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

CGMS XIX

C G M S

TASHKENT, USSR

10 - 14 DECEMBER 1990

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A. PRELIMINARIES

A.1 Introduction

CGMS-XIX was convened at 10.30 am on 10 December by Mr. V. Kharitonov, Deputy Director of the satellite division, Hydromet Centre of the USSR, Moscow.

In his welcome address, Mr N.N. Aksarin, Director of the Uzbekistan Met Service expressed his great pleasure that CGMS had chosen Tashkent as the meeting venue for CGMS XIX. Tashkent, he added, would be one of the main data processing centres for GOMS. The construction of the building was complete and a new computer system was currently being installed. He noted that the meteorological centre in Tashkent was already very aware of the importance of satellite imagery for weather forecasting, especially for observing the weather in neighbouring rather data sparse regions. Satellite data had been received in the centre for some 20 years. He looked forward to a close cooperation with the Members of CGMS over the coming years and wished the delegates a very enjoyable stay in Tashkent and a most productive and successful

The reader should note that a full list of acronyms and abbreviations can be found in Annex I.

A.2 Election of Chairman

Mr D.E. Hinsman, Senior Scientific Officer, Satellite Activities, WMO, was elected Chairman of this session of CGMS.

Mr N.F. Veltishchev, Deputy Director of the Hydromet Centre of the USSR, Moscow, was elected Vice Chairman.

A.3 Arrangements for the Drafting Committee

A Drafting Committee, comprising Messrs. G. Bridge (EUMETSAT) and C. Cripps (USA) was appointed. CGMS Members were requested to nominate a representative to provide inputs 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 the work programme of the Telecommunications and Satellite Products Working Groups. Mr L. Heacock (USA) was elected Chairman of the Telecommunications Working Group and Mr J. Morgan (EUMETSAT) the Chairman of the Satellite Products Working Group. The reader should note that the numbering of chapters in this report correspond to those used in the Agenda. A full list of Working Papers (WP) submitted to CGMS XIX can be found in Annex III.

A.5 Review of Actions from Previous Meetings

The Secretariat reviewed actions from previous CGMS meetings:

i) <u>Continuing Actions by All Parties</u>

1. Circulation of satellite Operating Quarterly Reports

Status: Operations reports were being regularly distributed to all CGMS members.

2. Quarterly exchange of Photography

Status: Photographs had been exchanged.

3. Intercomparison of Extracted Winds

Status: Results of intercomparison carried out by USA in January 1990 had been distributed (July 1990 data provided in CGMSXIX-USA-WP-12).

4. 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.

Status: Information had been sent by Members to NOAA when available. It was included in some quarterly operations reports.

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

Status: Information was being exchanged but on a rather irregular basis. See also Section F.1.

b) <u>Status of Actions From CGMS XVIII</u>

Action 18.1 All CGMS Members to review the proposal to extend the responsibilities of CGMS and transmit any objections to the Secretariat within the next three months.

If no objections are forthcoming by 1 April 1990 it will be assumed that the proposal should be implemented.

Completed. See Item A.7

Action 18.2 EUMETSAT to inform CGMS on the altitude of ejection of METEOSAT-2 from the geostationary orbit.

Continuing - METEOSAT-2 still in orbit.

Action 18.3 USSR to provide Meteor-3 temperature sounding data over the GTS as soon as practical.

Continuing. See Report of WG II.

Action 18.4 WMO to continue its efforts to acquire INSAT image data tapes.

Continuing. WMO awaits a response from India.

Action 18.5 WMO to obtain information on INSAT satellite image transmission schemes.

Continuing. WMO awaits response from India.

Action 18.6 EUMETSAT to consult with the WMO on the procedures for the inclusion of the MDD in Phase II of the OWSE-AF.

Completed - concept approved by OWSE-AF steering group.

Action 18.7 EUMETSAT to monitor the relay of messages of Syowa to Japan Meteorological Agency.

Completed - summaries sent to JMA.

Action 18.8 CGMS members to provide, on a quarterly basis, listings of IDCS channel assignments to the Secretariat.

Completed - consolidated assignments are being received on a regular basis from USA and Japan.

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.

Continuing - See F.1.

Action 18.10 The CGMS Secretariat to send all available information on the IDCS to the People's Republic of China and USSR.

Completed.

Action 18.11 People's Republic of China and USSR to inform the Secretariat when IDCS channels will be implemented.

Continuing. Will be announced following the successful launch of FY2 and GOMS respectively.

Action 18.12 (Wind Profiler interference) USA to initiate the action by a letter to the Secretary-General including a rationale why profilers could be classified as radio location systems.

Completed. See Report of WG I.

Action 18.13 (Wind Profiler interference) WMO to notify all Members accordingly.

Completed. See Report of WG I.

Action 18.14 The Secretariat to include the information in the consolidated IDCS assignment reports and to consider the use of ASCII data formats to allow change of information between CGMS members on diskette.

Continuing. See Item F.1.

Action 18.15 The WMO to provide the CGMS Secretariat with the results of the ASAP end-to-end test and indicate what action, if any, the CGMS should consider to improve the availability of ASAP data.

Completed.

Action 18.16 The CGMS Secretariat to work out an implementation programme with the ACC and the WMO Secretariat for allocating additional time slots to the ASAP.

Completed. Channels will be allocated on an as required basis.

Action 18.17 Satellite operators to work with the CGMS Secretariat (1) to open the necessary channel, (I10 proposed), (2) to monitor the channel to be certain that it would be usable and (3) to agree on time slot and channel assignments for ships, including ASAP.

Completed. I10 being checked again. Channels I6 & I7 opened.

Action 18.18 The WMO and EUMETSAT to arrange ASDAR test transmissions through the METEOSAT satellite system.

Completed. Initial tests being carried out.

Action 18.19 The WMO to complete the procedures for the three month flight trial and to inform the CGMS members.

Completed. See Item F.3.

Action 18.20 The WMO to inform the CGMS Secretariat when the first ASDAR systems will be reporting in time for the ground software to be activated.

Completed. See Item F.3.

Action 18.21 Members to inform CGMS Secretariat by 1 April 1990 if the format for WEFAX digital header is acceptable. Failure to notify will constitute acceptance.

Completed. See Item G.1.2.

Action 18.22 CGMS Members to provide details of the expected date of implementation (of the header) and the information contained in each field at CGMS XIX.

Continuing. See Item G.1.2.

Action 18.23 EUMETSAT to report on the progress made with the development of a standard for digital WEFAX to the next meeting of CGMS.

Continuing. See Item G.1.3.

Action 18.24 Japan to provide details on the estimation of ocean surface winds in a typhoon area from GMS images.

Completed.

