexed on the transmitting side and demultiplexed on the receiving side. Below packet multiplexing, the virtual channel data units (VCDUs) must be commutated onto the physical link and decommutated at the receiving side. Last, the VCDU stream must be serialized on the TX side and the VCDUs must be acquired from the serial bitstream on the RX side.

4.8 Physical Layer

The physical layer performs the transfer of the serial bitstream from the TX system to the RX systems. For this purpose, the bitstream must be modulated onto a transmission carrier signal and demodulated on the receiving side. The modulated signal must be transmitted through the communications media and received from that on the receiving side.

4.9 Applicability of Standards

LRIT should be understood as an open system by design, in conformance with the OSI reference model defined in ISO 7498 [2].

Network layer and data link layer are specified according to CCSDS recommendation 701 for advanced orbiting systems [1].

Related to that, the applied FEC mechanism (on data link layer) conforms with CCSDS recommendation 101 [5].

The physical layer is specified according to ESA standard PSS-04-105 [3] except for the downlink carrier frequency, which is selected according to the de-facto standard of 1691 MHz, while [3] does not foresee such frequency.

As far as time codes are used in the data structures, they are defined in accordance with CCSDS recommendation 301 [4].

4.10 Compatibility with Other Services

It is intended to specify LRIT as compatible as possible with LRPT, which is the related "secondary" dissemination service from polar orbiting satellites. At least up to the network layer both protocols are compatible as far as it concerns the RX side.
The physical layer specification for LRIT allows the usage of the same reception equipment except for antenna and first downconverter.

5. Application Layer

The application layer is the window between the application process and the communication system. For LRIT we have to outline possible applications of the data forwarded through the communication system.

Details are tbd.

6. Presentation Layer

The presentation layer provide means for representation of information. The structure of data sets is defined herein together with all codes used therein. For image data services are provided for navigation and for retrieving their physical representation.

Details are tbd.

7. Session Layer

The session layer provide means for interchange of data useable for presentation. Main approach of the session layer for LRIT is to perform compression and encryption of data, and the complementary transformations.

Details are tbd.

8. Transport Layer

The transport layer provides means for transparent transfer of data between session entities. It provides towards its user, the session layer, one service to transport a file. The transport service data unit (TP_SDU) is a variable length file.

Upon sending one file the TP_SDU has to be accompanied by the intended priority TP_PRIO (1... 63), where 1 designates the lowest and 63 the highest transport priority. The TP_SDU is a variable length data structure, having an arbitrary length (1 bit ... infinite). Within the transport service the file is filled up to an octet-aligned length, if necessary. Then the file is segmented and each segment is added up with a CRC error control field. The result is inserted into CCSDS packets, which can be forwarded to the network layer. The APID is internally calculated, depending on the priority and on the APIDs used by other open files having the same priority.

Upon reception of a file the reconstructed TP_SDU, accompanied by error information, is forwarded to the session layer.

Details are tbd.

9. Network Layer

The network layer is represented by the path layer defined for CCSDS advanced orbiting systems.

The path layer provides a single service, the socalled packet service, to its user, the transport layer. The packet service uses the multiplexing service of the VCLC sublayer at the top of the data link layer.

The CCSDS path service data unit (CP_SDU) is directly forwarded through the network layer as CCSDS path protocol data unit (CP_PDU). There is no internal processing on the CP_SDUs inside the path layer. In fact the only function of the path layer is to generate the correct VCDU-IDs upon forwarding CP_PDUs to the multiplexing service on the transmitting side of the communication link.

There is no separate path id to be specified when forwarding CP_SDUs into the path layer. The application process identifier (APID) included in the CP_SDU is used as path id.

The VCDU-ID is generated as follows:

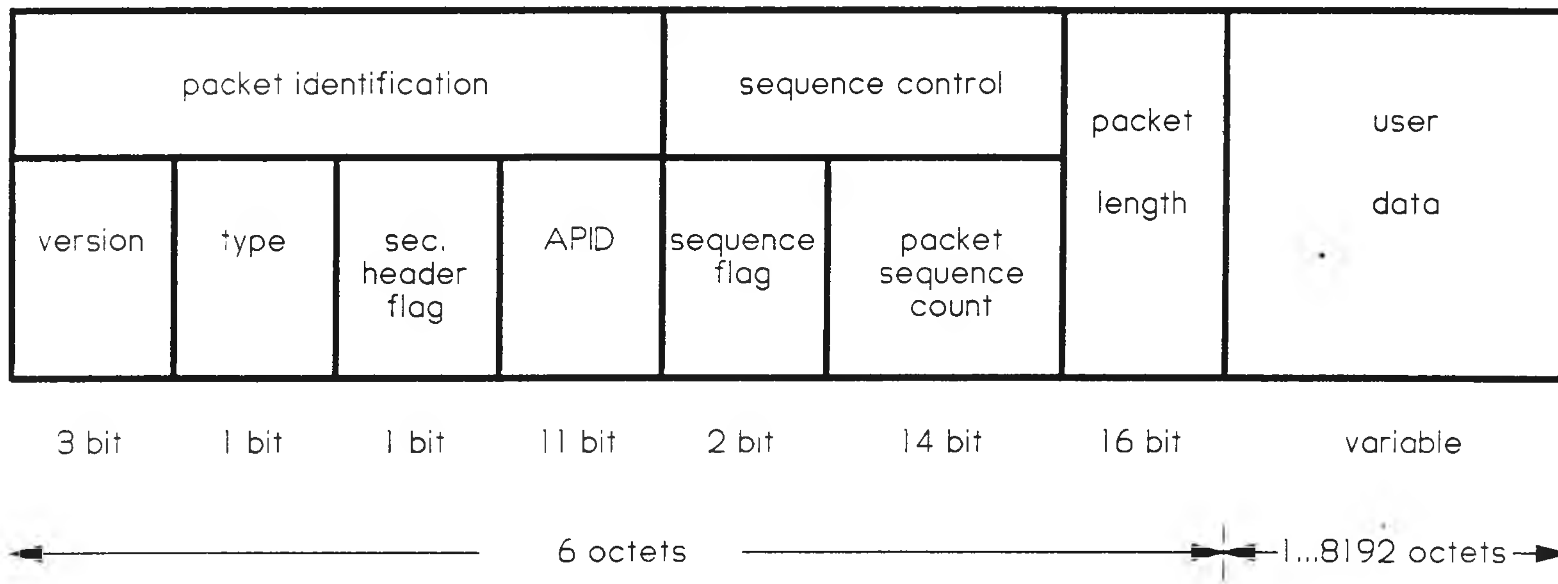
The spacecraft id is set statically to a value tbd.

The virtual channel id is set to a value resulting from an integer division of APID by 32. Thus, APID 0 ... 31 are mapped to VC 0, APID 32 ... 63 to VC 1, ... , up to APID 1984 ... 2015 being mapped to VC 62. APID beyond 2015 must not be used with LRIT. The user (i.e. the transport layer) is therefore capable of handling up to 2016 parallel packet streams, while groups of 32 each have the same priority on the link. With increasing APID the priority decreases. Refer to the description of the VCA sublayer for a description on how the virtual channel id affects the priority of the VC on the link.

Figure 9-1 shows the CP_PDU structure. It consists of a packet header (6 octets in length) and a variable length, octet aligned, user data field. This user data field is limited to 8192 octets in length, it contains a segment of a user data file.

The elements of the packet header are as follows:

version	set to 0 to specify version-1 CCSDS pakket
type	set to 0, irrelevant for AOS
secondary header flag	set to 1 if the user data begins with a header field (this is the case if sequence flags equals to one or three); set to 0 else
APID	set to 0 ... 2015, specifying the logical data path and implicitly the link priority (see explanations above)
sequence flags	set to 3 if the user data contains one user data file entirely; set to 1 if the user data contains the first segment of one user data file extending through subsequent packet(s); set to 0 if the user data contains a continuation segment of one user data file still extending through subsequent packet(s); set to 2 of the user data contains the last segment of a user data file beginning in an earlier packet.
packet sequence count	sequential count modulo 16384, numbering the packets on the specified logical data path specified by the APID.
packet length	number of octets in the user data field minus 1. Since the length of the user data field may vary between 1 and 8192 octets, the packet length field may be set to a value between 0 and 8191.



LRIT	CP_PDU Structure	Fig. 9-1

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10. Data Link Layer

10.1 Overview

The data link layer is implemented by the space link layer of the space link subnetwork specified by CCSDS for advanced orbiting systems. It consists of two sublayers:

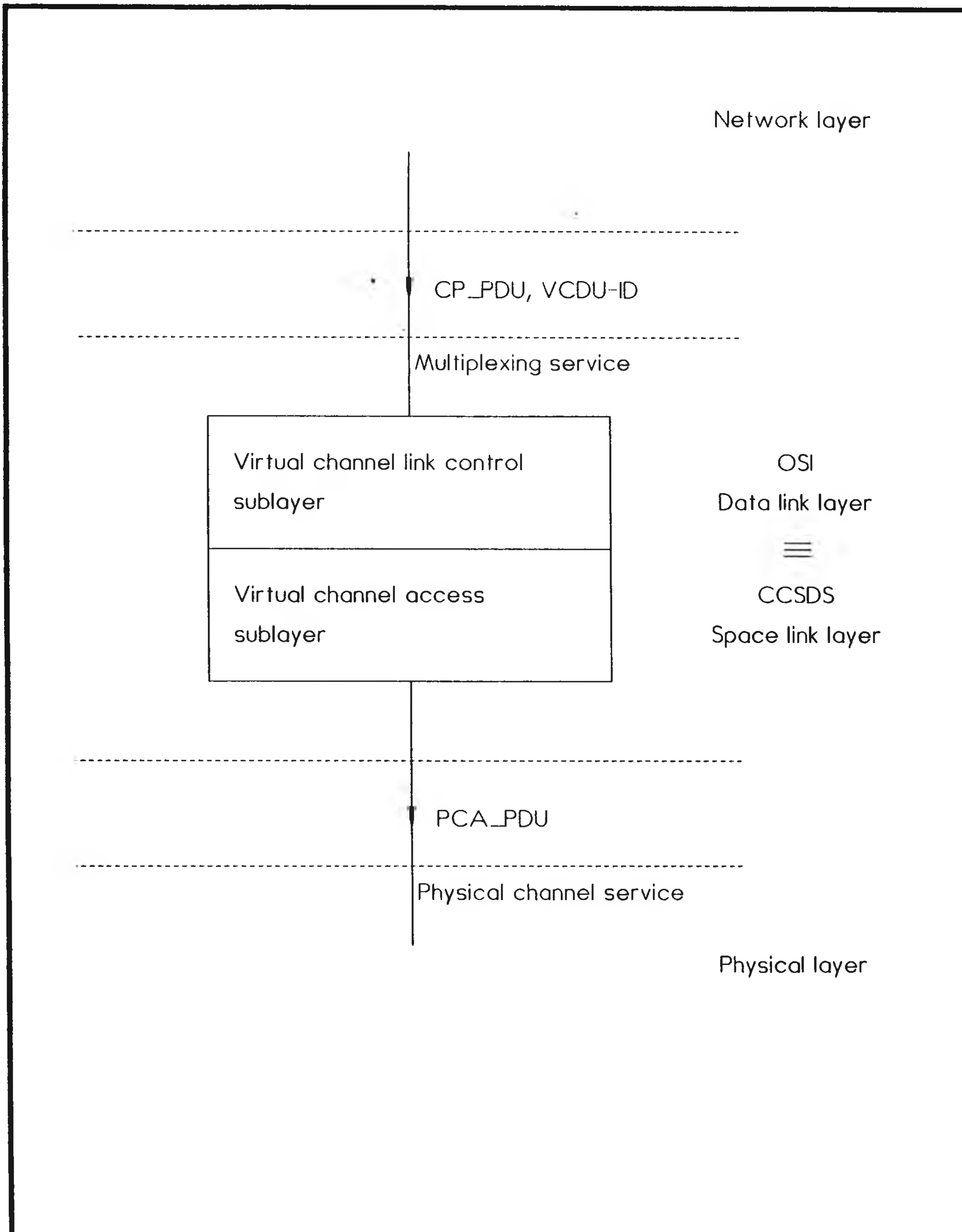
- virtual channel link control (VCLC) sublayer
- virtual channel access (VCA) sublayer

The VCLC sublayer receives CCSDS path protocol data units (CP_PDU) from the network layer, whereas the VCA sublayer forwards the physical channel access protocol data unit (PCA_PDU) to the physical layer.

The data link layer provides by means of the VCLC sublayer the multiplexing service to its user, the network layer. There are no more services provided by the LRIT data link layer. The data link layer only requires the physical channel service from the physical layer.

Figure 10-1 shows the overall configuration of the data link layer.

LRIT is designed as a Grade-2 service, i.e. transmission will be error controlled using Reed-Solomon coding. Due to the nonavailability of a duplex link there is no possibility of raising the service to Grade-1.



LRIT | Data Link Layer | Fig. 10-1 | VCS Nachrichtentechnik GmbH j:\ecad\ck\km\lrit\datalila.fcd

10.2 Virtual channel link control sublayer

The VCLC sublayer provides the multiplexing service only. Encapsulation and bitstream services are not supported.

The actual user of the service is the CCSDS path layer incorporated in the network layer. This user provides CP_PDUs as multiplexing service data units (M_SDUs) for multiplexing them into multiplexing protocol data units (M_PDUs). With each M_SDU the virtual channel is addressed by its VCDU-ID. Data from various packet channels addressing the same VC may be multiplexed into one M_PDU.

The VCLC sublayer uses the virtual channel access service of the VCA sublayer, the generated M_PDUs are forwarded as VCA_SDUs together with the VCDU_ID.

While the number of parallel data streams at the VCLC_SAP are determined by the number of packet channels on all virtual channels, at the VCA_SAP there are remaining as many data streams as virtual channels are used.

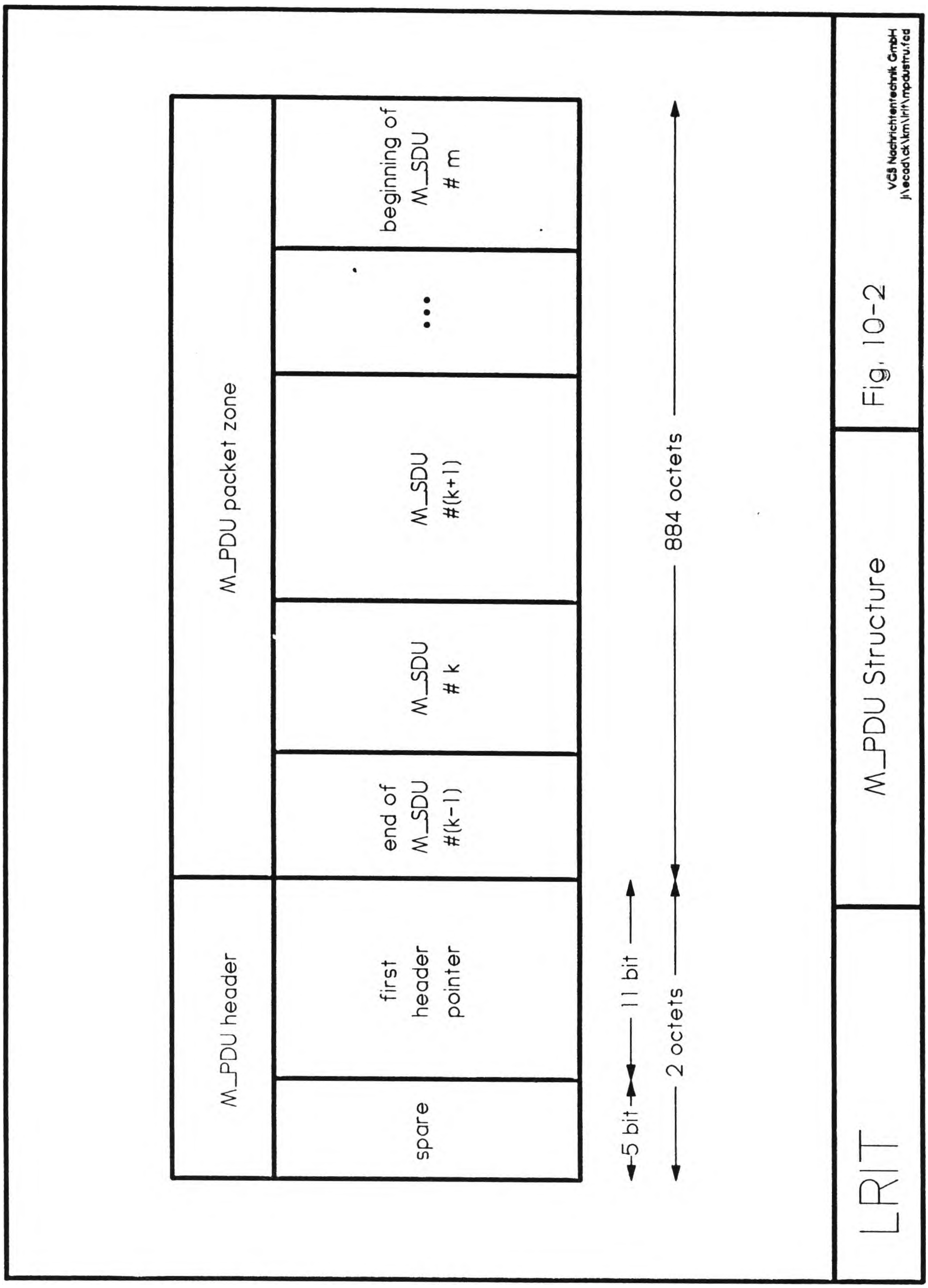
Figure 10-2 shows the structure of the M_PDU. The total length of one M_PDU is 886 octets. It consists of a header (2 octets) and a packet zone (884 octets), into which the M_SDUs for the actual VC are inserted.