Action 18.25 Japan to determine if typhoon CMV information can be relayed over the GTS.

Completed. See Report of WG II.

Action 18.26 USA to distribute missing wind statistics information to all members of CGMS.

Completed.

Action 18.27 CGMS members to include Type 2 data on a monthly basis in quarterly reports.

Completed.

Action 18.28 USA to provide CGMS with more details of its new wind extraction method.

Completed. See Report of WG II.

Action 18.29 EUMETSAT to provide members of CGMS with the COSPAR meeting Announcement.

Completed.

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

Continuing.

Action 18.31 EUMETSAT to arrange that the setting up of a CGMS sponsored International Winds Retrieval Group be an agenda item of the COSPAR Winds Workshop, and to provide draft terms of reference for the group.

Completed. See Report of WG II.

Action 18.32 The USA to provide information describing VAS products to CGMS-XIX.

Completed. See Report of WG II.

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

Continuing. See Report of WG II.

Action 18.34 USA to inform CGMS on the planning of the new archive storage system for its future GOES satellites at CGMS XIX.

Completed. See Report of WG II.

Action 18.35 EUMETSAT to provide CGMS members with the references of CEPT documents referring to the protection of the 2 Ghz frequency band.

Completed.

Action 18.36 WMO to prepare an information paper for submission to WARC 92 on the protection of the 2 Ghz frequency band.

Completed.

Action 18.37 CGMS members to raise the issue of the protection of the 2 Ghz frequency band with national PTT representatives.

Completed.

Action 18.38 CGMS members to ensure that the letter prepared by the Secretary-General of the WMO on the subject of the allocation of frequency to data collection services of meteorological satellites is brought to the attention of their national PTT authorities, representatives and frequency managers.

Completed.

Action 18.39 Japan to study the feasibility of developing an EBB.

Completed. See report of WG I.

Action 18.40 People's Republic of China to provide the Secretariat with details on telecommunication networks in its country.

Completed. The Chinese Packet Switching Network "China PAC" is able to connect networks world wide including the U.S.A network of AT & T ACCUNET, TELENET, TRT DATAPAK, TYMNET, WESTERN UNION etc.

Action 18.41 USA and EUMETSAT to submit a standardized subset of bulletin boards, which could be supported by all CGMS Members operating an EBB to the Secretariat by 1 February 1990.

Completed - EUMETSAT EBB implemented 8/90 (see Report of WG I)

Action 18.42 EUMETSAT to provide USA with details of its stand-alone PC based EBB system.

Completed. See Report of WG I.

Action 18.43 Japan, China and USSR to submit status reports on satellite frequency allocations to CGMS-XIX.

Completed. See Report of WG I.

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

Continuing - publication expected early 1991.

Action 18.45 EUMETSAT to distribute the EUMETSAT Missions and Services Guide to CGMS members.

Completed.

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.

Continuing.

Action 18.47 CGMS Secretariat to add Search and Rescue to the agenda of future CGMS meetings.

Completed.

Action 18.48 Satellite Operators to forward information on solar (and other) events to the NOAA National Geophysical Data Centre as soon as practical.

Completed. See Item H.4.

Action 18.49 The USA to bring an updated SAM data base to CGMS-XIX.

Completed.

Action 18.50 WMO to develop a plan for a rotating exhibit of satellite receiving and display stations and to submit it to CGMS for comment.

Completed.

Action 18.51 The Secretariat to make an earlier distribution of the Agenda for CGMS XIX and to identify Working Groups for items requiring significant or detailed discussions.

Completed.

A.6 Comments on the Consolidated Report

Working Paper (WP-1) from Japan, identifying corrections to the eighth edition of the CGMS Consolidated Report, were noted at the meeting. The Secretariat agreed that these corrections, together with new information arising from CGMS-XVIII and CGMS-XIX, would be included in a draft 9th Edition, which would be distributed to CGMS members during 1991.

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.**

A.7 Terms of Reference for CGMS

CGMS Members recalled earlier discussions proposing an extension of the responsibilities of CGMS to include the planning, operation and use of polar meteorological satellites. CGMS considered that this could be achieved by an extension of the present informal objectives of CGMS and a change in its name to "Co-ordination Group for Meteorological Satellites"

A proposal for CGMS Terms of Reference, jointly generated by the Secretariat and the USA was discussed at length by CGMS.

Several delegations expressed reservations over a WMO proposal to extend the Terms of Reference for CGMS from "meteorological observation satellites" to "environmental satellites" since many authorities might be responsible for environmental satellites thus causing complications in the decision making processes in several of the CGMS member countries.

Various modifications to the text were proposed by CGMS Members, which were included in a revised draft document (Annex XIX). **CGMS unanimously agreed to adopt this revision on a provisional basis.**

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.**
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.**
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.**

B. REPORT ON THE STATUS OF SATELLITE SYSTEMS

B.1 Polar Orbiting Meteorological Satellite Systems

B.1.1 Peoples Republic of China

China reported the successful launching of its second polar orbiting meteorological satellite FY-1B on 3 September 1990. Major problems of FY-1A attitude control and IR contamination were resolved with FY-1B. FY-1B is now operating correctly, however, the two problems mentioned above remain under observation.

EUMETSAT reported severe periodic radio interference to METEOSAT ground stations caused by FY-1B transmissions and requested that this matter be discussed by the Telecommunications Working Group.

B.1.2 USA

NOAA-10 is currently the operational morning satellite, with an ascending nodal crossing time of 1919 and a descending time of 0719 local solar time (LST). NOAA-11 is the operational afternoon satellite with an ascending nodal crossing time of 1414

LST. NOAA-9 is also being operated to recover data from the SBUV and ERBE instruments. Launched as an afternoon satellite, NOAA-9 has now become a morning satellite for practical purposes with a ascending nodal crossing time of 1757 LST. No soundings or imagery are being used from NOAA-9. The USA provided a detailed status report from October 1990 as an attachment to USA-WP.3.

CGMS noted that the launch of the next NOAA polar orbiting satellite, NOAA-D, was expected mid-May 1991.

B.1.3 USSR

At present the USSR has an operational meteorological satellite system, which includes "Meteor-2" polar meteorological satellites (H = 1000 km, i = 81-82 degrees). The system includes 2 - 3 satellites. The WMO and other international organizations have information on the onboard equipment (WMO Document 411 refers). The activities of these spacecraft will be completed in 1993 at which time the Meteor-3 design will take over as the operational satellite.

In parallel with the "Meteor-2" spacecraft meteorological satellites "Meteor-3" are in polar orbit, under test, on an experimental basis. Data received from these satellites is also used for operational meteorology. The full experimental operation of these satellites will commence in the 1991 - 1992 time- frame. The special features of these satellites will be:

1) The possibility for correction of spacecraft orbit altitude and period (nominal value is H = 1200 km, i = 81,5 degrees).