The components of the M_PDU header are defined as follows:

spare	for future use, set to all zero
first header pointer	contains a binary count P (0...2047) identifying the offset (in octets) between the begin of the M_PDU packet zone and the first M_SDU header (i.e. M_SDU #k in figure 10-2) therein. If the packet zone does not contain any M_SDU header at all (e.g. if a M_SDU spans over three or more M_PDUs) then P shall be set to all ones (i.e. 2047).

The M_PDU packet zone contains variable length M_SDUs, each of them being a CCSDS version-1 packet. The first and the last packet in the M_PDU zone are not necessarily complete. The M_PDU packet zone may contain a part of a single M_SDU only.

In case that a partly generated M_PDU cannot be completed since no more M_SDU is available for the related virtual channel, a fill packet is generated to complete the M_PDU, after a timeout of three seconds is expired.
Figure 10-3 shows the structure of this fill packet. The packet length has to be determined in such way that the incomplete M_PDU gets filled up. Within the fill packet the packet length element specifies the size of the user data field in octets minus one. If the remaining spare in the incomplete M_PDU is less than eight octets then the fill packet is sized to fill the incomplete M_PDU plus one more M_PDU entirely.


M_PDU header
M_PDU packet zone
spare
first header pointer
end of M_SDU #(k-1)
M_SDU # k
M_SDU #(k+1)
...
beginning of M_SDU # m
5 bit
11 bit
2 octets
884 octets
VCS Nachrichtentechnik GmbH
j:\ecad\ck\km\lrit\mpdustru.fed
LRIT
M_PDU Structure
Fig. 10-2

packet identification				sequence control		packet length	user data	
version	type	sec. header flag	APID	sequence flag	packet sequence count			element
0	0	1	2047	3	0	as required	0	contents (decimal)
3 bit	1 bit	1 bit	11 bit	2 bit	14 bit	16 bit	variable	size
← 6 octets →							←1...8192 octets→	

LRIT	Fill Packet	Fig. 10-3

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10.3 Virtual channel access sublayer

The VCA sublayer provides the virtual channel access service only. Both insert service and virtual channel data unit service are not used with the LRIT application.

In fact the VCLC sublayer is the only user of the VCA service, the VCA_SDU is the M_PDU. Each VCA_SDU is accompagnied by a corresponding VCDU-ID specifying the related VC. Since LRIT is a Grade-2 service, the VCA sublayer incorporates virtual channel procedures and channel access procedures only. Slap procedures are not supported at all.

The VCA sublayer generates the physical channel access protocol data unit (PCA_PDU), which is the serial bitstream forwarded to the physical layer. The VCA sublayer uses the physical channel service as it is provided by the physical layer.

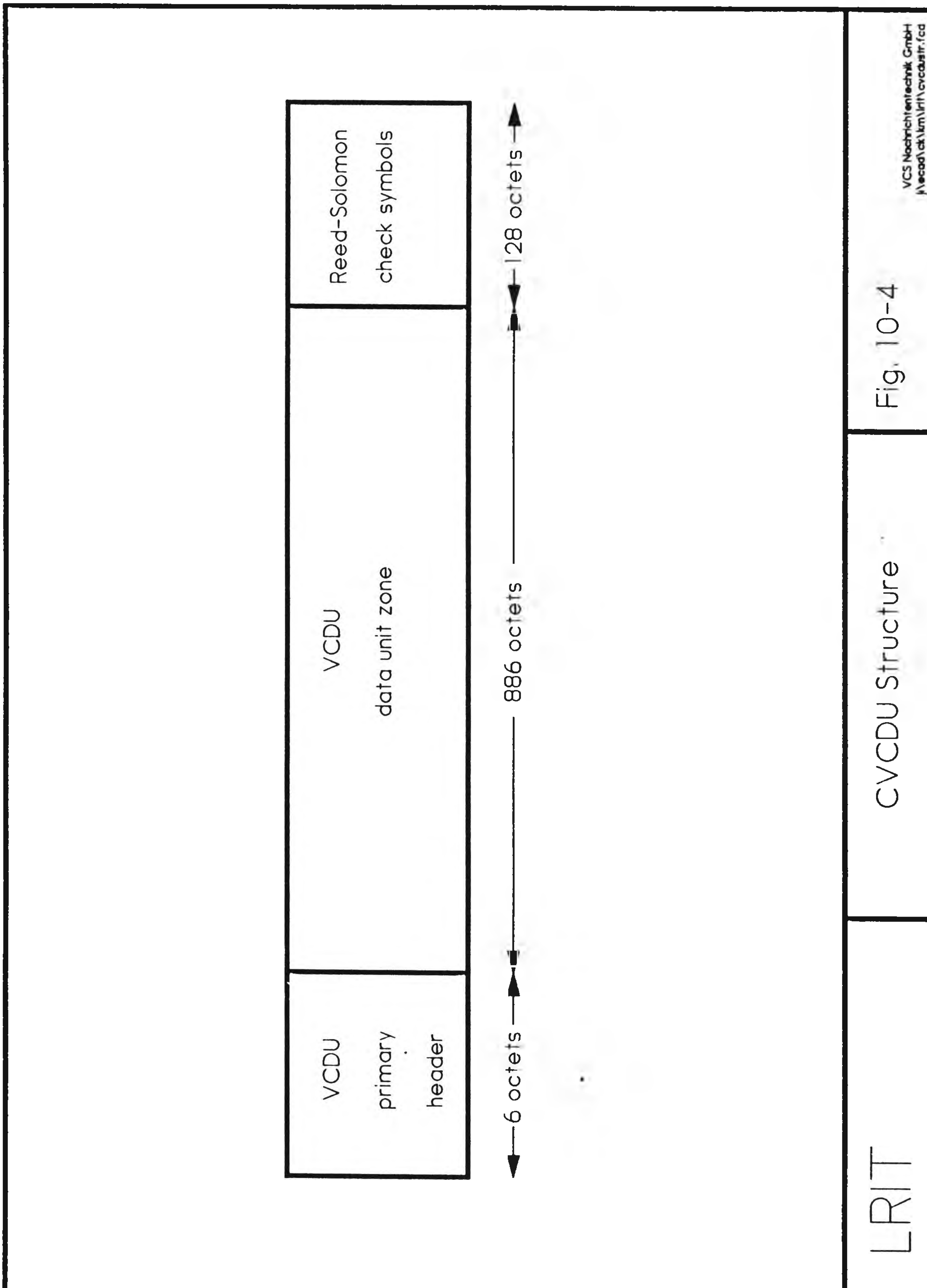
The virtual channel procedures are in fact functions required to generate virtual channel data units (VCDUs) from VCA_SDUs and vice versa. One of the channel access procedures is to handle Reed-Solomon check symbols. A VCDU with attached check symbols is called coded virtual channel data unit (CVCDU). The structure of one CVCDU is shown in figure 10-4.

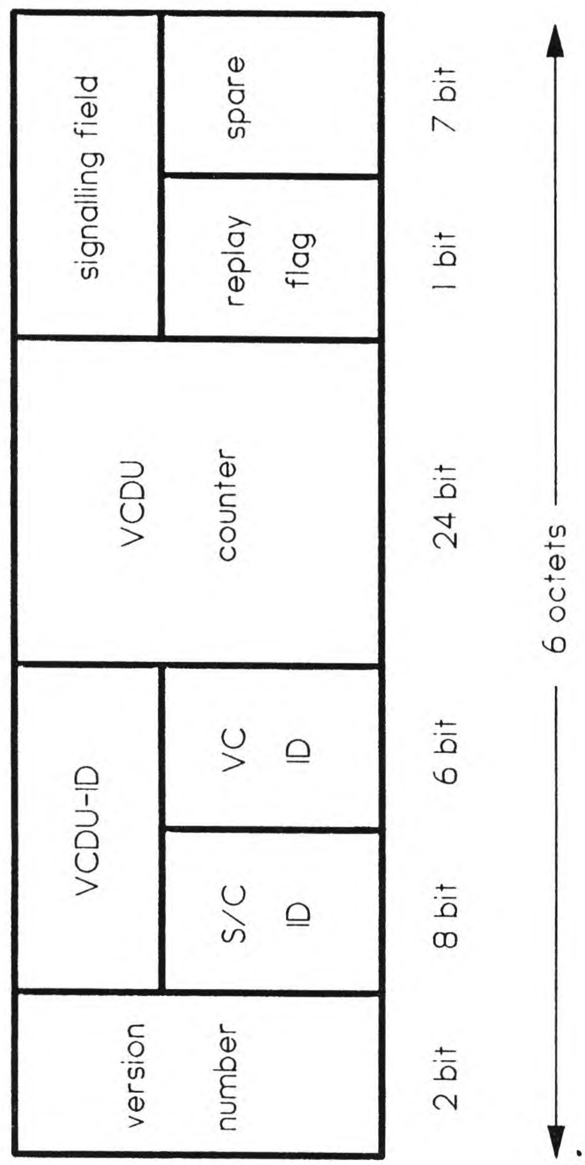
The elements of the CVCDU are as follows:

VCDU primary header	contains a six octets header structure as shown in figure 10-5 and as described subsequently
VCDU data unit zone	contains one VCA_SDU in case of a valid VCDU or all zeros in case of a fill VCDU
Reed-Solomon check symbols	contain Reed-Solomon code (255,223) encoded check symbols, calculated over the VCDU primary header and the VCDU data unit zone, as specified in [5].

The VCDU primary header shown in figure 10-5 consists of the following elements:

version number	set to 1 specifying version-2 CCSDS structure
VCDU-ID	virtual channel data unit identifier as specified by higher layers, consisting of spacecraft identifier and virtual channel identifier, set to 63 for fill VCDUs
VCDU counter	sequential count (modulo 16777216) of VCDUs on each virtual channel
signalling field	set to 0 specifying realtime VCDUs


VCDU
primary
header
VCDU
data unit zone
Reed-Solomon
check symbols
6 octets
886 octets
128 octets
LRIT
CVCDU Structure
Fig. 10-4
VCS Nachrichtentechnik GmbH



LRIT

VCDU Primary Header

Fig. 10-5

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j:\ecad\ck\km\lrit\vcduprhe.fcd

The other functions of the virtual channel access procedures are those described below and their complements:

CVCDUs for various VCs are commutated into a single sequence. Queues are generated for each VC used. Upon commutation a strong priority concept is executed, decreasing the VC priority with increasing VC identifier value. As long as CVCDUs for VC 0 are available, only these are inserted into the dissemination stream. As soon as no more CVCDUs are available for VC n, the queue for VC (n+1) is polled. At the end, if no CVCDUs at all are available, fill CVCDUs (i.e. CVCDUs with VC 63 and all zero data) are inserted.

The commutated sequence of CVCDUs is converted into a sequence of channel access data units (CADUs). For this purpose each CVCDU is randomized first and preceded by a synchronization marker then.

Randomization is performed by multiplying all 8160 bits of the CVCDU with a statically defined pseudonoise pattern. The pseudonoise sequence is generated by means of the following polynomial:

$$h(x) = x^8 + x^7 + x^5 + x^3 + 1$$

This sequence repeats after 255 bits and the sequence generator has to be started from an all-ones state. The resulting PN pattern begins with (hexadecimal) FF480EC09A... .

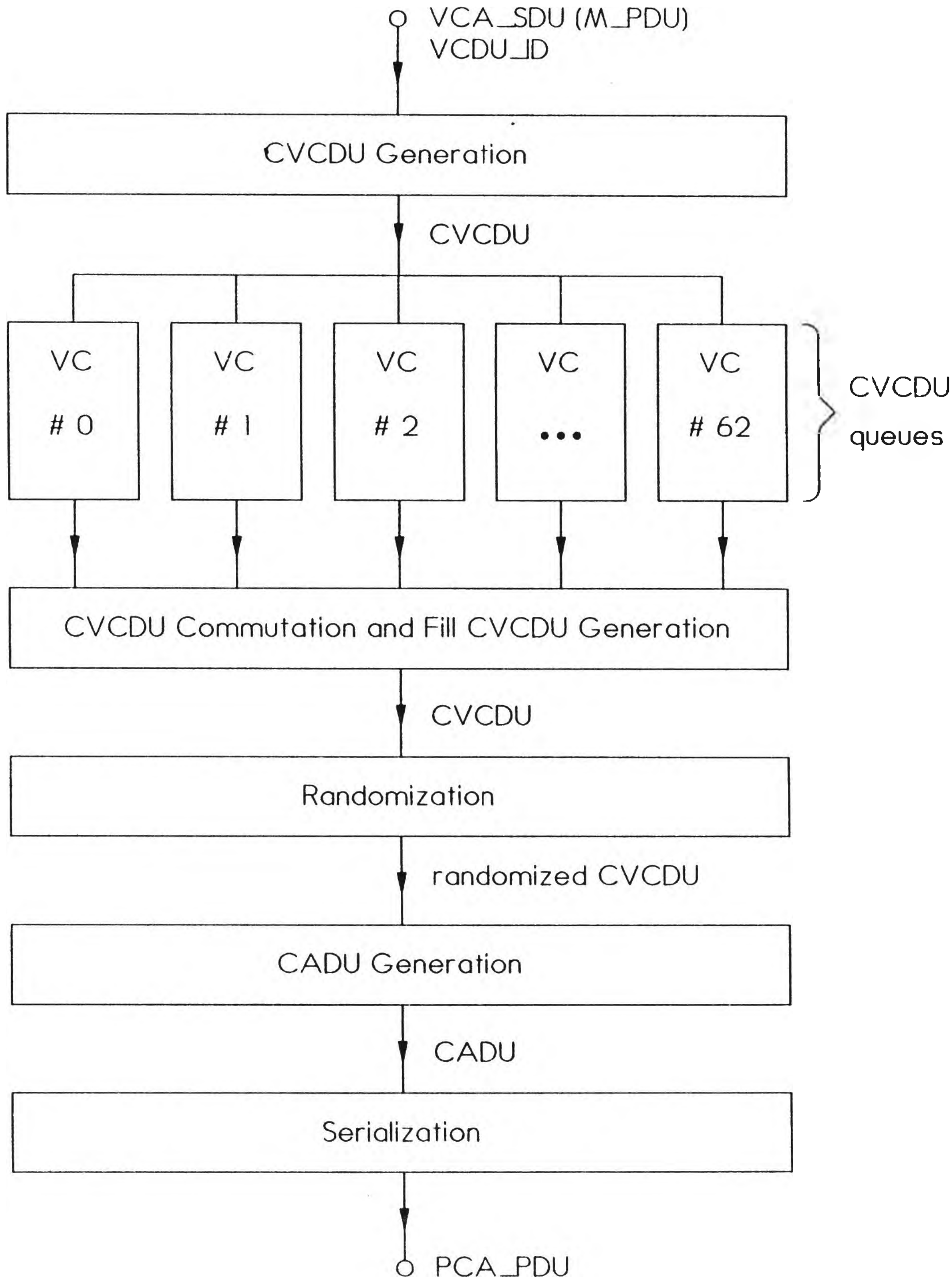
The synchronization marker is defined to be (hexadecimal)

1ACFFC1D

which describes a 32 bit pattern to precede each CVCDU.

The resulting CADU sequence is serialized at a bit rate of 73728 bits per second. Each CADU has a length of 8192 bits corresponding to 111.111 msec duration.

Figure 10-6 summarizes the function of the VCA sublayer.