2) Substantial retrofitting of the onboard instrumentation by the installation of the thermal IR-radiometer (10.5- 12.5 μm) with a resolution of about 1 km, and the addition of a capability for total ozone measuring and its distribution by the atmospheric sounder.

Data transmission from "Meteor-3" satellites is executed on 137 Mhz in APT mode and on 465,5 MHz to the central ground stations.

In 1991 it is planned to launch "Meteor-3" which, within the framework of international cooperation, will be equipped with:

- a TOMS spectrometer for mapping total ozone (NASA, USA),
- Earth Radiation Budget Experiment scanning radiometer (CNES, France).

In the future "Meteor-3" satellites are expected to carry further instrumentation developed under international cooperative agreements.

B.2 Geostationary Meteorological Satellite Systems

B.2.1 EUMETSAT

A status report on the METEOSAT Operational Programme (MOP) and the future MOP satellite launch schedule was presented by EUMETSAT. Three METEOSAT spacecraft are presently in operation status: METEOSAT-2 at 9 degrees West with an orbit inclination in excess of 3.5 degrees, METEOSAT-3 at 3 degrees West and METEOSAT-4 at 0 degrees West.

METEOSAT-2 is planned to be de-orbited after successful commissioning of METEOSAT-5. METEOSAT-3 is currently used as a stand-by spacecraft. Due to technical problems only one of the two data dissemination channels can be operated. The expected end of life of this satellite is end 1993.

METEOSAT-4 is being used as the prime operational spacecraft. Problems have been experienced with power supply synchronization resulting in interference of image data. The problems were investigated and modifications will be implemented on future spacecraft to avoid similar problems. The imagery problems on METEOSAT-4 can be reduced by switching between the two redundant onboard synchronization and imaging channels. A problem with the Black Body Calibration (BBC) measurement mechanics inhibits the continuation of Black Body calibrations on METEOSAT-4. Routine calibration of image data is performed, however, using ground based techniques.

Future Spacecraft in the METEOSAT series

METEOSAT-5 was shipped to the launch site in Kourou at the beginning of December 1990. (The successful launch took place at 2336 UTC on 2 March 1991).

METEOSAT-6 is currently scheduled for launch towards the end of 1993.

METEOSAT Operations

Radio interference has been experienced on METEOSAT Data Collection System (DCS) channel frequencies and data dissemination channels. Investigations on interfering sources are in progress.

Preparations for the operation of a METEOSAT spacecraft at 50 degrees West are in progress at the main METEOSAT ground station operated by ESOC and at the ground station of the Centre de Météorologie Spatiale in Lannion (France).

A new ranging system has been installed which allows multi-satellite ranging and precise orbit computation.

The relay of GOES image data via METEOSAT is continuing. At present, data are relayed from the USA via the GOES-2 spacecraft. Although this GOES satellite suffers from an extremely high unrecoverable satellite inclination in excess of 8.3 degrees, it has recently been possible to a maintain mission success rate of around 98%.

Preparations are in progress for the new GOES transmission format (GVAR) and for new uplink equipment in support of the GOES/ METEOSAT data relay system.

WMO expressed its appreciation of the efforts being made to provide GOES imagery to users in the METEOSAT field of view, despite the increasing operational tracking difficulties at Lannion (France) and Wallops (USA).

B.2.2 India

Status Reports on the INSAT system were received after the date of the meeting and can be found in Annex IV.

B.2.3 Japan

Japan, in its WPs-3 and 4, reported on the normal operational VISSR observation status for GMS-3 (up to Dec 1989) and GMS-4 (from Dec 1989 to the present), and the general good health of its Geostationary Meteorological Satellites (GMS-3 at 120 East and GMS-4 (operational satellite) at 140 East).

B.2.4 USA

CGMS noted from USA-WP-3 that only GOES-7 is fully operational among the GOES satellites. It is shifted between 98 degrees West in Summer and 108 degrees West in Winter to monitor hurricanes and winter storms coming out of the Gulf of Alaska, respectively. GOES-2, with an orbit inclination of 8.35 degrees, is currently stationed at 65 degrees West to provide WEFAX coverage for the eastern Atlantic region. GOES-6, orbit inclination 2.54 degrees, is stationed at 135 degrees West to provide Pacific WEFAX coverage. GOES-6 has very little station keeping hydrazine left and is expected to lose manoeuvring capability soon. GOES-3, which has been loaned to the PEACESAT program conducted by the US National Telecommunications and Information Agency (NTIA) is stationed at 175 degrees West and is controlled by the NASA Kokee Park Geophysical Observatory, located in Hawaii.

C. REPORT ON FUTURE SATELLITE SYSTEMS

C.1 Polar Orbiting Meteorological Satellite Systems

C.1.1 EUMETSAT

EUMETSAT Polar System (EPS)

In EUM-WP-5, CGMS learned that EUMETSAT was working towards the provision of an operational replacement from 1997 for the NOAA polar meteorological satellites in the morning orbit. The operational payload will include functional equivalents of AVHRR, HIRS and AMSU-A (all provided by NOAA) as well as AMSU-BE and a Meteorological Communications Package (MCP) provided by EUMETSAT. The plan is also to include the Search and Rescue (S & R) and Space Environmental Monitor (SEM) in the operational package. In addition, studies are in progress to prepare a new high spectral resolution infra-red sounder which should be flown as soon as possible to provide 1 degree C RMS temperature accuracy.

The present baseline plan is to fly this payload on the Polar Platforms now under development by the European Space Agency. In this case the operational payload would be complemented by many other instruments for ocean, climate and environmental studies. Final agreement between ESA and EUMETSAT has not yet been reached so EUMETSAT continues with contingency studies of smaller, dedicated, satellite platforms. One possibility under study is to define a small version of the ESA platform which could be used to fly a small meteorological payload in the event that a meteorological instrument should fail on the larger platform. In continuation of relevant studies, some $ 6 m is included in the approved EUMETSAT 1991 budget, in preparation for development work starting in 1992 or 1993.

In response to a question from the USSR, EUMETSAT agreed to inform the CGMS about the spectral resolution requirements of its proposed advanced IR sounder and/or interferometer.

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

C.1.2 Japan

No paper was presented on this item.

C.1.3 Peoples Republic of China

The FY-1B meteorological satellite series will continue on an experimental and trial basis, but with further improvements to enhance the properties of sensors, to increase the data storage volume thus providing better data coverage and to increase data transmission capacity. The following are under consideration:

1) To add more channels to the AVHRR,

2) To have an IR spectrometer similar to HIRS/2 for sounding,

3) To fly a microwave radiometer similar to MSU.

A specific launching plan has yet to be decided.

Studies of further improvements to FY-1 satellites were ongoing. Future instruments would require enhanced data formats and transmission schemes.

The Chairman remarked that the problem of enhanced data formats and transmission schemes would have to be faced by all satellite operators in the near future and would be addressed in detail in future CGMS meetings.

C.1.4 USA

USA plans for future operational polar-orbiting satellites were outlined in USA WP-4. Plans for launching the next six satellites are as follows:

NOAA-D (AM)	May 1991
NOAA-I (PM)	December 1991
NOAA-J (AM)	November 1993
NOAA-K (PM)	July 1994
NOAA-L (AM)	June 1996
NOAA-M (PM)	February 1997

Beginning with NOAA-K, the SSU and MSU instruments will be replaced by AMSU-A and B, an additional channel (1.6 um) will be added to the AVHRR instrument, and the capacity for the ARGOS System will be increased.

The USA will procure a replica of the NOAA-KLM series, NOAA-N, to continue the PM orbit service, before developing a new satellite series, NOAA-OPQ, for use in the beginning of the next century.

A new polar satellite command and control facility will become operational at the NOAA Suitland, Maryland facility in 1991.

C.1.5 USSR

CGMS were informed that the modernisation of the USSR polar meteorological satellites within the 1991-2000 time frame would be carried out in two steps:

- modernisation of "Meteor-3" spacecraft (1991-1993)
- development of "Meteor-4" spacecraft (1997-1998)

At the time of the meeting, design work on "Meteor-4" development was for the most part completed. These satellites would be launched in a sun-synchronous orbit with altitude of 950 ± 25 km and inclination of 98 degrees; the payload would be 800 - 900 kg; it would have an improved orientation accuracy (up to 10' on all axes with the angle velocity up to 0.005 angle degree per second), as well as a modular layout and improved electrical capacity (up to 2 Kw).

Payload component communication interfaces will be manufactured according to international standards, which will enable the installation of research instruments within the framework of international cooperation.

Spacecraft of this type may be manufactured by 1997-1998. That is why in the near future (1991-1993) retrofitting of the "Meteor-3" spacecraft will be carried out.

Such spacecraft (Meteor-3M) will have polar circular orbits with the orbit period of 103,5 minutes at an altitude of about 925 ± 25 km and inclination of about 82,5 degrees.

Orbit parameters will be maintained using two jet propulsion systems.

The following research instruments will be installed onboard "Meteor-3M":

a) An IR and Visible Scanning Radiometer with the following main parameters:

   - 2 spectral channels, with the possibility for a further 5
   - spatial resolution of about 1 x 1 km
   - swath width of about 3000 km
   - NEDT of about 0.15 K at 313 degrees K

b) A Multichannel Microwave Scanning Radiometer (MIVSA) for atmospheric temperature and moisture sounding with a spatial resolution of about 50 km and a swath width of about 1500 km.

c) Ozone sounding instruments.

d) Fourier IR-spectrometer for atmospheric sounding.

Where necessary, other types of instruments can be installed.

Data transmission will be made in three modes:

1) Direct broadcast (HRPT type, data rate at 665,4 Kbits per second).

2) One orbit stored data transmission to the central ground stations. Data rate at around 5 Mbits per second, image spatial resolution being 3 x 3 km.

3) Low resolution digital data transmissions with a data rate of 64 - 96 Kbits per second. (The parameters of this channel would be specified on the basis of international agreement).

The transmission of all the above data will be performed in S-band. In addition, APT type transmissions using 137 Mhz carrier frequency will be made. (A summary of METEOR-3 radio characteristics can be found in ANNEX XVIII).

In response to the USSR polar contribution, EUMETSAT welcomed the clear information provided about Meteor-3 and Meteor-4. The requirement for full satellite compatibility to ensure easy international cooperation at the instrument level was also strongly endorsed.

In this respect it was pointed out that both the Committee for Earth Observations Satellites (CEOS) and the Earth Observation - International Coordination Working Group (EO-ICWG) had responsibilities for satellite coordination. CEOS is concerned with overall system planning and coordination and had recently changed its terms of reference in such a way that both USSR and PRC could participate. EO-ICWG is concerned with detail planning of the polar platform of the International Space Station partners. They had studied satellite compatibility for several years within the framework of the so-called Common Instrument Interface Studies (CIIS). EUMETSAT welcomed the intention of the USSR to provide a digital replacement for APT and to provide a high speed data link compatible with the present HRPT. It was pointed out that the HRPT format must change in the coming years as new instruments are included. The changes should be in conformity with the recommendations of the CCSDS. Following further discussion a number of actions were noted:

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

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

CGMS noted that with the launch of the Meteor-3/4 series of satellites, there would be four different polar orbiting satellites transmitting HRPT type data to earth. The future coordination of data formats and transmission methods would therefore be necessary. The use of internationally agreed CCSDS data standards and CIIS interface standards was recommended .

C.2 Geostationary Meteorological Satellite Systems

C.2.1 EUMETSAT

METEOSAT TRANSITION PROGRAMME (MTP)

EUM-WP-6 described the METEOSAT Transition Programme. It is planned to manufacture one additional METEOSAT spacecraft which will be identical to the present MOP series in order to bridge a possible gap in observations between the expected end of lifetime of METEOSAT-6 in 1998 and the beginning of METEOSAT Second Generation. As an option it is foreseen to procure a second set of components which would allow the assembly of a second MTP spacecraft.

EUMETSAT has started investigations on a future ground system to support MTP spacecraft from 1995 onwards. The choice has to be made whether the ground segment will continue to be operated by ESA after the MOP cooperation agreement expires in November 1995 or if EUMETSAT will operate a system independent from ESA.

METEOSAT SECOND GENERATION

In WP-7, EUMETSAT reported on the progress being made with the development of METEOSAT Second Generation (MSG). A spinning satellite design has been chosen with up to four satellites being manufactured to provide some 12 years of operations in geostationary orbit from 1998. Five missions would be supported by MSG:

- Basic imagery (similar to MOP satellites)
- High resolution Visible imagery (in support of Nowcasting and short range weather forecasting)
- Air mass analysis (limited atmospheric sounding)
- Image and data dissemination and relay
- Support to scientific or operational activities related to climate, environment and satellite safety (e.g. SEM)

The core payload of MSG would be the Spinning Enhanced Visible and Infra-red Imager (SEVIRI), a Meteorological Communication Payload (MCP) and a possible complementary payload of scientific/experimental instruments (non design drivers)

Phase A studies (system design) for MSG are expected to begin in 1991 with a first launch scheduled in 1998.

C.2.2 India

A Status report on the development of future satellites in the INSAT series was received after the date of the meeting and can be found in Annex IV.