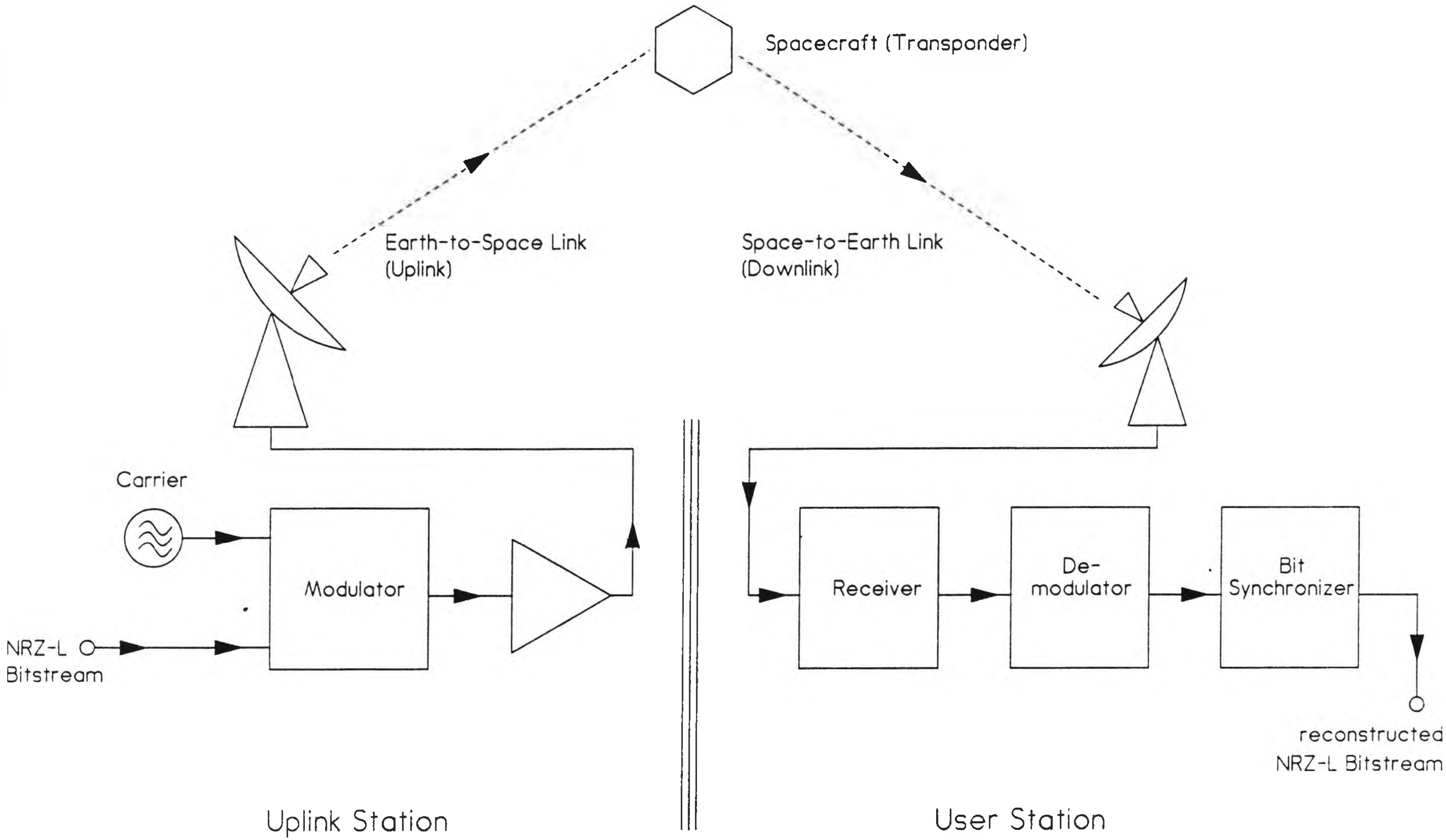


LRIT	VCA Sublayer Functions	Fig. 10-6 VCS Nachrichtentechnik GmbH j:\ecad\ck\km\lrit\vcasubfu.fcd

11. Physical Layer

11.1 Service access point

The physical layer provides the physical channel service. The service data unit (PC_SDU) is a serial NRZ-L bit stream. The PCA_PDU is passed from the data link layer to the physical layer on the transmitting side and vice versa on the receiving side. Figure 11-1 provides an overview of the physical channel up to the physical channel service access points on both sides of the communication link.



LRIT	Physical Channel Overview	Fig. 11-1

VCS Nachrichtentechnik GmbH
j:\ecad\ck\km\lrit\phychaov.fcd

11.2 Carrier

The downlink carrier frequency is 1691 MHz. The uplink frequency is to be selected, depending on the spacecraft transponder characteristics, for resulting in that downlink.

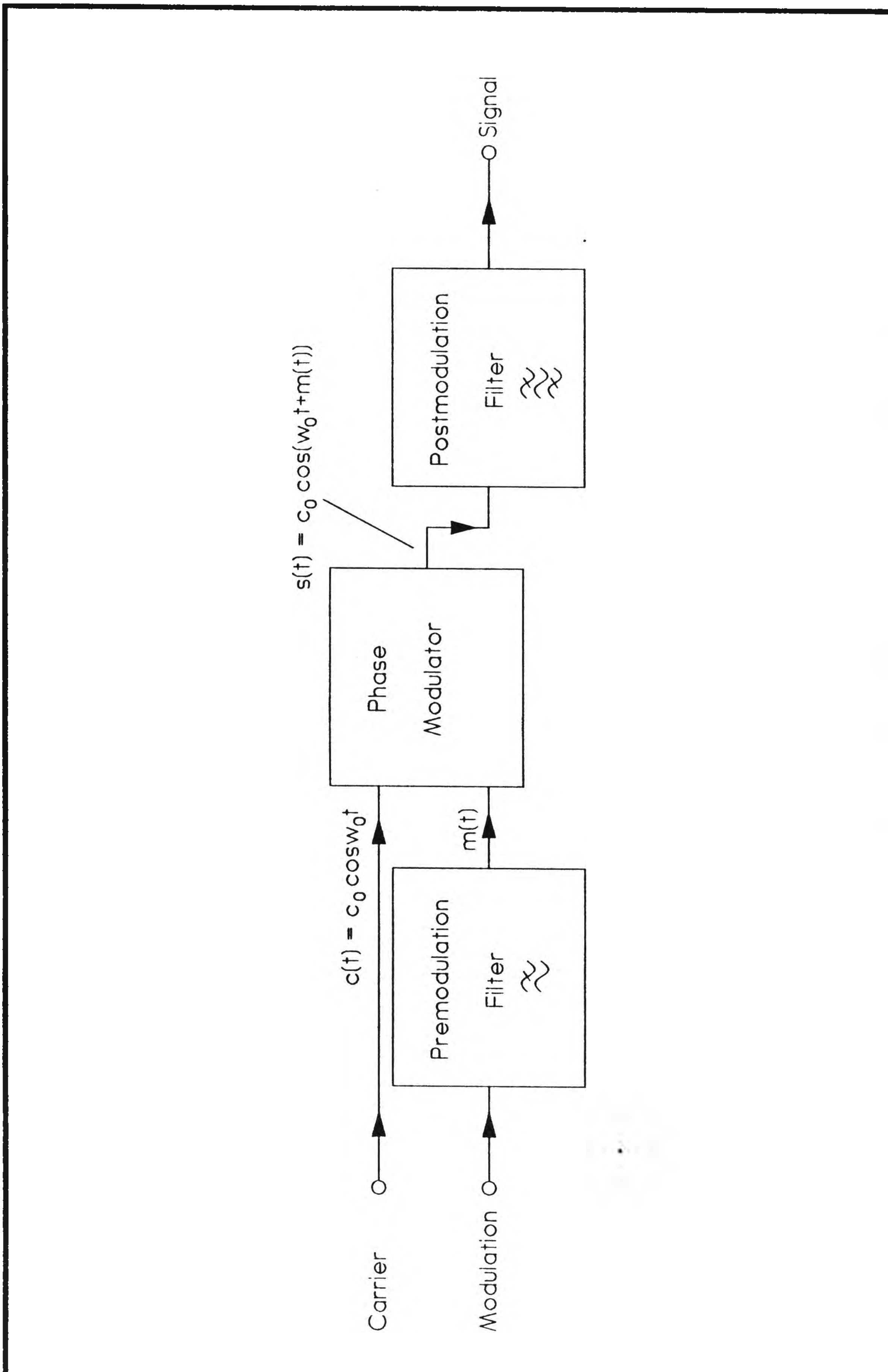
Uncertainty and spectral purity of the carrier are tbd.

11.3 Modulation

The service data unit (i.e. the NRZ-L data stream) is directly used to modulate the phase of the carrier. The phase of the carrier phase is advanced during a logical "1" bitcell, and delayed during a logical "0" bitcell.
Figure 11-2 shows the functional structure of the modulator in the uplink station.

The modulation parameters are listed in the following table.

Parameter	Value	Unit
bit rate	73728	bps
carrier modulation	BPSK	-
modulation index	tbd	deg
premodulation filter	tbd	-
postmodulation filter	tbd	-
signal spectrum	tbd	-



LRIT

Modulator

Fig. 11-2

VCS Nachrichtentechnik GmbH
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11.4 Uplink

tbd

11.5 Transponder

tbd

11.6 Downlink

The downlink has to be dimensioned in such way, that the resulting bit error rate after applying Reed-Solomon FEC (included in the data link layer) does not exceed 10^{-8} under worst case considerations.

This figure shall be achieved with a reception front end as specified below:

central angle in degree	figure of merit in dB/K
0 ... 30	1.5
30 ... 65	2.5
above 65	3.0

The central angle is, seen from the centre of the earth, the angle between subsatellite point and reception site.

It is assumed that the FEC gain is approximately 4.6 dB for Gaussian channel noise. However, the abovementioned specification shall be kept with the actual noise considerations on the space link.

Appendix A. List of Acronyms

AOS	Advanced orbiting systems
APID	Application process identifier
BPSK	Binary phase shift keying
CADU	Channel access data unit
CCSDS	Consultative Committee for Space Data Systems
CP_PDU	CCSDS path protocol data unit
CP_SDU	CCSDS path service data unit
CVCDU	Coded virtual channel data unit
EIRP	Equivalent isotropic radiance power
ESA	European Space Agency
FEC	Forward error correction
LRIT	Low Resolution Image Transmission
M_PDU	Multiplexing service protocol data unit
M_SDU	Multiplexing service data unit
MSB	Most significant bit
NRZ-L	Nonreturn-to-zero-Level
OSI	Open systems interconnection
PC_SDU	Physical channel service data unit
PCA_PDU	Physical channel access protocol data unit
RX	Reception
S/C	Spacecraft
SDUS	Secondary data user station
tbd	to be defined
TP_PDU	Transport protocol data unit
TP_SDU	Transport service data unit
TX	Transmission
VC	Virtual channel
VC_PDU	Virtual channel protocol data unit
VCA	Virtual channel access
VCA_SAP	Virtual channel access service access point
VCA_SDU	Virtual channel access service data unit
VCDU	Virtual channel data unit
VCDU-ID	Virtual channel data unit identifier
VCLC	Virtual channel link control
VCLC_SAP	Virtual channel link control service access point
WEFAX	Weather Facsimile

OPERATIONAL MDD PRODUCT SCHEDULE - BRACKNELL FROM 26 MARCH 1992						
TIME UTC	IDENTIFIER HEADER			CFFFF	CHART AREA	DESCRIPTION
	TTAAII	CCCC	DTIME			
0000	PPLA98	ECMF	1200	96031	(B)	MSLP & 850hPa Temp, T+00
0004	PTKA98	ECMF	1200	96007	(A)	10m Wind & 2m Temp, T+00
0008	PEKC98	ECMF	1200	96018	(A)	Precipitation, T+12
0012	PWKC85	ECMF	1200	96001	(A)	850hPa winds,T+00/T+12
0016	PTKC98	ECMF	1200	96008	(A)	10m Wind & 2m Temp, T+12
0020	PPLE98	ECMF	1200	96032	(B)	MSLP & 850hPa Temp, T+24
0024	PTKE98	ECMF	1200	96009	(A)	10m Wind & 2m Temp, T+24
0028	PEKE98	ECMF	1200	96019	(A)	Precipitation, T+24
0032	PHLE50	ECMF	1200	96028	(B)	500hPa heights,T+00/T+24
0036	PWJE20	ECMF	1200	96037	(C)	200hPa winds T+00/T+24
0040	PTKG98	ECMF	1200	96010	(A)	10m Wind & 2m Temp, T+36
0044	PEKG98	ECMF	1200	96020	(A)	Precipitation, T+36
0048	PWKG85	ECMF	1200	96002	(A)	850hPa winds,T+24/T+36
0052	PPLI98	ECMF	1200	96033	(B)	MSLP & 850hPa Temp. T+48
0056	PTKI98	ECMF	1200	96011	(A)	10m Wind & 2m Temp, T+48
0100	PEKI98	ECMF	1200	96021	(A)	Precipitation, T+48
0104	PTKJ98	ECMF	1200	96012	(A)	10m Wind & 2m Temp, T+60
0108	PEKJ98	ECMF	1200	96022	(A)	Precipitation, T+60
0112	PWKJ85	ECMF	1200	96003	(A)	850hPa winds,T+48/T+60
0116	PPLK98	ECMF	1200	96028	(B)	MSLP & 850hPa Temp, T+72
0120	PTKK98	ECMF	1200	96013	(A)	10m Wind & 2m Temp, T+72
0124	PEKK98	ECMF	1200	96023	(A)	Precipitation, T+72
0128	PHLK50	ECMF	1200	96029	(B)	500hPa heights,T+48/T+72
0132	PWJK20	ECMF	1200	96038	(C)	200hPa winds T+48/T+72
0136 to 0203						RESERVED FOR DATA BACKUP
0204	PTKL98	ECMF	1200	96014	(A)	10m Wind & 2m Temp, T+84
0208	PEKL98	ECMF	1200	96024	(A)	Precipitation, T+84
0212	PWKL85	ECMF	1200	96004	(A)	850hPa winds,T+72/T+84
0216	PPLM98	ECMF	1200	96035	(B)	MSLP & 850hPa Temp, T+96
0220	PTKM98	ECMF	1200	96015	(A)	10m Wind & 2m Temp, T+96
0224	PEKM98	ECMF	1200	96025	(A)	Precipitation, T+96
0228	PTKN98	ECMF	1200	96016	(A)	10m Wind & 2m Temp, T+108
0232	PEKN98	ECMF	1200	96026	(A)	Precipitation, T+108
0236	PWKN85	ECMF	1200	96005	(A)	850hPa winds,T+96/T+108
0240	PGRE99	LFPW	1200	98505	R	WAFS SigWx EURAFI T+24
0245	PGCE15	EDZW	1200	99267	O	WAFS SigWx MID T+24
0250	PGSE99	LFPW	1200	98508		WAFS SigWx EURSAM T+24
0255	PGBE15	EDZW	1200	99263	M	WAFS SigWx EUR T+24
0300	PPLO98	ECMF	1200	96036	(B)	MSLP & 850hPa Temp, T+120
0304	PTKO98	ECMF	1200	96017	(A)	10m Wind & 2m Temp, T+120
0308	PEKO98	ECMF	1200	96027	(A)	Precipitation, T+120
0312	PWKO85	ECMF	1200	96006	(A)	850hPa winds,T+120
0316	PHLO50	ECMF	1200	96030	(B)	500hPa heights, T+96/T+120
0425	PPCA98	EDZW	0000	99269	EUR/NAF/ME	SFC Anal+Obs T+00
0440 to 0503						RESERVED FOR DATA BACKUP

OPERATIONAL MDD PRODUCT SCHEDULE - BRACKNELL FROM 26 MARCH 1992

TIME UTC	IDENTIFIER HEADER			CFFFF	CHART AREA	DESCRIPTION
	TTAAII	CCCC	DTIME			
0504	PGDE15	GCLP	1200	96503	(Q)	WAFS SigWx GCPL T+24
0509	PHCA50	EDZW	0000	99270	EUR/NAF/ME	500hPa contours+Obs T+00
0513	PHCA30	EDZW	0000	99271	EUR/NAF/ME	300hPa contours+obs T+00
0517	PHCA20	EDZW	0000	99272	EUR/NAF/ME	200hPa contours+obs T+00
0521	PPME98	EGRR	0000	99802	TROP BELT	MSLP/Rain rate T+24
0525	PEME98	EGRR	0000	99816	TROP BELT	24Hr raind acc to T+24
0530	PWCD20	EGRR	0000	99720	O	WAFS FL390 MID T+18
0534	PWCD25	EGRR	0000	99721	O	WAFS FL340 MID T+18
0538	PWCD30	EGRR	0000	99722	O	WAFS FL300 MID T+18
0542	PWBD20	EGRR	0000	99356	N	WAFS FL390 EUR T+18
0546	PWBD25	EGRR	0000	99357	N	WAFS FL340 EUR T+18
0550	PWBD30	EGRR	0000	99358	N	WAFS FL300 EUR T+18
0554	PWBD40	EGRR	0000	99359	N	WAFS FL240 EUR T+18
0558	PWBD50	EGRR	0000	99360	N	WAFS FL180 EUR T+18
0602	PWBD70	EGRR	0000	99361	N	WAFS FL100 EUR T*18
0606	PWBD85	EGRR	0000	99362	N	WAFS FL050 EUR T+18
0610	PWDD20	EGRR	0000	99756	Q	WAFS FL390 AFI/SAM T+18
0614	PWDD25	EGRR	0000	99757	Q	WAFS FL340 AFI/SAM T+18
0618	PWDD30	EGRR	0000	99758	Q	WAFS FL300 AFI/SAM T+18
0622	PWTD20	EGRR	0000	99871	R	WAFS FL390 LFAFI T+18
0626	PWTD25	EGRR	0000	99872	R	WAFS FL340 LFAFI T+18
0630	PWTD30	EGRR	0000	99873	R	WAFS FL300 LFAFI T+18
0634	PWTD40	EGRR	0000	99874	R	WAFS FL240 LFAFI T+18
0638	PWTD50	EGRR	0000	99875	R	WAFS FL180 LFAFI T+18
0642	PWTD70	EGRR	0000	99876	R	WAFS FL100 LFAFI T+18
0646	PWTD85	EGRR	0000	99877	R	WAFS FL050 LFAFI T+18
0650	PHME20	EGRR	0000	99810	TROP BELT	200hPa contours T+24
0654	PTME98	EGRR	0000	99820	TROP BELT	1.5m temp C T+24
0658	PPMI98	EGRR	0000	99804	TROP BELT	MSLP/Rain rate T+48
0702	PHMI20	EGRR	0000	99812	TROP BELT	200hPa contours T+48
0706	PEMI98	EGRR	0000	99818	TROP BELT	24Hr rain acc to T+48
0711	PTMI98	EGRR	0000	99822	TROP BELT	1.5m temp C T+48
0715	PWRA04	LFPW	0000	98151	AF/ME	850hPa wind/isotherms T+00
0719	PWRA07	LFPW	0000	98150	AF/ME	700hPa wind/isotachs T+00
0723	QWQE00	LFPW	0000	98163	(M)	MSLP/wind T+12
0727	QWQI00	LFPW	0000	98165	(M)	MSLP/wind T+24
0731	QWQM00	LFPW	0000	98167	(M)	MSLP/wind T+36
0735	QMQQ00	LFPW	0000	98169	(M)	MSLP/wind T+48
0739	PPAI98	EDZW	0000	99290	AF	Surface, T+24, T+48 Africa
0743	PPAK98	EDZW	0000	99291	AF	Surface, T+72, Africa
0747	PXXK00	EDZW	0000	99292	AF/ME	Trajectories
0750 to 0811						RESERVED FOR DATA BACKUP

OPERATIONAL MDD PRODUCT SCHEDULE - BRACKNELL FROM 26 MARCH 1992

TIME UTC	IDENTIFIER HEADER			CFFFF	CHART AREA	DESCRIPTION
	TTAAII	CCCC	DTIME			
0812	PWRE04	LFPW	0000	98154	AF/ME	850hPa wind/isotherms T+24
0816	PWRI04	LFPW	0000	98158	AF/ME	850hPa wind/isotherms T+48
0820	PWRK04	LFPW	0000	98161	AF/ME	850hPa wind/isotherms T+72
0824	PWRE07	LFPW	0000	98152	AF/ME	700hPa wind/isotachs T+24
0828	PWRI07	LFPW	0000	98156	AF/ME	700hPa wind/isotachs T+48
0832	PWRK07	LFPW	0000	98160	AF/ME	700hPa wind/isotachs T+72
0836	QRQE07	EDZW	0000	98162	(M)	700hPa humidity T+12
0840	QRQI07	LFPW	0000	98164	(M)	700hPa humidity T+24
0844	QRQM07	LFPW	0000	98166	(M)	700hPa humidity T+36
0848	QRQQ07	LFPW	0000	98168	(M)	700 hPa humidity T+48
0852	PGRD99	LFPW	0000	98516	R	WAFS SIGWX EURAFI T+18
0857	PGCDI5	EDZW	0000	99268	O	WAFS SIGWX MID T+18
0902	PGSD99	LFPW	0000	98522		WAFS SIGWX EURSAM T+18
0908	PGBD15	EDZW	0000	99264	M	WAFS SIGWX EUR T+18
1005	PWCE20	EGRR	0000	99729	O	WAFS FL390 MID T+24
1010	PWCE25	EGRR	0000	99730	O	WAFS FL340 MID T+24
1015	PWCE30	EGRR	0000	99731	O	WAFS FL300 MID T+24
1020	PWDE20	EGRR	0000	99765	Q	WAFS FL390 AFI/SAM T+24
1025	PWDE25	EGRR	0000	99766	Q	WAFS FL340 AFI/SAM T+24
1030	PWDE30	EGRR	0000	99767	Q	WAFS FL300 AFI/SAM T+24
1035	PPCA98	EDZW	0600	99273	EUR/NAF/ME)	SFC ANAL + obs T+00
1040	PGDD15	GCLP	0000	96500	(Q)	WAFS SIGWX GCLP T+18
1045 to 1109					RESERVED FOR DATA BACKUP	
1110	PWBE20	EGRR	0000	99365	N	WAFS FL390 EUR T+24
1115	PWBE25	EGRR	0000	99366	N	WAFS FL340 EUR T+24
1120	PWBE30	EGRR	0000	99367	N	WAFS FL300 EUR T+24
1125	PWBE40	EGRR	0000	99368	N	WAFS FL240 EUR T+24
1130	PWBE50	EGRR	0000	99369	N	WAFS FL180 EUR T+24
1135	PWBE70	EGRR	0000	99370	N	WAFS FL100 EUR T+24
1140	PWBE85	EGRR	0000	99371	N	WAFS FL050 EUR T+24
1145	PWTE20	EGRR	0000	99880	R	WAFS FL390 LFAFI T+24
1150	PWTE25	EGRR	0000	99881	R	WAFS FL340 LFAFI T+24
1155	PWTE30	EGRR	0000	99882	R	WAFS FL300 LFAFI T+24
1200	PWTE40	EGRR	0000	99883	R	WAFS FL240 LFAFI T+24
1205	PWTE50	EGRR	0000	99884	R	WAFS FL180 LFAFI T+24
1210	PWTE70	EGRR	0000	99885	R	WAFS FL100 LFAFI T+24
1215	PWTE85	EGRR	0000	99886	R	WAFS FL050 LFAFI T+24
1220	PPMK98	EGRR	0000	99806	TROP BELT	MSLP rain rate T+72
1225	PHMK20	EGRR	0000	99814	TROP BELT	200hPa contours T+72
1230	PPMA98	EGRR	0000	99800	TROP BELT	MSLP T+00
1235	PHMA20	EGRR	0000	99808	TROP BELT	200hPa contours T+00
1239 to 1259	PLUK21-25 EGRR - SCHEDULES AND/OR ADMINISTRATIVE MESSAGES					
1300	PZXA21	DRRN	0000	96402	SAHEL	10 day maximum NDVI
1305	PZXA22	DRRN	0000	96403	SAHEL	change in NDVI - 10 day maxi
1310	PEXA21	DRRN	0000	96400	SAHEL	10 day acc precipitation
1315	PEXA22	DRRN	0000	96401	SAHEL	total acc precipitation
1320	PZXA24	DRRN	0000	96405	SAHEL	first date of millet sowing
1325	PZXA23	DRNN	0000	96404	SAHEL	10 day mean pest situation
1330	PZXA25	HKNC	0000	96406	TEXT	Decade climate summary
1335	PZXA26	HKNC	0000	96407	SE Africa	Drought severity index
1340	PZXA27	HKNC	0000	96408	SE Africa	Decade weather outlook
1345	PZXA28	HKNC	0000	96409	SE Africa	3 month weather outlook

OPERATIONAL MDD PRODUCT SCHEDULE - BRACKNELL FROM 26 MARCH 1992						
TIME UTC	IDENTIFIER HEADER			CFFFF	CHART AREA	DESCRIPTION
	TTAAII	CCCC	DTIME			
1350 to 1439						RESERVED FOR DATA BACKUP
1440	PGRE99	LFPW	0000	98555	R	WAFS SIGWX EURAFI T+24
1452	PGCE15	EDZW	0000	99265	O	WAFS SIGWX MID T+24
1458	PGSE99	LFPW	0000	98558		WAFS SIGWX EURSAM T+24
1504	PGBE15	EDZW	0000	99261	M	WAFS SIGWX EUR T+24
1510	PBHA00	LFPW	0000	98170		Decade cold cloud occurrence
1515	PBHA01	LFPW	0000	98171		Decade cold cloud occurrence
1520	PTHA00	LFPW	0000	98172		Decade thermal field
1525	PTHA01	LFPW	0000	98173		Decade thermal field
1615	PGDE15	GCLP	0000	96501	(Q)	WAFS SIGWX GCLP T+24
1620	PPCA98	EDZW	1200	99274	EUR/NAF/ME	SFC Anal + obs T+00
1640 to 1708						RESERVED FOR DATA BACKUP
1709	PHCA50	EDZW	1200	99275	EUR/NAF/ME	500hPa contours+obs T+00
1713	PHCA30	EDZW	1200	99276	EUR/NAF/ME	300hPa contours+obs T+00
1717	PHCA20	EDZW	1200	99277	EUR/NAF/ME	200hPa contours+obs T+00
1721	PHLA07	LFPW	1200	98174		700hPa Indian Ocean T+00
1725	PHLE07	LFPW	1200	98175		700hPa Indian Ocean T+24
1729	PHLI07	LFPW	1200	98176		700hPa Indian Ocean T+48
1733	PZLA00	LFPW	1200	98177		SFC Indian Ocean T+00
1737	PPME98	EGRR	1200	99803	TROP BELT	MSLP/Rain Rate T+24
1741	PEME98	EGRR	1200	99817	TROP BELT	24 Hr Rain Accum to T+24
1746	PWCD20	EGRR	1200	99702	O	WAFS FL390 MID T+18
1752	PWCD25	EGRR	1200	99703	O	WAFS FL340 MID T+18
1756	PWCD30	EGRR	1200	99704	O	WAFS FL300 MID T+18
1800	PWBD20	EGRR	1200	99338	N	WAFS FL390 EUR T+18
1804	PWBD25	EGRR	1200	99339	N	WAFS FL340 EUR T+18
1808	PWBD30	EGRR	1200	99340	N	WAFS FL300 EUR T+18
1812	PWBD40	EGRR	1200	99341	N	WAFY FL240 EUR T+18
1816	PWBD50	EGRR	1200	99342	N	WAFS FL180 EUR T+18
1820	PWBD70	EGRR	1200	99343	N	WAFS FL100 EUR T+18
1824	PWBD85	EGRR	1200	99344	N	WAFS FL050 EUR T+18
1828	PWDD20	EGRR	1200	99738	Q	WAFS FL390 AFI/SAM T+18
1832	PWDD25	EGRR	1200	99739	Q	WAFS FL340 AFI/SAM T+18
1836	PWDD30	EGRR	1200	99740	Q	WAFS FL300 AFI/SAM T+18
1840	PWTD20	EGRR	1200	99853	R	WAFS FL390 LFAFI T+18
1845	PWTD25	EGRR	1200	99854	R	WAFS FL340 LFAFI T+18
1850	PWTD30	EGRR	1200	99855	R	WAFS FL300 LFAFI T+18
1855	PWTD40	EGRR	1200	99856	R	WAFS FL240 LFAFI T+18
1900	PWTD50	EGRR	1200	99857	R	WAFS FL180 LFAFI T+18
1905	PWTD70	EGRR	1200	99858	R	WAFS FL100 LFAFI T+18
1910	PWTD85	EGRR	1200	99859	R	WAFS FL050 LFAFI T+18
1915	PHME20	EGRR	1200	99811	TROP BELT	200hPa contours T+24
1920	PTME98	EGRR	1200	99821	TROP BELT	1.5m temp C T+24
1925	PPMI98	EGRR	1200	99805	TROP BELT	MSLP/rain rate T+48
1930	PHMI20	EGRR	1200	99813	TROP BELT	200hPa contours T+24
1935	PEMI98	EGRR	1200	99819	TROP BELT	24Hr rain acc T+48
1940	PTMI98	EGRR	1200	99823	TROP BELT	1.5m temp C T+48
1945 to 2014						RESERVED FOR DATA BACKUP

OPERATIONAL MDD PRODUCT SCHEDULE - BRACKNELL FROM 26 MARCH 1992						
TIME UTC	IDENTIFIER HEADER			CFFFF	CHART AREA	DESCRIPTION
	TTAAII	CCCC	DTIME			
2015	PWRE04	LFPW	1200	98155	AF+ME	850hPa wind/isotherms T+24
2020	PWRE07	LFPW	1200	98153	AF+ME	850hPa wind/isotherms T+48
2025	PWRI04	LFPW	1200	98159	AF+ME	700hPa wind/isostachs T+24
2030	PWRI07	LFPW	1200	98157	AF+ME	700hPa wind/isotachs T+48
2040	PGRD99	LFPW	1200	98566	R	WAFS SIGWX EURAFI T+18
2052	PGCD15	EDZW	1200	99266	O	WAFS SIGWX MID T+18
2058	PGSD99	LFPW	1200	98571		WAFS SIGWX EURSAM T+18
2104	PGBD15	EDZW	1200	99262	M	WAFS SIGWX EUR T+18
2110	PPMK98	EGRR	1200	99807	TROP BELT	MSLP/rain rate T+72
2115	PHMK20	EGRR	1200	99815	TROP BELT	200hPa contours T+72
2120	PPMA98	EGRR	1200	99801	TROP BELT	MSLP T+00
2125	PHMA20	EGRR	1200	99809	TROP BELT	200hPa contours T+00
2130	PWCE20	EGRR	1200	99711	O	WAFS FL390 MID T+24
2135	PWCE25	EGRR	1200	99712	O	WAFS FL340 MID T+24
2140	PWCE30	EGRR	1200	99713	O	WAFS FL300 MID T+24
2145	PWBE20	EGRR	1200	99347	N	WAFS FL390 EUR T+24
2150	PWBE25	EGRR	1200	99348	N	WAFS FL340 EUR T+24
2155	PWBE30	EGRR	1200	99349	N	WAFS FL300 EUR T+24
2200	PWBE40	EGRR	1200	99350	N	WAFS FL240 EUR T+24
2205	PWBE50	EGRR	1200	99351	N	WAFS FL180 EUR T+24
2210	PWBE70	EGRR	1200	99352	N	WAFS FL100 EUR T+24
2215	PWBE85	EGRR	1200	99353	N	WAFS FL050 EUR T+24
2220	PWDE20	EGRR	1200	99747	Q	WAFS FL390 AFI/SAM T+24
2225	PWDE25	EGRR	1200	99748	Q	WAFS FL340 AFI/SAM T+24
2230	PWDE30	EGRR	1200	99749	Q	WAFS FL300 AFI/SAM T+24
2235	PPCA98	EDZW	1800	99278	EUR/NAF/ME	SFC anal+obs T+00
2240	PGDD15	GCLP	1200	96502	(Q)	WAFS SigWx GCLP T+18
2245 to 2309					RESERVED FOR DATA BACKUP	
2310	PWTE20	EGRR	1200	99862	R	WAFS FL390 LFAFI T+24
2315	PWTE25	EGRR	1200	99863	R	WAFS FL340 LFAFI T+24
2320	PWTE30	EGRR	1200	99864	R	WAFS FL300 LFAFI T+24
2325	PWTE40	EGRR	1200	99865	R	WAFS FL240 LFAFI T+24
2330	PWTE50	EGRR	1200	99866	R	WAFS FL180 LFAFI T+24
2335	PWTE70	EGRR	1200	99867	R	WAFS FL100 LFAFI T+24
2340	PWTE85	EGRR	1200	99868	R	WAFS FL050 LFAFI T+24

SCHEDULE OF ALPHANUMERIC BULLETINS DISSEMINATED

FROM THE ROME MDD UPLINK

SMAA01	CMAA1	SMAA2	SMAA10	SMAB01	SMAC01	SMAF01	SMAF02	SMAF03	SMAF04
SMAF05	SMAF06	SMAF07	SMAF08	SMAF09	SMAG1	SMAG2	SMAG3	SMAH01	SMAH1
SMAI1	SMAK1	SMAL01	SMAL02	SMAL1	SMAL2	SMAU01	SMBC01	SMBD1	SMBI01
SMBJ1	SMBM01	SMBN01	SMBN1	SMBN10	SMBO1	SMBU01	SMBW01	SMBW1	SMBX1
SMBY10	SMBZ1	SMBZ10	SMBZ11	SMBZ12	SMBZ13	SMBZ2	SMBZ3	SMBZ4	SMBZ5
SMBZ6	SMBZ7	SMBZ8	SMBZ9	SMCA1	SMCA2	SMCA3	SMCE1	SMCD01	SMCE1
SMCG01	SMCG1	SMCH1	SMCH2	SMCI11	SMCI12	SMCM01	SMCM1	SMCN1	SMCN2
SMCN3	SMCN4	SMCN5	SMCN6	SMCO1	SMCO2	SMCR1	SMCV01	SMCV1	SMCY01
SMCZ10	SMDD01	SMDJ01	SMDL01	SMDN01	SMDY01	SMEG01	SMEG02	SMEG03	SMEN01
SMER10	SMET01	SMEU01	SMFA01	SMFG1	SMFI01	SMFJ01	SMFR1	SMFW01	SMGB1

SMGE01	SMGH1	SMGI01	SMGL1	SMGO01	SMGO1	SMGR01	SMHE01	SMHK1	SMHU01
SMHV1	SMID1	SMIE1	SMIL1	SMIN01	SMIN02	SMIN03	SMIN04	SMIN05	SMIQ01
SMIQ1	SMIR01	SMIR02	SMIS01	SMIV1	SMIY01	SMJD10	SMJP01	SMKB01	SMKK01
SMKN01	SMKO1	SMKP01	SMKR01	SMKR1	SMKR02	SMKU01	SMKW10	SMLA01	SMLB01
SMLI01	SMLS01	SMLY01	SMLY1	SMMA01	SMMB01	SMMC01	SMMC1	SMMC02	SMMC2
SMMD1	SMMG01	SMMG1	SMMI1	SMML01	SMML1	SMMO01	SMMO02	SMMS1	SMMT1
SMMV01	SMMV1	SMMW01	SMMX1	SMMX2	SMMX3	SMMZ01	SMNC01	SMMC02	SMNF01
SMNI1	SMNL10	SMNO11	SMNP01	SMNR01	SMNR1	SMNV01	SMNV1	SMNZ01	SMOM10
SMOS01	SMPA01	SMPA1	SMPF01	SMPH1	SMPH2	SMPK01	SMPK1	SMPL01	SMPO1
SMPR1	SMPY1	SMPZ1	SMQT10	SMRA1	SMRA10	SMRA11	SMRA12	SMRA13	SMRA14
SMRE01	SMRO01	SMRS10	SMRS11	SMRS12	SMRS13	SMRW01	SMSC01	SMSD10	SMSD12
SMSG01	SMSG1	SMSI01	SMSL1	SMSN01	SMSO01	SMSP01	SMSR01	SMST1	SMSU01
SMSU02	SMSW01	SMSY01	SMTG1	SMTH01	SMTK01	SMTN01	SMTO01	SMTO02	SMTP1
SMTS1	SMTU10	SMTV01	SMUG01	SMUK01	SMUR10	SMUS1	SMUS2	SMUS3	SMUS4
SMUS5	SMUS6	SMUY1	SMVN1	SMVS01	SMYE10	SMYG10	SMZA01	SMZB01	SMZM1
SMZR01	SMZR1	SMZW01	SIAB20	SIAB21	SIAB22	SIAL20	SIAL21	SIAL22	SIAR20
SIBC20	SIBU20	SIBU21	SIBU22	SIBX20	SIBX21	SIBX22	SIBY20	SIBZ20	SIBZ21
SICR20	SICV20	SICY20	SICY21	SICZ20	SICZ30	SIDD20	SIDL21	SIDL22	SIDL23
SIDL24	SIDL25	SIDN21	SIDN22	SIDN23	SIDY20	SIEG20	SIEG21	SIEG22	SIEG23
SIEG24	SIEG26	SIEN21	SIEU21	SIFA21	SIFA22	SIFG20	SIFI20	SIFI21	SIFR20