C.2.3 Japan

Japan informed the meeting on the development status of GMS-5, which will be launched in 1994. GMS-5 will carry a radiometer providing one visible channel, one water vapour channel and two IR channels.

Japan also reported that a satellite design to follow on after GMS-5 was in pre-Phase A design stage. Future radiometers would contain more IR channels. More information will be provided at the next meeting of CGMS.

C.2.4 People's Republic of China

PRC informed the meeting that at the present time there was no new information on FY2. Further details on both the satellite and the ground segment designs would be provided at the next meeting of CGMS.

C.2.5 USA

The USA reported on its plans for the GOES-I to M system (USA-WP-5 refers). The GOES system will provide atmospheric soundings from geostationary orbit on an operational basis, simultaneously with and totally independent of the imaging mission. Increased use of numerical data will be supported by the new capabilities of the system. These important weather missions will be complemented by the important space environmental monitoring (SEM) mission.

The other mission requirements include three additional services which are also provided simultaneously and independently of each other :

a) An interrogation and relay service for the rapidly expanding data collection platform operation,

b) a relay service of weather and GOES data satisfied by the concurrent WEFAX operation and retransmitted processed data,

c) an operational Search and Rescue relay service, complementing the polar satellite operation.

Finally, the operational weather satellite program has a history of adding or retrofitting new instruments into existing spacecraft. The GOES-I to M, designed with a spacecraft bus to operate into the 21st century, is planned to accommodate such new instruments important to the overall mission.

The GOES-I to M Telemetry and Command System (GIMTACS) is being installed in the NOAA facility in Suitland, Maryland. It is anticipated that the system will be ready by the end of 1991. CGMS noted that the GIMTACS cannot contact the older GOES satellites, and that the old command system will be operated in parallel with GIMTACS for as long as necessary.

C.2.6 USSR

An engineering and flight model of the Geostationary Operational Meteorological Satellites (GOMS) were shown to Members of CGMS at the All-Union Research Institute of Electromechanics (VNIIEM) in Moscow on December 7, 1990. The engineering model has been developed for technological ground testing, the second for flight testing. This flight model is still in a preliminary test phase. While developing GOMS some difficulties have been experienced with the control system using on-board computers. CGMS noted that the problem is expected to be corrected by the first part of 1991 and the satellite prepared for launch at the end of 1991.

D. OPERATIONAL CONTINUITY AND RELIABILITY

D.1 Inter-regional Planning

The USA presented a no-GOES operations scenario in its WP-6.

EUMETSAT indicated that it had established a capability for operating two satellites. After the successful launch of METEOSAT-5 in February 1991 a move of the in-orbit spare METEOSAT to 50 degrees West for Atlantic Data Coverage (ADC) will be considered. Operations on a experimental basis might be expected from about August 1991. Should GOES-7 fail before that date, urgent consideration will be given to an earlier EUMETSAT action.

The USA welcomed the support of EUMETSAT in providing Atlantic Data Coverage, adding that it would wish to conduct some product intercomparison tests within the areas of overlap of GOES and ADC.

USA assured CGMS Members than in the event of a catastrophic failure of GOES-7 information would be provided of the services available within the no-GOES operations scenario via WEFAX, EBB and via the GTS (from the WMO).

D.2 Global Planning

The USA submitted a paper (WP-7) which developed the rationale for coordination of Earth Observation missions among national and regional agencies to overcome resource limitations, avoid duplication of effort, and make a significant contribution to global change monitoring and assessment. A global observing system must involve all agencies with programmatic and funding responsibility and must be responsive to scientific inputs and user needs. To this end, the Committee on Earth Observation Satellites (CEOS), a coordination group created as a result of the Group of Seven Economic Summit's Panel of Experts on Remote Sensing from Space, was expanded and strengthened at its recent November meeting in Brazil.

CGMS also noted that the International Polar Orbiting Meteorological Satellite Group (IPOMS) is likely to consider its main work as successfully completed next year and that the September 1990 IPOMS Plenary noted that some of its activities might be continued by CGMS.

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

E. METEOROLOGICAL SATELLITES AS PART OF WMO PROGRAMMES

E.1. World Weather Watch

There were no presentations under this item.

E.2 Other Programmes

ESA presented WP 2 which provided information on the provision of METEOSAT data to the ISCCP and GPCP programmes. Those countries who will be placing geostationary meteorological satellites in orbit in the near future (USSR, PRC) were strongly encouraged to participate in these programmes.

Both the PRC and USSR expressed a willingness to participate in these and other international programmes of the WMO when data from their respective satellite systems becomes available.

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

F. CO-ORDINATION OF INTERNATIONAL DATA COLLECTION & DISTRIBUTION

F.1 Status and Problems of the IDCS

F.1.1 ESA

ESA (WP-3) reported a considerable increase in the use of its DCP Retransmission System (DRS) such that the distribution of messages on magnetic tape was no longer required. Modifications of ASDAR processing software was expected to be completed during December 1990.

CGMS noted that several tools were available within the METEOSAT DCS for monitoring interference on channels, including the ESA Reference DCP, which uplinks a message containing pseudo-random code on each regional channel every hour. The received message provides information on the performance of each channel on a continuous basis. ESA proposed that the ESA Reference DCP might also be used to monitor the METEOSAT IDCS channels in the same way as for regional channels. This was agreed by the meeting subject to the allocation of suitable time slots. Once these time slots have been agreed they could be used by all satellite operators for monitoring IDCS channels.

CGMS endorsed the ESA proposal to monitor the "cleanliness" of all IDCS channels on a regular basis. CGMS Members agreed to investigate the possibility for regular interference monitoring of IDCS channels in addition to their Regional Channels.

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.**

F.1.2 EUMETSAT

In its WP-8, EUMETSAT summarised the current utilisation of IDCS channels. By the end of September 1990, 664 DCPs had been admitted to the total system (349 International DCPs) and around 91000 messages are being processed in the month. Most messages are still retransmitted via METEOSAT and around 38000 messages per month are injected in the GTS. 6 International Channels (I06, I07, I12, I14, I15 and I17) are currently in regular use. Channel I10 is available for use by future ships and ASAP vessels. CGMS noted that interference continues to be a problem and the monitoring of further channels in 1991, depending upon requirements, may be necessary.