SIFR21	SIFR22	SIGI21	SIGL21	SIGL22	SIGR20	SIGR21	SIGR22	SIHE20	SIHU20
SIHU21	SIHU30	SIIE21	SIIE22	SIIE23	SIIE25	SIIL21	SIIL22	SIIO1	SIIS21
SIIS22	SIIY20	SIIY21	SIIY22	SIJD20	SIJD21	SILB20	SILB21	SILS20	SILY20
SIMA21	SIMB20	SIMC21	SIMC22	SIMC23	SIMG20	SIMG21	SIML20	SIMW20	SIMW21
SIMZ20	SINL21	SINO21	SINO22	SINO23	SINO24	SIOS21	SIOS22	SIPL20	SIPL30
SIPO20	SIPO21	SIPO22	SIRE20	SIRO20	SIRO21	SIRO22	SIRO23	SIRO24	SIRS20
SIRS21	SIRS22	SIRS23	SIRS24	SIRS25	SIRS26	SISD20	SISD21	SISI20	SISM20
SISN21	SISN22	SISP20	SISP21	SIST21	SISU21	SISU22	SISW21	SISW22	SISW23
SISY20	SITS20	SITS21	SITU10	SITU11	SITU12	SIUK21	SIUK22	SIUR20	SIYE20
SIYG20	SIYG21	SIZA40	SIZB20	SIZB21	SIZW20	SIZW21			

US - UK - UL - UE

USAA01	USAA02	USAA1	USAA10	USAF01	USAF02	USAF03	USAF04	USAF05	USAF06
USAF07	USAG1	USAG2	USAG3	USAG4	USAH01	USAI1	USAK1	USAK2	USAL01
USAL1	USAL02	USAL2	USAU01	USAU02	USAU03	USAU04	USBA1	USBC01	USBD1
USBO1	USBU01	USBW01	USBX1	USBY10	USBZ1	USBZ2	USBZ3	USCA1	USCA2
USCA3	USCE01	USCH1	USCH2	USCH3	USCI11	USCI12	USCM1	USCN1	USCN2
USCN3	USCN4	USCN5	USCN6	USCO1	USCR1	USCV1	USCY01	USCZ10	USDD01
USDD02	USDL01	USDL02	USDN01	USER10	USET01	USEU01	USFA01	USFI01	USFI02
USFI03	USFJ01	USFR1	USGE01	USGI01	USGL1	USGL2	USGL3	USGR01	USHE01
USHK1	USHU01	USHU02	USHW1	USID1	USIE1	USIL1	USIN01	USIN02	USIO1

USIQ01 USIR01 USIS01 USIV01 USIY01 USIY02 USJP01 USKB01 USKB1 USKK01
USKN01 USKO1 USKR01 USKR1 USKR02 USKU01 USKW10 USLB01 USLY1 USMB01
USMC1 USMD1 USMG01 USMI1 USMK01 USMO01 USMO1 USMS1 USMT1 USMX1
USMZ01 USNC01 USNF01 USNG01 USNL1 USNO11 USNO12 USNO13 USNR01 USNR1
USNV01 USNZ02 USOM10 USOS01 USPA01 USPA1 USPA2 USPF01 USPF02 USPF03
USPF04 USPF05 USPH1 USPH2 USPK01 USPK1 USPL01 USPO1 USPY1 USQT10
USRA10 USRA11 USRA12 USRA13 USRA14 USRA15 USRA16 USRA17 USRE01 USRO01
USRS10 USRS11 USRS12 USRS13 USRS14 USRS15 USRS16 USRS17 USRS18 USRS19
USSB1 USSC01 USSD1 USSD10 USSD12 USSG1 USNO01 USNO03 USNO04 USNO05
USNO06 USSO01 USSP01 USSR01 USST1 USSU01 USSW01 USSY01 USTHQ1 USTN01
USTS1 USTU10 USTV01 USUK01 USUR10 USUS1 USUS10 USUS2 USUS3 USUS4
USUS5 USUS6 USUS7 USUS8 USUS9 USVA01 USVA1 USVA10 USVB1 USVB10
USVB13 USVB15 USVC1 USVC10 USVD1 USVD10 USVE01 USVE1 USVE10 USVF01
USVF1 USVF10 USVJ1 USVJ10 USVM1 USVN1 USVS01 USVX01 USVX1 USVX10
USVX13 USWD1 USWD10 USWF01 USWK1 USXX01 USYE10 USYG01 USYG02 USZA01
USZA02 USZB01 USZW01 USZW02
UP - UH
UPAA01 UPAA1 UPAF01 UPAF02 UPAF03 UPAF05 UPAF06 UPAF07 UPAF08 UPAF09
UPAG1 UPAG2 UPAG3 UPAG4 UPAL01 UPAL02 UPAU01 UPAU02 UPAU03 UPAU04
UPBC01 UPBD1 UPBJ1 UPBM01 UPBU01 UPBW01 UPBY10 UPBZ1 UPCD1 UPCE1

UPCG1 UPCM1 UPCY01 UPCY02 UPCY1 UPCY21 UPCZ10 UPDD01 UPDJ01 UPDL01
UPDL02 UPDN01 UPEG01 UPER10 UPET01 UPEU01 UPFG01 UPFI01 UPFI02 UPFI03
UPFJ01 UPFR1 UPFR21 UPGE01 UPGH1 UPGI01 UPGO1 UPGR01 UPHE01 UPHK1
UPHU01 UPHV1 UPID1 UPIE1 UPIN01 UPIN02 UPIS01 UPIY01 UPJP01 UPKB01
UPKI1 UPKK01 UPKP01 UPKU01 UPKW01 UPKW1 UPKW10 UPLA01 UPLY01 UPLY1
UPMA01 UPMB01 UPMC01 UPMC1 UPMG01 UPMG02 UPMI01 UPMI1 UPMK01 UPML1
UPMS1 UPMT01 UPMT1 UPMV1 UPMW01 UPMZ01 UPNC01 UPNF01 UPNG01 UPNR1
UPNV01 UPNZ02 UPNZ03 UPOS01 UPPH1 UPPH2 UPPL01 UPPS01 UPRA10 UPRA11
UPRA12 UPRA13 UPRA14 UPRA15 UPRA17 UPRE01 UPRO01 UPRA11 UPRS12 UPRS13
UPRS14 UPRS15 UPRS16 UPRS17 UPRS24 UPRW01 UPSB01 UPSB1 UPSC01 UPSG1
UPSN03 UPSN04 UPSN05 UPSO01 UPSR01 UPSU01 UPSW01 UPSY01 UPTG01 UPTG1
UPTH01 UPTK01 UPTN01 UPTS1 UPTV01 UPUK01 UPUR10 UPVA01 UPVA1 UPVB01
UPVB1 UPVB10 UPVD1 UPVE01 UPVF1 UPVM1 UPVN1 UPVN2 UPVS1 UPVX01
UPVX1 UPWF01 UPYG01 UPZA01 UPZA02 UPZB01 UPZR1 UPZW01 UPZW02 UPZW40
UG - UQ
UGAA01 UGAA20 UGAF02 UGAF03 UGAF05 UGAF06 UGAF07 UGAF08 UGAF09 UGAL20
UGAL21 UGAU21 UGAU22 UGAU23 UGAU24 UGBC20 UGBJ20 UGBU20 UGCG20 UGCM20
UGCO1 UGCY20 UGCY21 UGCZ20 UGDD21 UGDJ20 UGDL01 UGDL02 UGDN21 UGER20
UGEU21 UGFI40 UGFI41 UGFI42 UGFR20 UGFR21 UGGE01 UGGE20 UGGI21 UGGL21
UGGO20 UGGR20 UGHE21 UGHU20 UGHV20 UGIE21 UGIN20 UGIO1 UGIS21 UGIY20

UGKK21 UGKN20 UGKU20 UGKW20 UGLA20 UGLY20 UGMA20 UGMB01 UGMB20 UGMG20
UGMG21 UGMI20 UGMK21 UGML20 UGMT20 UGMW20 UGNR20 UGOS21 UGPL20 UGRE20
UGRO20 UGSC20 UGSG20 UGSN21 UGSN23 UGSN24 UGSN25 UGSO21 UGSW21 UGTG20
UGTH20 UGTK20 UGTN20 UGTP20 UGTS20 UGTV20 UGUK21 UGVA01 UGVA20 UGVA21
UGVB10 UGVB20 UGVD21 UGVE01 UGVF20 UGVF21 UGWF21 UGYG20 UGZA01 UGZA02
UGZA03 UGZB20 UGZR20 UGZW20 UGZW21 UGZW40
UANT1 UAME01 UAAL1 UAAL2 UAAO1 UAAO2 UAST1 UAEW1 UAEW2 UAEW3
UAXX01 UAMA1 UADL01 UAXE1 UANT20 UACA1 UACN21 UABZ1 UABZ2 UAAW30
UAAF30 UAAG1 UAAO01 UAAO02 UAAP01 UACD1 UADJ1 UAEA20 UAIN1 UAIO1
UAIO01 UAIO02 UAIO10 UAMC1 UANA1 UANT11 UASA1 UAST10 UAST11 UATN1
UATS1 UAXX10 UAAF01
SIVX01 SIVX70 SIVX72 SIVX73 SIVX75 SMVX01 SMVX70 SMVX72 SMVX73 SMVX74
SMVX75 SNVX21 SNVX70
TBUS01 TBUS02 TBUS03 TBUS04
-
-

ANNEX XII

CGMS-20 USA WP-29
Prepared by USA
Agenda Item: H.2

CoastWatch: NOAA's New System for Monitoring the Coastal Ocean

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Abstract

The National Oceanic and Atmospheric Administration's (NOAA) CoastWatch is a scientific theme within NOAA's Coastal Ocean Program which delivers NOAA polar orbiting satellite data and other environmental information in near real-time to regional NOAA facilities. These data are used by NOAA, federal, state and local officials to monitor U.S. coastal waters and to perform environmental research and management functions. The initial product of CoastWatch is a set of re-mapped, high resolution surface water temperature images covering the U.S. coastal regions and Great Lakes. Delivery of satellite imagery began to the National Marine Fisheries Service (NMFS) Beaufort, North Carolina Laboratory in February 1989, and to the Office of Oceanic and Atmospheric Research's (OAR) Great Lakes Environmental Research Laboratory in May 1990. Components of the CoastWatch system including a wide-area communications system, on-line product databases, an electronically-accessible product archive, integrated PC software for rudimentary display and analysis of satellite imagery, and NOAA-wide research efforts, are described. Potential applications of the imagery for detection and location of thermal fronts, analysis of circulation patterns and upwelling, and ice and snow mapping are discussed. Future plans for CoastWatch are also presented.

Introduction

CoastWatch is a capability within the National Oceanic and Atmospheric Administration (NOAA) to supply polar orbiting satellite data and supporting environmental information in near real-time to regional NOAA facilities within the U.S. coastal waters and Great Lakes. The CoastWatch system consists of a suite of satellite products, atmospheric model-based output and **in situ** data, a communications system supporting near real-time and retrospective distribution of CoastWatch products to regional NOAA sites, entry-level PC-based workstation software for rapid display and analysis of satellite and environmental parameters, and NOAA-wide research efforts. CoastWatch data are used by Federal and state managers and researchers responsible for coastal living marine resources and ecosystems to make environmental assessments and management decisions. CoastWatch is a cooperative effort within NOAA's Coastal Ocean Program that involves all of NOAA's line offices, including the National Environmental Satellite Data and Information Service (NESDIS), the National Marine Fisheries Service (NMFS), the National Ocean Service (NOS), the Office of Oceanic and Atmospheric Research (OAR), and the National Weather Service (NWS).

The primary product of CoastWatch is mapped, high resolution satellite-derived sea surface temperature (SST) imagery of the coastal U.S. and Great Lakes. Other products that are made available include atmospheric model-based charts of various parameters such as oceanic surface winds and wind drift, **in situ** buoy and ship measurements, satellite-derived SST contour and ocean feature charts. Satellite imagery is used by CoastWatch users to determine the location, strength and movement of oceanic thermal fronts, eddies, ocean currents, ice edge, snow, upwelling and river outflow boundaries. This environmental information is critically important in supporting NOAA's mission of assessing and monitoring the status of the coastal U.S. and Great Lakes in order to protect living and non-living marine resources, estuaries and ecosystems.

CoastWatch support began in response to a 1987-1988 "red tide" event off the North Carolina coast at the NMFS Beaufort, North Carolina Laboratory in February 1989 (Pyke, 1989; Tester, et al., 1991). Support was expanded to the OAR Great Lakes Environmental Research Laboratories (GLERL) in May 1990 and to the NMFS Narragansett, Rhode Island Laboratory in May 1991. Additional details of the initial CoastWatch system are found in Weaks (1991). This paper will provide a detailed overview of the present CoastWatch system, describe applications of satellite data at two operational CoastWatch sites, and summarize future plans for CoastWatch.

The CoastWatch System

Satellite Mapping

Mapped, high resolution satellite imagery is the primary input product of the CoastWatch system. These data are derived from NOAA-11, one of two NOAA polar orbiting weather satellites operated by NESDIS which carry the Advanced Very High Resolution Radiometer (AVHRR) instrument. NOAA-11 is in a sun synchronous orbit at an altitude of approximately 859 km, and therefore provides coverage of a CoastWatch region twice a day at about 2:47 a.m. and 2:47 p.m. local time. The AVHRR scans a swath of approximately 2600 km perpendicular to the path of the satellite in five radiometric bands: Visible, 0.58-0.68 μm; reflected infrared, 0.725-1.0 μm; and thermal infrared, 3.55-3.93 μm, 10.3-11.3 μm, 11.5-12.5 μm (Schwalb, 1978, 1982).

AVHRR data are processed in two resolutions: 1.1 km (at nadir) High Resolution Picture Transmission (HRPT) and Local Area Coverage (LAC), and Global Area Coverage (GAC) at approximately 4 km resolution. NESDIS obtains HRPT data within a specified area surrounding two Command and Data Acquisition (CDA) receiving stations, one in Wallops, Virginia, and one in Fairbanks, Alaska. Direct read out facilities are located at several other sites in the U.S., including one at Redwood City, California, and Anchorage, Alaska. These direct read out facilities are operated by the NWS. Both LAC and GAC data are recorded aboard the satellite and are therefore available in a delayed mode. LAC data coverage is limited; users submit their requests to NESDIS and they are implemented on a priority schedule. GAC data coverage is obtained along the path of the satellite, resulting in nearly global coverage in about 14 orbits a day.

From the NESDIS CDA sites at Wallops and Fairbanks, digital HRPT/LAC/GAC data are transmitted in near real-time via commercial satellite links to the NOAA computer facilities located in Suitland, Maryland. The data are calibrated, earth located, and quality controlled into AVHRR 1B data sets (Kidwell, 1991) which are submitted automatically on an orbit-by-orbit basis to an ocean mapping program. This program remaps each of the five AVHRR channels and associated ancillary information into Mercator or polar stereographic projections and the data resampled into 512x512 pixel images. Coastlines and latitude/longitude grids are also produced as overlay graphics. In a separate routine, the mapped IR channels are used to produce sea surface temperature (SST) images using the multichannel SST equations (MCSST) described in Pichel (1991) and McClain et al. (1985). The ocean mapping program is a very flexible system which supports a number of processing options such as interactive program submission, generation of cloud masks as overlay graphics and compositing. Additional details about this system can be found in Pichel (1991).

Coverage along the U.S. coast and in the Great Lakes is achieved by processing SST imagery in near real-time at two distinct resolutions: "Synoptic" views for large regions and "high resolution" views for smaller sectors within each region. In Figure 1, top panel, the synoptic and high resolution views available for the Great Lakes are illustrated; the larger box represents the synoptic resolution of 3.6 km, the smaller boxes are defined as high resolution at 1.8 km. Actual grid resolution is calculated by $d\cos\emptyset$, where d is the spatial resolution at the equator, and $\emptyset$ is the latitude (Schwab et al., 1991). Figure 1, bottom panel, illustrates the areas available for the southeast U.S.; the synoptic view at 4.4 km resolution, and the high resolution views at 1.5 km resolution. Presently only the northernmost high resolution view is available to users. The Northeast sectors are not shown here but can be found in Pichel (1991). Using the NOAA-11 satellite, coverage for each sector/region is provided approximately twice per day. In addition to these operational sectors, two sectors in the

ANNEX XII

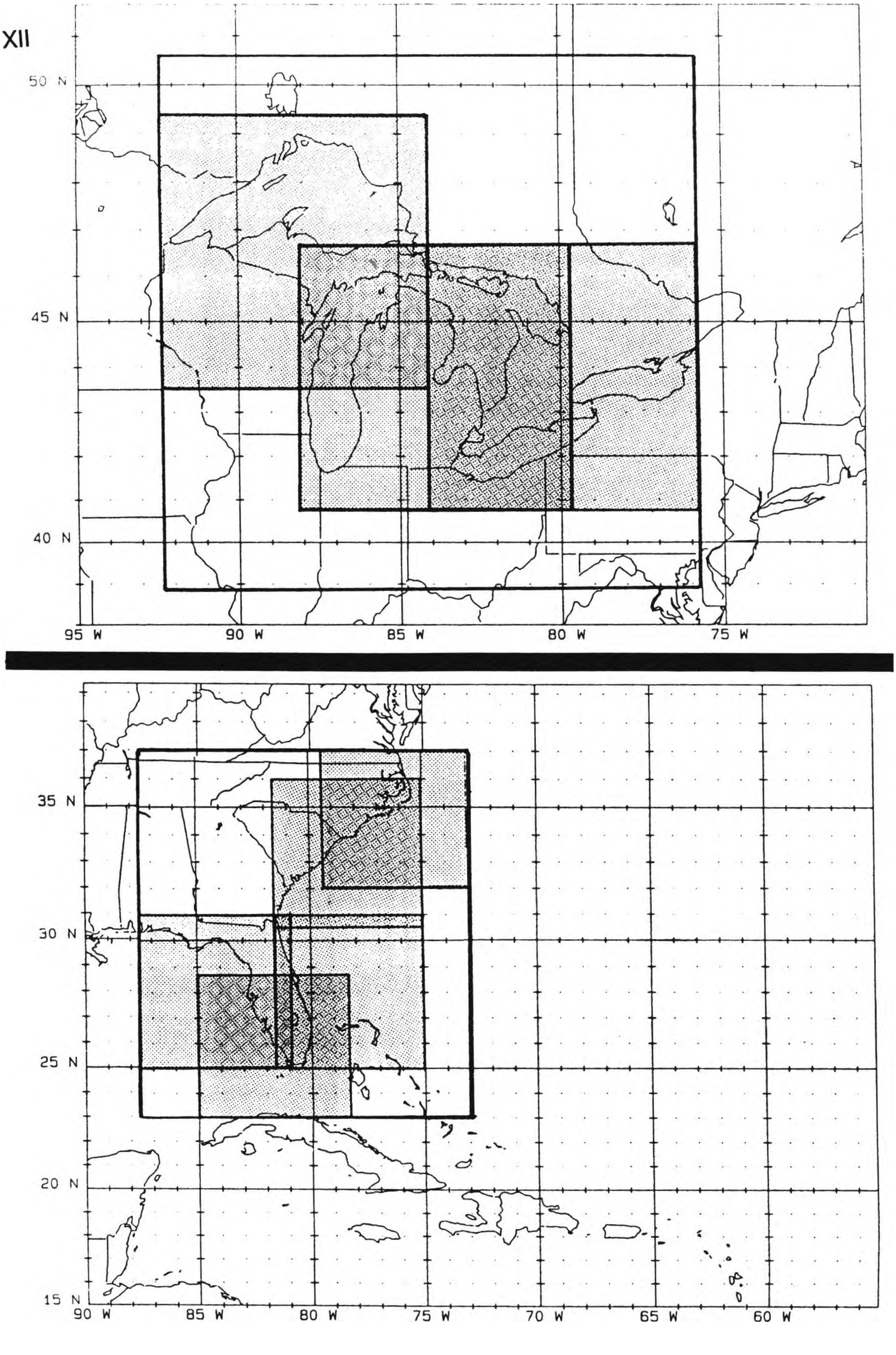


Figure 1. Coverage for two CoastWatch regions. Top panel shows synoptic view (large box) of the Great Lakes CoastWatch region at 3.6 km resolution; three smaller, overlapping boxes are high resolution views at 1.8 km resolution. Bottom panel illustrates the synoptic view (large box) at 4.4 km resolution for the Southeast CoastWatch region, and five smaller, overlapping high resolution views at 1.5 km resolution.

Caribbean, one of Chesapeake Bay, and a synoptic view of the Gulf of Mexico are being produced experimentally for NOAA internal use.

Accuracies of the satellite mapping algorithm for the Great Lakes have been determined for a years worth of images in Schwab (1991). Adjustments of up to 5 - 10 km were found to be necessary to align the image with coastlines (Table 1). These errors are expected to be reduced when a new navigation routine is introduced into NESDIS's AVHRR 1B processing in 1992.

TABLE 1. Average geographic corrections for Great Lakes CoastWatch images (E-W displacements are positive eastward, N-S displacements are positive northward)

Satellite	Number of images	Displacement (km) E-W	Displacement (km) N-S	RMS deviation (km) E-W	RMS deviation (km) N-S
NOAA 10 Daytime	122	4.2	6.6	2.8	4.2
NOAA 10 Nighttime	192	-8.4	0.8	5.3	2.9
NOAA 11 Daytime	189	-8.2	4.9	4.8	4.0
NOAA 11 Nighttime	127	7.6	3.4	3.2	3.5

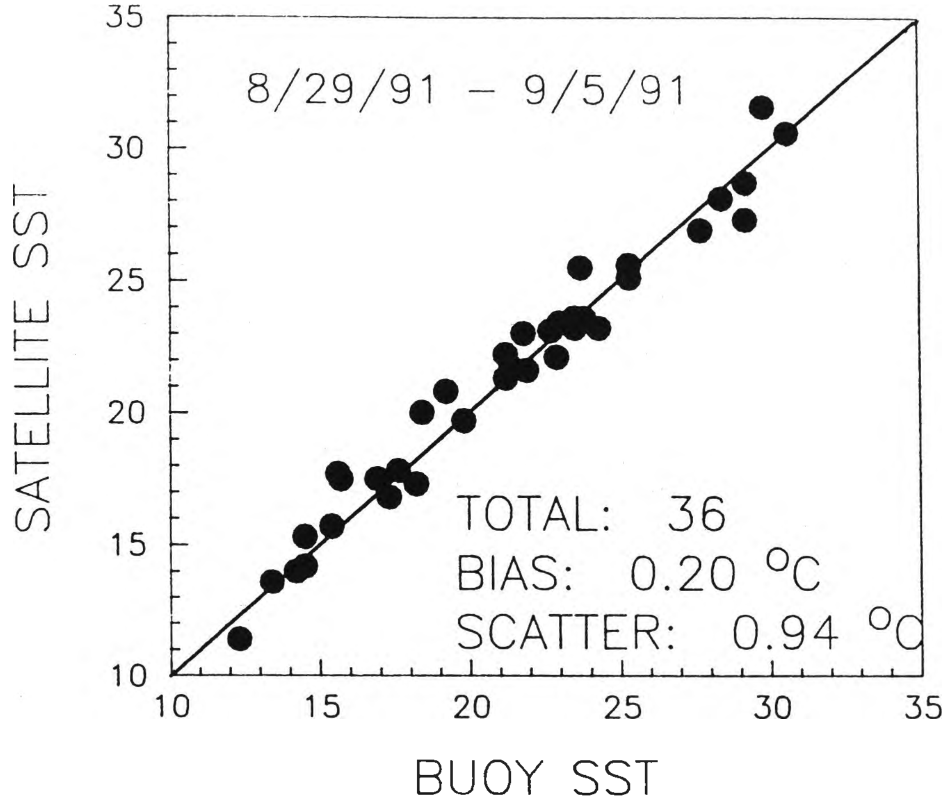
The accuracy of the global-based multichannel SST algorithm was compared with fixed buoy measurements during a week long period for three operational CoastWatch regions (Figure 2). Although the accuracy of the SST algorithm in these regions and time frame is quite good (mean difference of 0.1 - 0.2°C, standard deviation of up to 0.9°C), this study illustrates a slight diurnal influence on the accuracy of satellite SST measurements. Sea surface temperature accuracy will be continuously monitored and adjustments may be necessary for diurnal effects, presences of volcanic ash, etc. For an excellent review of the accuracy and validation of satellite SST's, see Minnett (1991).

Other Products

In Figure 3, examples of other NOAA data available experimentally to selected CoastWatch users are shown. These include satellite-derived 14 km resolution SST contour charts, buoy and ship SST and surface wind data, and ocean feature charts. Not shown are Limited Fine Mesh (LFM)-derived surface wind-induced drift and Ekman transport charts; these are shown in Weaks et al., 1990. Presently, CoastWatch management is defining specific user needs for each of these products and other useful environmental data.

Communications

DAY SATELLITE-BUOY COMPARISON



NIGHT SATELLITE-BUOY COMPARISON

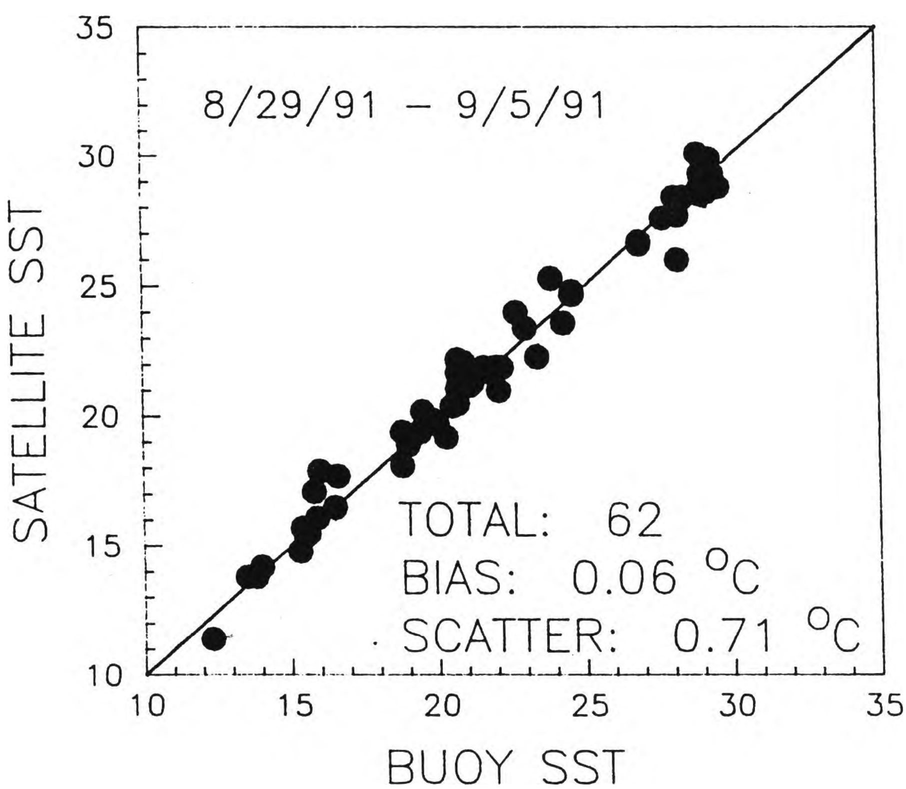


Figure 2. Comparison of satellite-derived SST observations from synoptic CoastWatch imagery of the Great Lakes, Southeast and Northeast regions with fixed buoy SST reports, August 29 - September 5, 1991. The top panel shows the results of the comparison using only daytime measurements; the bottom panel is the results of the nighttime comparisons.

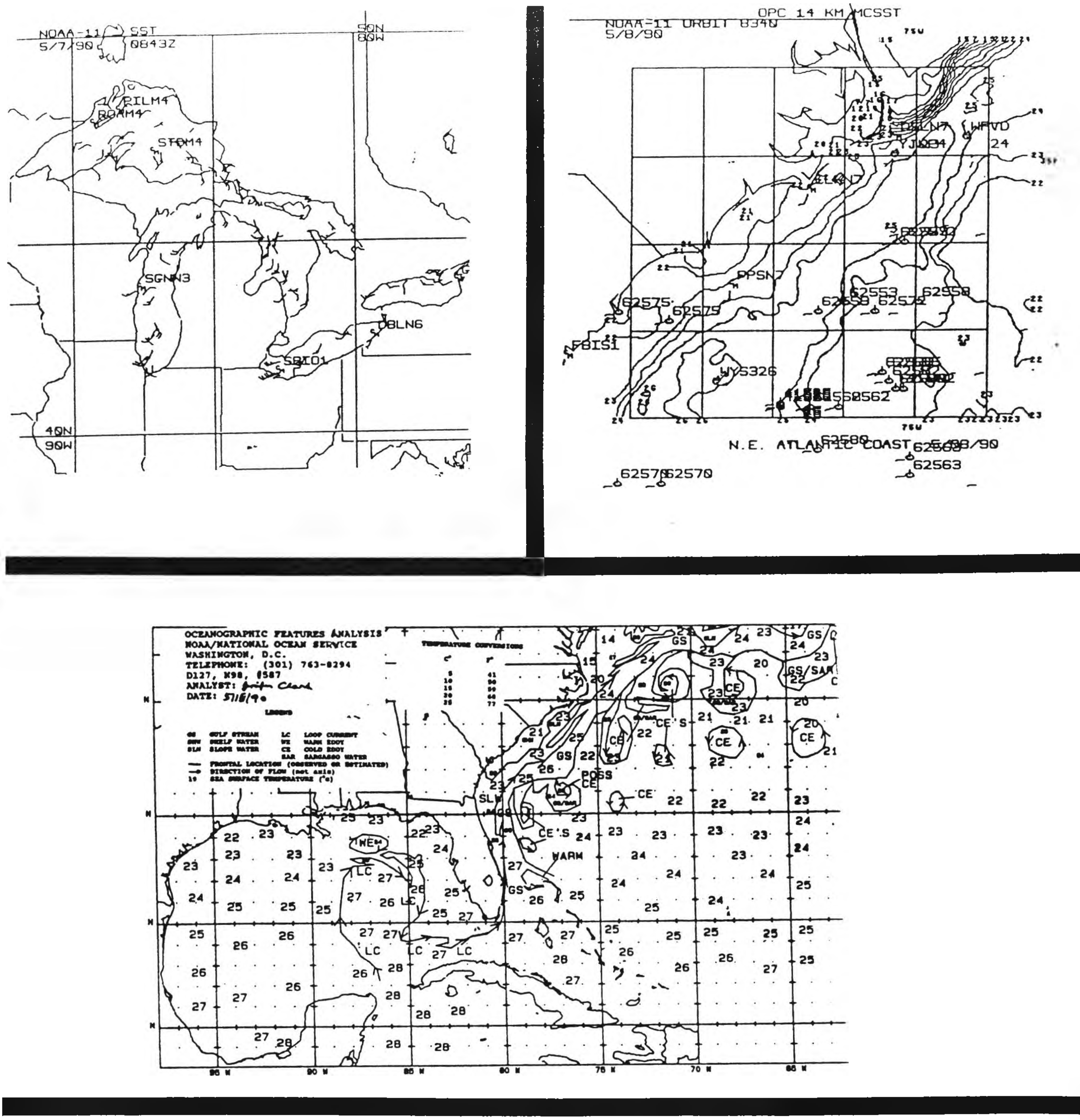


Figure 3. Selected examples of other (non-satellite image) CoastWatch products. Wind reports from buoy and ships in the Great Lakes are shown in the upper left panel; buoy and ship wind reports overlaid on a 14 km SST contour chart for the Southeast region are shown in the upper right panel; satellite-derived Ocean Feature Analysis (OFA) of the Southeast region and Gulf of Mexico is shown in the bottom panel. The SST reports in the OFA are derived from satellite retrievals, buoys, expendable bathythermographs and ships.

CoastWatch imagery and other products are presently available to Coastwatch sites electronically via a prototype high speed network called NOAA Ocean Communications Network (NOCN). After processing, CoastWatch imagery and other products are transferred from the NOAA computer facility in Suitland, Maryland, to a minicomputer located within NOAA's Ocean Products Center (OPC) in Camp Springs, Maryland. This minicomputer is at the heart of NOCN and it contains a database tailored for each CoastWatch region. Coastwatch users at Beaufort, North Carolina, Narragansett, Rhode Island, and Ann Arbor, Michigan access their portion of the database and then download files via dial-in, modem-based telephone lines. At 19.2 bps, each 320 kb image file takes several minutes to download. CoastWatch data are also transferred to the NOAA Coastal Archive and Access System (NCAAS), located at NESDIS's National Oceanographic Data Center (NODC) in Washington, D.C. NCAAS consists of an optical Write Only Read Many (WORM) "jukebox" with a menu-driven user interface supporting a catalogue directory. Data are available via most communication means and according to a pricing structure allowing free access for NOAA programs and researchers. Whereas NOCN services real-time user needs, NCAAS serves retrospective data needs and is a backup to NOCN. CoastWatch data flow is illustrated in Figure 4.