Coordination of IDCS Data Bases

In response to CGMS XVIII Action 18.14, EUMETSAT (WP-9) proposed a procedure for the regular exchange of listing of DCP assignments on IDCS Channels between the meteorological satellite operators. This listing is designed to be exchanged either on floppy disk or via the EBB. EUMETSAT proposed the following:

FIELD DEFINITION

Explanation:	Format:
1. **DCP Address:**(8 characters)	aaaaaaaa
2. **Channel Number**: (2 characters) with leading 0 (zero) required, if necessary, for example 01, 10, 15	cc
3. **Time of First Transmission:** (6 characters) hh = hours mm = minutes ss = seconds leading zeros must be provided	hhmmss
4. **Repetition Factor**: (6 characters) pp = hours qq = minutes tt = seconds example of repetition factor of once every 3 hours: 030000	ppqqtt
5. **Name Field:** (20 characters)	nnnnnnnnnnnnnnnnnnnn
6. **Type of Data:** (6 characters) in coded form; if not applicable the field should be filled with zeros	dddddd
7. **Type of Processing**: (6 characters) in coded form; if not applicable the field should be filled with zeros	pppppp
8. **Reserved for future use:** (6 characters)	xxxxxx

CGMS considered that fields 1-5 were acceptable, however, the coordination of information fields 6 (type of data) and 7 (type of processing) would be required. For the time being, these fields would be set to 000000.

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

F.1.3 JAPAN

Japan WP-5 explained the procedures for the relay of IDCS ship messages via the MSC computer centre of the JMA. Problems caused by the unannounced change in a SEAS ship call sign were brought to the attention of CGMS.

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

The Secretariat added that this sort of problem would hopefully be eliminated in the near future once the procedures for the regular exchange of IDCS assignments had been implemented by all parties to the IDCS.

Japan WP-6 provided an updated listing of IDCS channel assignments. Following the installation of new ground processing facilities, JMA expected a further increase in the utilisation of this data relay service in the near future. In the Working Paper JMA also proposed monitoring of IDCS channel cleanliness to permit an adequate number of channel assignments. Japan noted that this proposal was reflected in Action 19.10.

F.1.4 USA

The USA submitted a paper (USA-WP-8) requesting CGMS members to consider support for the Global Sea Level Monitoring Programme (GSLMP) as an IDCS programme and make suggestions for its implementation.

EUMETSAT and Japan, noting that IDCS channels were intended for the use by mainly fixed platforms, preferred the use of regional channels from METEOSAT, GMS and GOES.

WMO commented that GSLMP was a programme coordinated under the World Climate Research Programme and, as such, qualified for use of the GTS for transmission of data, assuming the data would be in a standard WMO format.

EUMETSAT, Japan and USA agreed to discuss further the use of available DCP channels for this project.

F.2 Ships, including ASAP

F.2.1 JAPAN

Japan reported the status of ship DCP assignments (including ASAP) in its WP-7.

F.2.2 WMO

WMO WP-4 summarised the status of the ASAP programme, and provided CGMS with a report of the recently held ASAP Coordination Committee (ACC) meeting held in Helsinki, Finland, in September 1990. Several actions on EUMETSAT concerning the allocation of future ASAP vessels were identified at that meeting and brought to the attention of CGMS. CGMS noted that some ASAP data were being lost and that one of the actions requested the Secretariat to check that ASAP messages, being relayed through GMS, were being placed on the GTS.

USA requested further details of the flow of data from the ASAP to the end user, in order that it could check for possible sources of data loss.

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

F.3 ASDAR

Japan reported the status of ASDAR in its WP-8. CGMS noted that Japan is now ready to accept operational ASDAR coded messages.

US WP-9 and WMO WP-5 described the current status of the ASDAR System and its possible incorporation into the AMDAR concept. 13 ASDAR units were expected to be in operation by mid 1992. Further units may be purchased for operation after 1992. In addition some 50-60 Australian aircraft will be fitted with the VHF ACARS system (for more regional data relay) from 1992.

EUMETSAT and USA informed the meeting that they were now ready to accept coded data from operational ASDAR units. CGMS was pleased to note that the relay of ASDAR messages would be supported by future PRC and USSR geostationary meteorological satellites.

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

ESA indicated that there had been a considerable increase in the number of messages distributed on the GTS, however, this growth had been far exceeded by messages distributed using the DCP Retransmission System.

Japan reported the status of various DCPs. Japan also appreciated the cooperation of EUMETSAT in monitoring the data from the Japanese Antarctic stations.

The Use of CLS ARGOS for Non-Meteorological METEOSAT DCP Message Processing

In EUMETSAT WP-10, CGMS were informed that a contract with CLS ARGOS had been established for the processing of DCP messages requiring non-GTS coding. The contract came into force on 1 November 1990. The CLS ARGOS service would also provide "value added" data processing and a facility for world-wide data distribution.

F.5 Review of IDCS Users' Guide

CGMS recalled that the 6th edition of the International Data Collection System (IDCS) Users' Guide had been distributed in January 1988. Members were invited by the Secretariat to inform it of any errors in the document and to indicate where information required updating. The Secretariat was already aware that Annex 15 of the document, ASDAR, would require updating in order that revised section 3.2, dealing with the GTS format for data from operational ASDAR flight units could be included. CGMS were also informed that the document would be revised in 1991 to include modifications resulting from CGMS XVIII and CGMS XIX.

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.**

In its WP-10, Japan proposed a modification to the format of Annexes 12 and 14 of the IDCS Users' Guide as follows :

Modification	Annex 12	6. Channel Number
	Annex 14	5. Channel Number

CGMS agreed to adopt this proposal.

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.**

G. CO-ORDINATION OF DATA DISSEMINATION

G.1 Dissemination via Satellite

G.1.1 High resolution

A paper describing the real-time rectification of METEOSAT images was presented by ESA (WPs 5 and 6). The new scheme, which combines estimated parameters with those determined from the first part of the incoming data, was introduced on 13 November 1989. The net result for the user is that disseminated image formats are now available twelve minutes earlier than previously. As a follow-up to this scheme ESA is also looking into the possibility of real-time dissemination to further enhance the timely availability of image data.

ESA presented a paper (WP 7) on interference experienced on METEOSAT's High Resolution dissemination mission. This was first identified during a series of performance tests on METEOSAT-3 and METEOSAT-4. Regular performance measurements have indicated that the interference is not generated anywhere within the METEOSAT space or ground segment and generally does not appear at night or weekends. ESA has engaged the help of the Deutsche Bundespost to try and identify the source of the interference.

A further ESA paper (WP 8) described the results of a study relating to the compression and encryption of digital image data. The method of compression is based on coding pixel differences of successive counts and like the encryption system can be initiated by an indicator in the image data header. The encryption keys are handled by a key management system and the current dissemination system would need only to be modified by two "black boxes", one (encoder) at the ground station and one (decoder) at the receiving station. Testing of the system has shown a reliable performance of the system.

In EUM WP 12, CGMS learned that during 1990 several modifications were made to the transmission of METEOSAT High Resolution and Analogue images. The Working Paper, based primarily on the METEOSAT Dissemination Newsletter No 1/90, described these changes and included other information of interest to the user community.