Satellite Image Processing

Each of the Coastwatch sites have been supplied with an entry-level 386 PC-based desktop workstation complete with NOAA-developed software for rapid integration and interactive analysis of Coastwatch information (Tseng et al., 1991). This system uses a proprietary graphics board and high resolution color monitor. It is used for a variety of purposes, from serving as a "quick-look" facility for ocean thermal patterns, to quality control of imagery, to determining optimum ship survey routes. In addition, software for VGA display and manipulation of CoastWatch imagery which can run concurrently with the above software is also now available in a "Beta" test mode. The CoastWatch sites have other computer workstations not supplied as part of Coastwatch that are used for more intensive research and operational projects.

Research efforts

A number of research projects have been funded as part of CoastWatch. These include an effort to track ocean features using successive AVHRR IR imagery on a PC-based system, development of PC-based software to calculate turbidity from the AVHRR visible channels, an effort to estimate diffuse attenuation coefficient to determine how deep Photosynthetic Active Radiation (PAR) penetrates (PAR is related to the health of seagrasses), development of visualization-oriented MacIntosh software to support fisheries research, development of database management software tailored for CoastWatch, and development of a system for quality monitoring CoastWatch imagery.

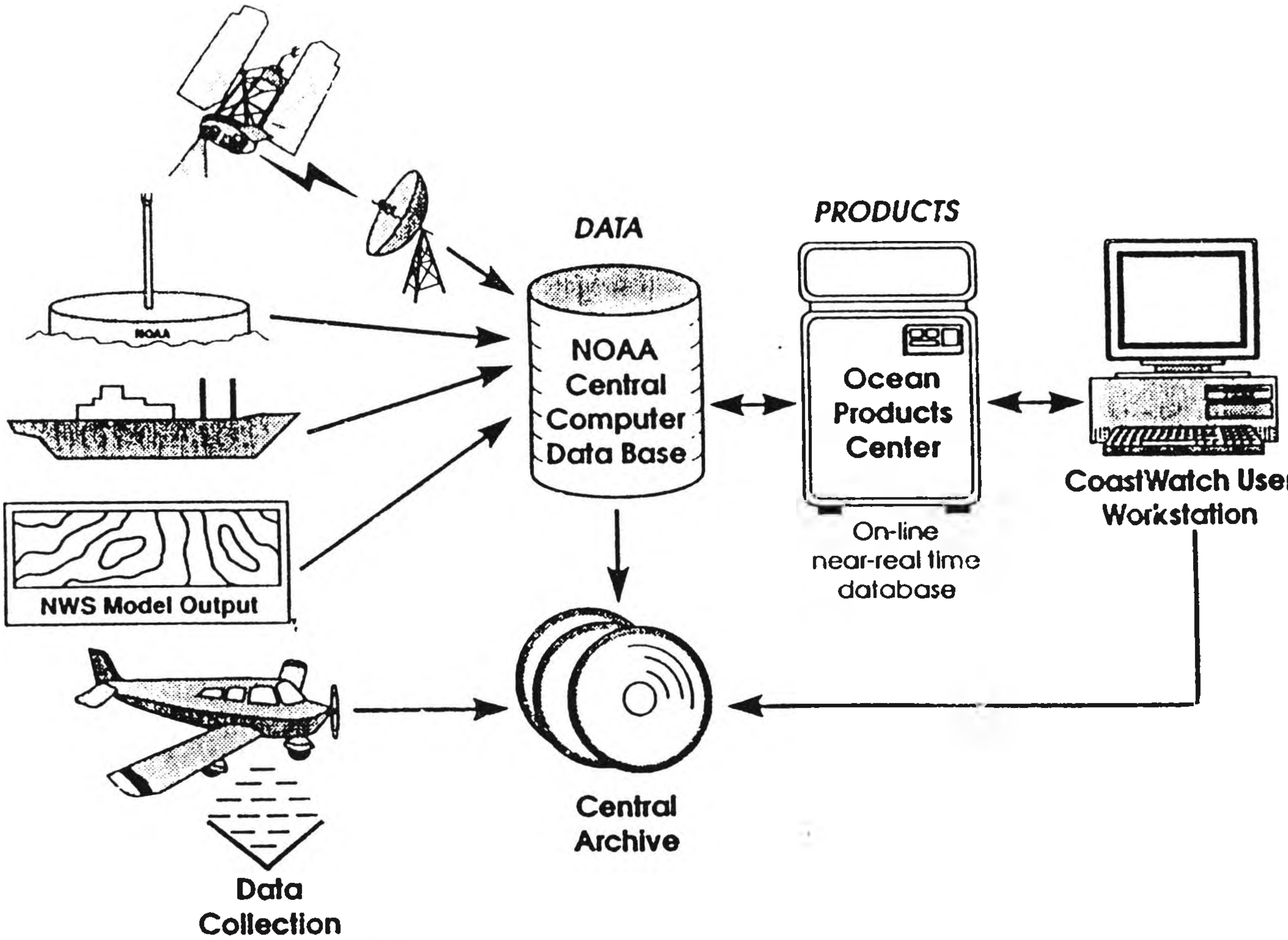


Figure 4. CoastWatch data flow. Satellite data, atmospheric model output, ***in situ*** *reports and other data are available from the NOAA computer facilities in Suitland, Maryland. NOAA's Ocean Product Center (OPC) obtains these datasets and stores them in customized regional databases for real-time electronic access by regional CoastWatch users. CoastWatch data are also transmitted to the NOAA Coastal Archive and Access System (NCAAS) for retrospective use.*

Applications of CoastWatch Imagery

CoastWatch imagery is used to detect thermal fronts, eddies, currents, water turbidity, ice extent and estuarine algal blooms. This biological and physical information can be used by federal, state and local officials to assist in making environmental decisions. In this section, several environmental applications are described where CoastWatch imagery is used by the NMFS laboratory in Beaufort, North Carolina and the GLERL facility in Ann Arbor, Michigan.

NMFS Beaufort Laboratory

In November and December, 1990, more than 50 sea turtles were observed "stranded" on the beaches of the North Carolina Outer Banks. The strandings were coincident with the beginning of the winter trawl season along the beach. The NMFS Beaufort Laboratory scientists analyzed CoastWatch SST imagery in November and found that an intrusion of relatively warm Gulf Stream-derived water was located in the immediate vicinity of the Hatteras, North Carolina inlet. This feature persisted for several weeks, followed by unusually warm SST's remaining in shore into January 1991. The NMFS scientists hypothesized that these warm SST features, along with other environmental factors, served to concentrate sea turtles and winter flounder in a common area. When fishermen trawled for flounder, the turtles were apparently being caught in the nets, even those with Turtle Excluder Devices (TEDs). As a consequence, the North Carolina Division of Marine Fisheries closed state waters for finfish trawling on December 7 and reopened the fishery on December 26, 1990.

Historically, sea turtle strandings have been recorded during the winter trawl fishery season (November - April). In this event, precise locations of the trawling fleet and turtles, as well as knowledge of pertinent environmental information such as winds and currents were lacking and therefore a correlation cannot be proven. Since the event, however, the North Carolina Division of Marine Fisheries has called for a more intensive effort in monitoring nearshore turtle/trawler interactions. The NMFS Beaufort Laboratory will be involved in this effort in the following areas: 1) Providing trained observers for aerial in shore surveys, and 2) monitoring SST imagery for unusual conditions. Locations of turtles and fleet boats will be overlaid on satellite imagery and these relationships will be regularly reported to State agencies. Surface wind drift information supplied via CoastWatch will also be used in the analysis. In addition, historical SST data, flounder landings, and turtle stranding data will be reviewed for possible correlations (Chester, personal communication).

Because of the possible correlation between turtle location and SST's, satellite SST imagery will also be used by the Beaufort Laboratory to monitor sea turtle migration patterns. In an event spanning September 12 to December 12, 1990, a satellite-tagged turtle was observed to "follow" a pocket of relatively warm SST's into the Gulf Stream instead of following the usual southern migration path (Chester, personnel communication). In another project involving fish larvae, SST imagery will be used in a hypothesis that survivability is linked to certain thermal patterns. Adult fish swim offshore to spawn and the larvae are transported back in shore via unknown mechanisms. One of these mechanisms may be related to the concentration of nutrients, a food source, at the edges of thermal features. Still another project involves the determination of factors such as thermal patterns which may affect fish year class strength.

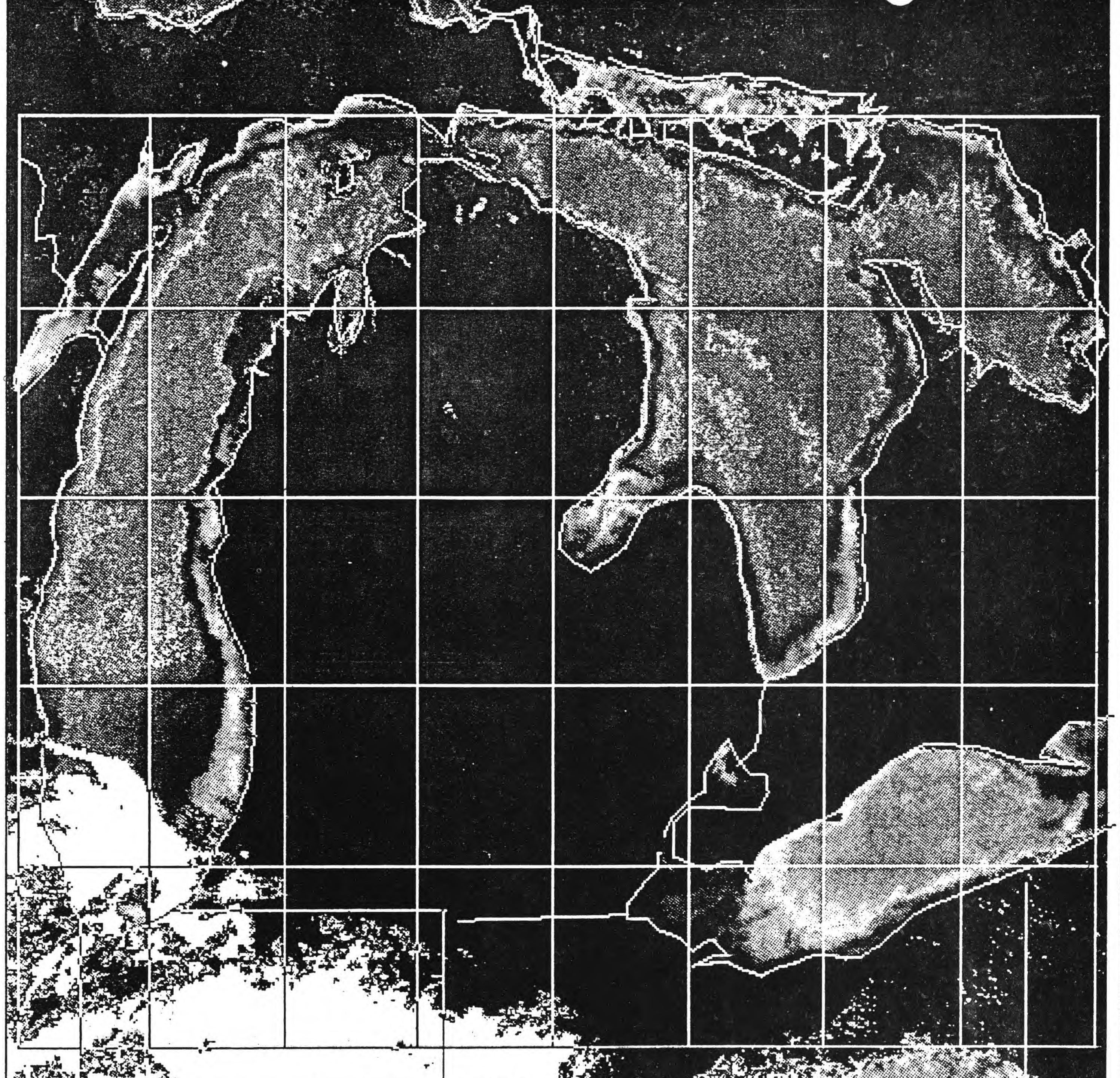
GLERL Ann Arbor

At the GLERL facility, SST imagery is used in several research efforts with the intention of supporting state and local agencies once the concepts are proven and an operational support system developed. These include monitoring nearshore water temperatures to better anticipate temperature changes for municipal drinking water treatment, industrial and recreational usage, and water quality. In Figure 5, cooler water along the eastern side of Lake Michigan and Huron can be easily detected; likewise, very warm temperatures in Lake Erie are evident. Water treatment decisions are partially based on water temperature and thus SST trend information would be useful for state and local management. Annual and interannual water temperature variability for subregions within each lake basin is being examined for possible correlations with biological productivity. Impacts of temperature changes on algal blooms, fish spawning, zebra mussel growth, etc., is being considered. And finally, SST and visible imagery is useful in monitoring ice coverage for ship routing, ice-breaking activities and shoreline protection. Time series analysis of these data provides information about the location and extent of ice cover in each of the lakes.

Future Efforts and Summary

The primary CoastWatch goal of supplying satellite and environmental information to NOAA regional sites in near real-time to support environmental decision making is expanding. In 1992, sites in Miami, Florida (NWS), Bay St. Louis, Mississippi (NMFS), La Jolla, California (NMFS), and Seattle, Washington (OAR) will be added to the CoastWatch system. Regionally-tailored satellite SST and visible imagery and a host of **in situ** and model output data sets will be added to NOCN's databases at the OPC for transmittal to each site in near real-time. NCAAS will be augmented by these additional data sets, including NOAA fixed buoy and CMAN station data and the European's Earth Resources Satellite (ERS-1) Low Bit Rate Fast Delivery Products. Details of the enhanced communications system are in the development stage but involve several additional communication components other than NOCN. In 1993, sites in Alaska (NWS/NMFS) and Hawaii (NWS/NMFS) will be added to the system, and

Figure 5 (next page). High resolution (1.8 km), mapped CoastWatch SST image of Lake Michigan, Lake Huron and Lake Erie. This NOAA-11 image was taken on May 19, 1991 and transmitted via the NOAA Ocean Communications Network (NOCN) to the Great Lakes Environmental Research Laboratory in Ann Arbor, Michigan. According to the color bar, warmer temperatures are represented in red; cooler temperatures by blue.

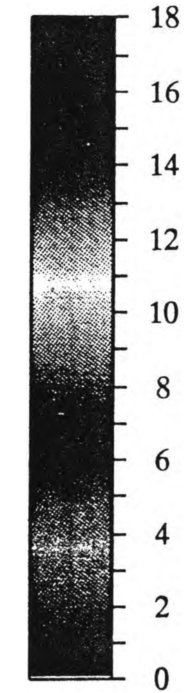


CoastWatch

MCSST Temperature

Filename:
/glerl/prv2/cw/md1/91/g9113919.m‹
SSTMAP Image
NOAA 11 Orbit: 13646
5/19/91 JD 139 19:10 GMT
Pixel Size: 1.30 km
Lat Range: 40.76N to 46.73N
Lon Range: 88.05W to 79.78W
Ioffset: -5440 -7
Joffset: 11386 +0

MCSST Temperature (Degrees Centigrade)



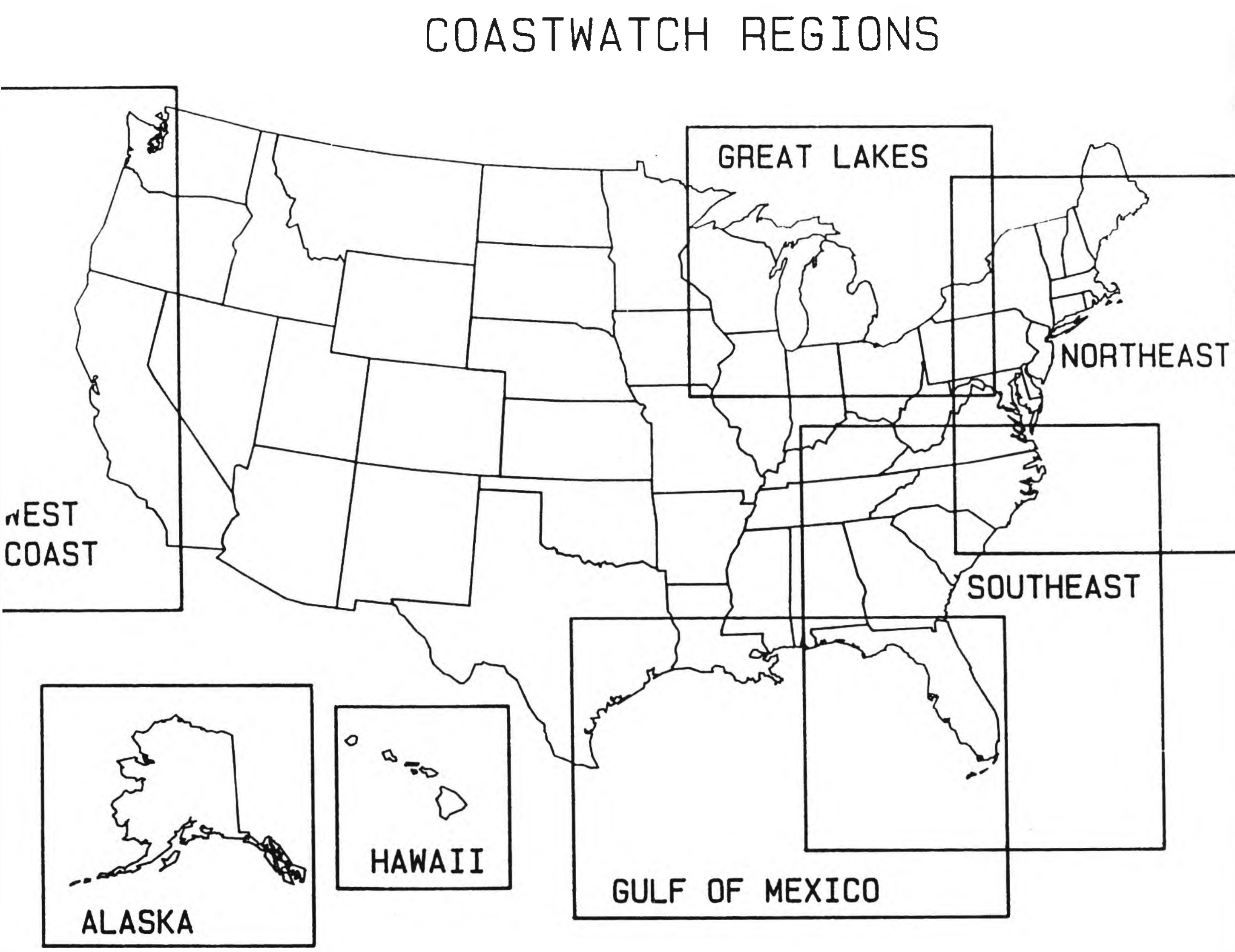


Figure 6. Coverage of current and future CoastWatch regions. The Northeast, Great Lakes and Southeast regions are now operational. In 1992, CoastWatch data will flow to all other regions other than Alaska and Hawaii, which will be added in 1993. Not shown is the Caribbean CoastWatch region.

redistribution to local users will be addressed. Figure 6 shows the location and coverage of all current and future Coastwatch regions.