Noting the success of the GMR, EUMETSAT asked Japan if it might be possible to acquire GMS imagery for relay over METEOSAT dissemination. Japan informed the meeting that in principle there was no problem with access to GMS data by EUMETSAT. EUMETSAT agreed to discuss the matter further with Japan on a bilateral basis in the near future.

In PRC-WP's 2 and 3 CGMS were informed that China has developed a meteorological satellite data receiving and processing system equipped with personal computer (see Annex V). CGMS noted that this system can receive and process data from polar orbiting HRPT and Geostationary S-VISSR and it takes less than two minutes to obtain a GMS map re-projection in this system.

G.1.2 Low resolution (WEFAX)

CGMS were informed that the USA WEFAX schedule had been modified to take account of a loss of GOES imagery. Should GOES-7 fail, most GOES images would be replaced by other products, such as polar images; the remainder of the schedule would remain unchanged. The USA also plans to implement the computer-readable code for WEFAX products which was proposed during CGMS XVIII. Two new computer systems are also planned to become operational by January 1991: the new WEFAX Transmission System (FXTS) and an automated signal strength monitoring and alarm system for the WEFAX and DUS antenna systems. The FXTS will result in increased efficiency allowing a decrease in the period of WEFAX transmissions from 5 minutes to 4 minutes.

Japan reported the status of its GMS digital header identification of existing WEFAX, in WP-11. CGMS were informed that at the present time Japan was not in a position to modify its header format, because it was already being used by so many (500) users. In response, EUMETSAT commented that since Japan had not raised any objections to the agreed new format by 1 April 1990 it had proceeded to implement the CGMS agreed digital header format.

CGMS recalled that it was important to properly coordinate this kind of technical issue thus developing a true "CGMS standard".

CGMS also noted that the Japan digital header would remain unchanged for the time being, whilst USA/EUMETSAT would adopt the standard defined at CGMS XVIII.

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

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

G.1.3 Digital WEFAX

Documents from EUMETSAT (WP-13) and the USSR (Annex XVIII) were presented on a digital transmission format to replace the present analogue WEFAX format. It was proposed that similar codes should be used on geostationary and polar orbiting satellites. The code to be used on geostationary spacecraft would be named "Low Rate Image Transmission (LRIT)" the corresponding code on polar satellites "Low Rate Picture Transmission (LRPT)".

The new code shall be based on packetized telemetry and shall make use of existing standards wherever possible. Reference was made to codes established by CCSDS.

The code shall allow transmission of image, alphanumeric, and binary data including grid, coastline, and other graphical information.

The document of the USSR delegation proposed a data resolution of 3 x 3 km at swath width of about 3000 km, 8 bits/pixel resolution, and 3 - 5 different image data channels for LRPT.

The recommended data rate shall be in the order of 64 - 128 kbit/sec.

The design of low cost user stations with a performance figure of 2.5 Db/K (similar to present METEOSAT SDUS stations) shall be targeted. This will allow the use of small antennae with diameters between 1 and 2 m. The data processing facility should be PC based.

Due to heavy disturbance in the envisaged frequency band for LRIT it is highly recommended to use forward error correction methods. Several candidate codes were presented.

It was stressed that the acceptance of an international standard for LRIT and LRPT would allow the development of "Very Large Scale Integrated Circuits (VLSI)" for decoding of data.

CGMS noted that further studies on the most suitable packets sizes, telemetry format, modulation techniques, and detailed frame structures will be necessary.

The USSR also presented their proposals for digital data transmissions in APT mode. The USSR supported the approach taken by EUMETSAT, which was consistent with its own proposals. The USA also supported the EUMETSAT concepts. All Members considered that it was necessary to agree a standard quickly, for both polar and geostationary digital transmissions so that a single digital standard can replace APT and WEFAX respectively. The goal should be to agree on the standard during the next meeting of CGMS.

In the mean time CGMS agreed that digital WEFAX shall be known as LRIT (Low Rate Image Transmission) and digital APT as LRPT (Low Rate Picture Transmission). In order to achieve an agreed definition at an earlier date the following actions were agreed:

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

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

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

G.1.4 Other Product Dissemination

PRC informed the meeting that various FY-2 data dissemination schemes are currently under consideration. They are S-VISSR, LR-FAX ad S-band WEFAX. The S-VISSR and LR-FAX are compatible with those of GMS. The S-band WEFAX is designed to transmit synoptic charts and satellite images to small scale meteorological user stations.

Status of the MDD Mission

A report on the current status of the METEOSAT Meteorological Data Distribution (MDD) mission was presented in EUMETSAT WP-14. Following a successful demonstration phase, systems will now be located at two African Centres for a longer term evaluation by EUMETSAT and the WMO.

Provisional schedules of MDD products have been developed for this demonstration phase to allow manufacturers to develop MDD user stations. A more comprehensive product schedule will be implemented following the encryption of MDD broadcasts, expected by the end of 1991.

Japan commented that MDD would appear to be a very effective medium for the transmission of all types of weather information to data sparse regions. WMO and Japan requested EUMETSAT to consider the inclusion of Antarctic areas products in future MDD transmission schedules. WMO agreed to provide EUMETSAT with information on Antarctic products.

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

G.2 Dissemination via GTS or other means

No Working Papers were presented under this Agenda Item.

REPORT FROM THE TELECOMMUNICATIONS WORKING GROUP

The newly created CGMS Working Group I met to consider primarily matters relating to Radio Frequency Coordination (A participants list can be found in Annex XVII).

I/1. Co-ordination of Frequency Allocations

I/1.A Interference between GMS 3, 4 and FY2

Japan and PRC presented their WPs-12 and 6, respectively, on the results of studies carried out by Japan and the PRC. The two sides concurred in the conclusion that no interference will occur in the absence of ranging operations. For ranging, there may be minor interference from GMS-4 at 140 degrees E to FY-2 at 105 degrees E. In addition there would certainly be interference between FY-2 and GMS-3, located at 120 degrees E. The agreed upon resolution was as follows:

ACTION 19.23	**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).**
ACTION 19.24	**Once informed of the schedule of ranging operations for FY-2 by the PRC, Japan will schedule ranging for GMS-3 to avoid interference.**

CGMS noted that this will be possible because GMS-3 is a standby spacecraft for which only occasional ranging operations are required.