Research efforts will continue and expand to regional-specific projects such as those described above. In addition, much effort will focus on appropriate uses of newly available satellite data such as ERS-1 Synthetic Aperture Radar (SAR) and the National Aeronautics and Space Administration's (NASA) SeaWiFS ocean color sensor. New products using AVHRR data will be developed, such as an index of algal blooms, regional turbidity/reflectance imagery and composite imagery. As new CoastWatch sites are added, and familiarity of the capabilities of CoastWatch data are realized, the scope and importance of CoastWatch in environmental management will undoubtedly grow to benefit all U.S. citizens.

Acknowledgements

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Prepared by USA
Agenda Item H.4

Solar Activity

Information on Solar Activity for Environmental Satellites

Action

None

SOLAR and UPPER ATMOSPHERE:

Solar and Upper Atmosphere databases are at the heart of the STP Division's activities. They are a mix of analog images (photographs of sunspots and flares on film), tabular values (solar flare reports), and digital data (GOES and NOAA/TIROS energetic particle measurements). They come from a world-wide array of ground-based sensors as well as NOAA and DOD satellites. Data are processed into the archival collection as they are received, with emphasis on a monthly schedule to support publication of summary figures and tables in **"Solar-Geophysical Data (SGD) Reports".** Galactic Cosmic Ray measurements from ground-based sensors (the global neutron monitor network) also are also part of the responsibilities of this group. Derived values held by this group such as the International Sunspot Number and the 10.7-cm solar radio flux have acquired global acceptance and status as measures of solar activity.

Because of the effects of galactic and solar radiation on technological and biological systems in space and at Earth, these databases are increasing in importance. Growing susceptibility of complex technological systems to disruption by solar activity (e.g. the North American electric power grid outages) and the possibility of linking variable solar energy output to long-term Earth System changes make continued monitoring and improved accessibility to these data important. The NGDC program to document effects of solar activity at Earth and in near-Earth space, including satellite anomalies, is carried out in this area of the STP Division. We have limited responsibility for interplanetary magnetic field and solar wind (plasma) data sent by NASA PIs for SGD publication. SXI and L-1 databases will reside in this program area.

GEOMAGNETIC VARIATIONS:

The geomagnetic field originates deep inside the Earth and extends out into space to a distance of about 10 Earth-radii towards the Sun while streaming hundreds of radii anti-Sunward behind Earth in a "magnetotail", much like the tail of a comet. In shape, the geomagnetic field is similar to that of a large dipole (bar magnet) located near the center of the Earth and tilted some 11.5° from the axis of rotation. It creates a region of near-Earth space called the "magnetosphere" inside which it is a dominant force controlling the access and direction of flow of incoming charged particles. High energy galactic cosmic rays and the most energetic particles from solar activity penetrate this shield in a chaotic way and distort the geomagnetic field as they set up temporary current systems with their own temporary magnetic fields.

There are regular daily changes in the geomagnetic field caused by sunlight on the upper atmosphere and the regular motion of charged particles trapped in the Van Allen belts inside the magnetosphere. Seasonal field changes are caused by the changing orientation of the Earth as it tilts the dipole toward or away from the Sun. Longer-term field changes come from inside the Earth and reflect changes in the dynamo region. They may be of particular significance for long-term Global Change as the dipole intensity declines and effects of arriving cosmic rays, solar plasma and solar magnetic fields penetrate closer to Earth surface inside the decreasing volume of the shielding magnetosphere.

The geomagnetic field is measured continuously at a global array more than 100 monitoring sites called "magnetic observatories." Additional measurements are made systematically at "repeat locations" and irregularly by ship, land, and air magnetic surveys. In recent decades, magnetometers have been carried by short-lived low-alitutde satellites and by NOAA's GOES geostationary monitoring satellites. Historically, ground-based magnetic field changes were recorded as analog time series on film sheets, usually as daily magnetograms. Values of the vector components of the field were scaled by hand from these records and accumulated to provide hourly, daily, monthly, and annual means. Hand scaling techniques also were used to obtain local indices of magnetic activity from individual observatory magnetograms and these were combined for global arrays to produce world-wide quantitative measures of levels of magnetic disturbance.

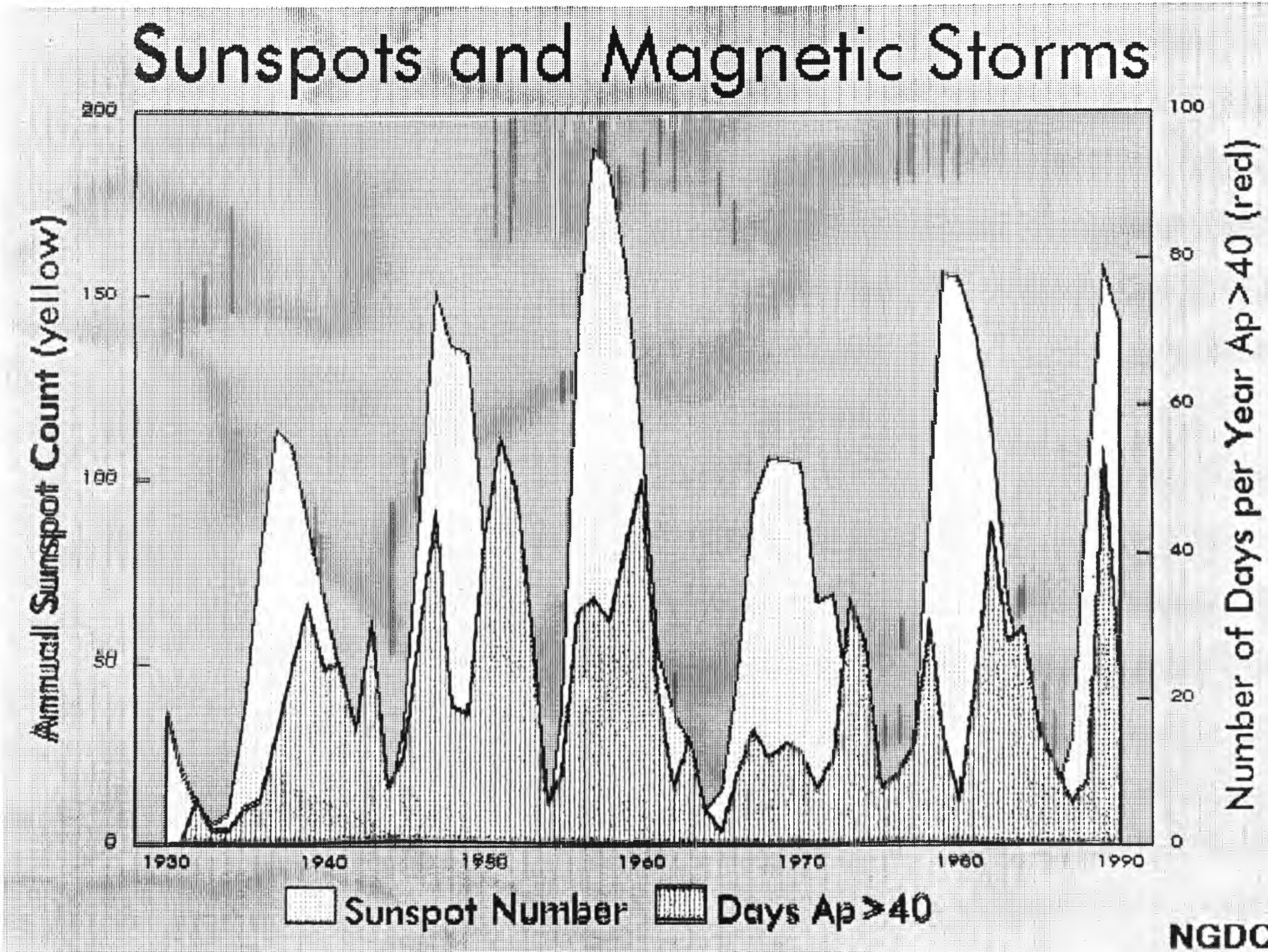
Since the mid-1970's, a steady change from analog to digital recording has been a pervasive worldwide characteristic of geomagnetic observing. This has had major impact on institutions operating observatory networks -- reduced the need for field personnel at observatories, resulted in more frequent data gaps due to lost data, complicated the taking of absolute field calibration measurements yet produced digital databases once only obtained at great cost. It also made an impact on data centers and derivation of indices.

Spherical harmonic geomagnetic field models have been computed from global databases since 1829. Calculation of the Earth's dipole magnetic moment shows that it has declined steadily for as long as it can be calculated from observatory data. Linear projection implies that the magnetic moment will become zero in about 1700 years. However, the rate of decline has been greater in the last few decades -- they should be more accurate for these years because satellite data were used in their derivation -- suggesting the moment will reach zero in some 1600 years. Consistent measures of global magnetic activity (the "aa" index) from mid-latitude records have been produced back to 1868. These show that the annual level of magnetic storminess has increased steadily since about 1900. It is not clear whether this change can be ascribed to the Earth's declining magnetic moment -- hence smaller magnetosphere and stellar shock waves produce larger storms for a given size shock -- or whether solar activity is increasing. These are important, basic questions about the Sun and Earth which can only be answered by continued observations of both solar activity and geomagnetic field changes.

Because of the clear relationship between magnetic storms and degradation of technological systems in space and on the ground, there continues to be a compelling need to acquire geomagnetic data at monitoring sites on satellites and at ground observatories. A complete suite of other needs arising from the Solid Earth community further supports the need for geomagnetic data to measure the short and long-term changes in the main geomagnetic field. Geomagnetic data cut across STP, Marine, and Solid-Earth disciplines.

SUA-1. SUNSPOTS AND MAGNETIC STORMS

The International Sunspot Number is the basis for the well-known "11-year **sunspot cycle"** which is the most used measure of solar variability. NGDC has values of sunspots continuously from 1700 and inferred from earlier intermittant historical observations since 1610. Solar flares emerge from the largest, magnetically complex sunspot regions and often are accompanied by an eruption of solar plasma (energetic charged particles, mainly electrons and protons). When the trajectory of the plasma stream intersects Earth, the result is often a disturbed condition called a **"Magnetic Storm"**. The Ap index is a global measure of daily magnetic disturbance and when Ap=40, a large magnetic storm is in progress during that day. While the annual sunspot number rises and falls in a fairly regular 11-year pattern, the distribution of magnetic storm days is more variable. Both measures track important physical phenomena for which accurate forecasts are needed. Planning future satellite missions must take the height of the solar cycle into account because changes in atmospheric heating reduce satellite lifetimes by producing greater atmospheric drag during years of peak activity. Ionospheric conditions are more disturbed during high sunspot years, while access of galactic cosmic rays to near-Earth space is greatest during years around sunspot minimum. The same plasma flow that causes magnetic storms also degrades operation of satellites in orbit and seriously degrades the operation of technologically complex systems on Earth, e.g. failures of the N. American electrical power grid. The most persistent evident relationship between the sunspot cycle and number of magnetically disturbed days is a peak in magnetic storms during the years of declining sunspots. The reasons are known but their result is extremely difficult to forecast and it is important to improve our monitoring capability in space with new instruments such as the GOES-NEXT Solar X-Ray Imager and the L-1 "space weather" monitor.


Sunspots and Magnetic Storms
Annual Sunspot Count (yellow)
Number of Days per Year Ap>40 (red)
0
50
100
150
200
0
20
40
60
80
100
1930
1940
1950
1960
1970
1980
1990
Sunspot Number
Days Ap≥40
NGDC

CGMS P.R.C WP-4
Prepared by P.R.C
Item:

The FY-2 Satellite Operation Schedule

--- Response to CGMS Action 19.23----

On CGMS-XIX Japan and China presented the results of studies on the possible interference between GMS-4 or GMS-3 and FY-2. It was shown that there may be interference between GMS-4 or GMS-3 and FY-2 ranging signal. To avoid interference, ranging periods of GMS-3, GMS-4 and FY-2 would be interlaced. Japan has decided the GMS-4 operation schedule, the ranging periods are in 01:20-01:29, 08:20-08:29, 14:20-14:29 and 20:20-20:29 GMT. Therefore FY-2 ranging periods will be temporally in 01:50-01:59, 08:50-08:59, 14:50-14:59 and 20:50-20:59 GMT. In future, if the ranging periods change , China and Japan will coordinate bilaterally.

The observation periods of GMS VISSR are in the second half of every hour. To increase the frequency of VISSR image covered by GMS and FY-2,the observation periods of FY-2 will be temporally in the first half of every hour.

CGMS-XX WP-16
Prepared by Japan
Agenda Item II/3

Products for Geostationary Meteorological Satellite-5 (GMS-5)

When GMS-5 is launched it will be carrying an improved Visible and Infrared Spin Scan Radiometer (VISSR) with a visible channel, a water vapor channel and split window channels. At the same time a new operational data processing system will be implemented for the control of GMS-5 and the generation of new and improved products. The GMS-5 products showed in attached table are available through the GTS and the satellite link and are possible to be exchanged through the GTS in the future.

In the stretched VISSR dissemination, all of the observed data will be broadcast with the almost same signal format as that of the current broadcast. The WEFAX is principally the same as that of the current broadcast. Broadcast of water vapor images will be newly made twice a day.

Cloud motion wind is planned to be extracted using a visible channel, one of split window channels and a water vapor channel. The water vapor channel will be used to improve the height assignment, which will be similar to the method applied to METEOSAT data at the European Space Operations Centre(ESOC). Water vapor wind is planned to be extracted from a water vapor channel data of GMS-5.

Though the current data system uses one infrared channel to estimate sea surface temperature, the new system will utilize split window channels.

Cloud amount and equivalent black body temperature data will continue to be generated from one channel of split window data and to be used for a moisture profile estimation applied to the numerical weather prediction model of JMA.

Upper air humidity is planned to be made from a water vapor channel and one of split window channels using a method similar to the current method applied to METEOSAT data at the ESOC. Furthermore, precipitable water will be made from split window channels. Upper air humidity and precipitable water are expected to improve the moisture profile estimation from GMS data.

TABLE GMS-5 PRODUCTS LIST (planned)

Type of Product		Frequency	Channel	Horizontal Resolution	Cover
Direct Broadcast					
Stretched VISSR		Hourly (added 4times for wind observation)	VIS, IR1, IR2, WV	1.25 km (VIS) 5.0 km (IR1, IR2, WV) at nadia	Full Disk
WEFAX	Polar-Stereographic	Hourly	IR1	1710 × 800 pixels	Far East
		Hourly(day time)	VIS		
	Four-Sectorized Rectified Disk	Every 3 Hours	IR1		Sectorized Disk
		Every 12 Hours	WV		
Wind					
Cloud Motion Wind		Every 6 Hours	VIS, IR1, WV	1.0° Lat/Long (candidate point of target)	50° N - 50° S 90° E -170° W
Water Vapor Wind		Every 6 Hours	WV		
Sea Surface Temperature					
Observation		Every 3 Hours	IR1, IR2	0.5° Lat/Long	50° N - 50° S 90° E -170° W
Five-Day Mean		Every 5 Days			
Upper Air Humidity					
Observation		Every 3 Hours	IR1, WV	0.5° Lat/Long	50° N - 50° S 90° E -170° W
Precipitable Water					
Observation		Every 3 Hours	IR1, IR2		
Cloud Amount					
Observation		Every 3 Hours	IR1		60° N - 60° S 80° E -160° W
Equivalent Black Body Temperature					
Observation		Every 3 Hours	IR1		
Typhoon Analysis					
Typhoon Center Location		Every 3 Hours (hourly)	IR1, IR2, WV, VIS	—	Northern Hemisphere 100 E -180° E
Typhoon Intensity		Every 6 Hours			

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