Item I/1.B Interference between FY1-B and METEOSAT

EUMETSAT informed Working Group members that interference caused by FY-1B was being encountered in the METEOSAT reception area. Measurements had shown that transmissions at 1695.5 MHz, having a bandwidth of 20 MHz, produced signal levels which exceeded the second METEOSAT dissemination channel (1694.5 MHz) by 10 dB and the Meteorological Data Distribution (MDD) channels by 20 dB. Interference occurred for a period of 2 - 5 minutes, depending upon antenna diameter. A telex from EUMETSAT to the State Meteorological Administration (SMA) of the PRC (and supported by WMO) requested that FY-1B be switched to its back-up frequency of 1704.5 MHz as agreed at CGMS XVIII. Because this did not produce a response, the French PTT (the official registration agency for satellites launched by ESA) approached the IFRB. As of the date of the meeting, the interference was still present.

The PRC informed CGMS that two independent down link frequencies will be required for the operation of future polar orbiting spacecraft of the PRC and that cycling the downlink transmitter off and on is technologically difficult. CGMS requested prior coordination of such frequencies.

The PRC inquired whether the interference problem could be solved by re-scheduling some METEOSAT transmissions. EUMETSAT responded that this is not possible due to the different location of the various user stations which implies that interference could occur at any time in the transmissions schedule.

EUMETSAT repeated its request to the PRC to ensure that interference caused by FY-1B will be stopped at the earliest possible date.

ACTION 19.25 **SMA to transmit the EUMETSAT request for a cessation of interfering transmissions to the Chinese frequency authorities.**

CGMS recalled that because FY-1B had not been registered with the IFRB, there was no opportunity for other administrations to comment on potential interferences. It was explained that where there was interference between polar and geostationary satellites, by international agreement, priority was given to geostationary satellites.

(FY-1B interference finally ceased in February 1991).

I/1.C Coordination of Satellite Frequencies

EUMETSAT presented document WP-16 on the coordination of satellite frequencies. It was explained that the frequency band 1670-1710 MHz is used as follows:

1670 - 1690 MHz	Main down-links for unprocessed data and satellite control telemetry (e.g. central reception sites)
1690 - 1698 MHz	Direct transmissions from geostationary spacecraft to user stations
1698 - 1710 MHz	Direct transmissions from polar orbiting satellites to user stations and central data acquisition stations.

This separation is based on the fact that different power limits are allowed in the various sections of the band and to avoid interference between the various systems. Main data down links in the band 1670 - 1690 MHz are operated towards central stations which are equipped with larger antennae. The more restricted power limits in this part of the band due to neighbouring radioastronomy bands could therefore be compensated.

The separation between direct transmissions of geostationary and polar orbiting systems was made to guarantee interference free operations of both types of user stations. CGMS agreed to provisionally adopt the above separation of transmission into the three different bands.

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 CGMSXX.**

CGMS agreed that prior coordination of frequency management matters in the planning stages of new satellite programmes is becoming of critical importance because of the desirable increase in meteorological satellite services without corresponding increases in available frequency bands. WMO pointed out that it was highly preferable to pre-coordinate such matters among colleagues who know and understand the nature and importance of meteorological satellites, rather than entrusting such decisions to the formal procedure of the IFRB where considerations might be political and somewhat bureaucratic. For example, a possible decision by ITU/IFRB could be to force movement of meteorological satellite operations from 1670 - 1710 MHz to the Ku band. This would be extremely costly for both the meteorological satellite operators and their users.

I/2 Preparation of the World Administrative Radio Conference (WARC 92)

Documents EUMETSAT WP-15, Japan WP-13 and WMO WP-6 were presented to indicate potential problems related to requests for frequency band allocations to be discussed during WARC-92.

The main problem areas for CGMS Members appear to be:

1. The allocation of frequency bands 2025-2110 MHz and 2200-2290 MHz to space operations services.

2. Requests for mobile services for co-allocation in the band 1670-1710 MHz presently allocated to "Meteorological Satellite Services" on a primary basis.

3. Allocation of wind profiler systems.

4. Allocation within the band 402-406 MHz.

CGMS noted that several Members were involved in preparatory meetings for WARC-92 at both national and international levels.

The present status of discussions could be summarized as follows:

a) Consensus has been reached that space operations services shall be upgraded within the frequency bands 2025-2110 MHz and 2200-2290 MHz from their current footnote allocation to a primary status in the table of frequencies in the radio regulations. However, there is still a request from mobile service operators to be equally allocated within parts of the band. The exact partition of the band is still under discussion.

b) Mobile services have forwarded requests for primary allocation within the frequency band 1670-1710 MHz which is the major band for meteorological satellite operations. Detailed requests were forwarded to accommodate "Terrestrial Flight Telephone Services" within the band 1700-1710 MHz which is used for direct read-out services of polar orbiting meteorological satellites. Sharing of these services with mobile services would be difficult if not impossible.

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 the member states to protect the interests of meteorological satellite services within this band.**

CGMS were informed that during discussions within the working groups dedicated to WARC-92 it was realized that only a few meteorological user stations were officially registered with their national authorities. It was noted, in particular, that only registered stations can be protected against interference.

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

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

c) CGMS also noted that CCIR has been made aware of concerns for the allocation of frequencies for wind-profilers (around 406 MHz). Harmful interferences have occurred to the COSPAS-SARSAT satellite based distress system caused by wind-profilers operating in the band 402-406 MHz. Interference to the IDCS can also be expected.

Based on these concerns, CCIR agreed to tackle a new issue in the study period 1990-1994 whereby the most suitable frequency bands for the operation of such systems will be studied, including criteria for sharing with other services. CGMS noted that WMO had submitted a document on this matter to the relevant CCIR Interim Working Party (IWP 8/15). The document advocated possible frequencies for wind-profilers outside the 401-406 MHz band preferably the 420-450 MHz band.

CGMS noted that as part of the justification for a frequency allocation in the 420-450 MHz band, wind-profilers should be identified as radio-location devices. CGMS agreed that wind profilers are radio-location devices and that several reports have confirmed this.

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

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

d) WMO presented a draft proposal for upgrading the allocation of the band 401-403 MHz to the Meteorological Satellite (earth-to-space) Service to a primary service. This draft proposal was circulated to WMO Members for comments and support has been received by 25 Members. CGMS noted that consideration of problems associated with the use of the frequency bands in the range 401-403 MHz will be an agenda item for WARC-92. In preparation for WARC-92, WMO has submitted a document on this matter, including the draft proposal to the CCIR Joint Interim Working Party entrusted with studies preparing for WARC-92.

CGMS urged all Members to notify their national telecommunication administration, which will relay the notification to IFRB, all relevant information related to the operation of radio-communication stations and frequencies assigned in the framework of the Meteorological Satellite Services.

When reviewing areas of responsibility for coordination, CGMS felt it appropriate that satellite operators should coordinate with their national entities and/or membership and their user community. It also noted the important and effective note played by WMO through its Membership.

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 will conduct notification campaigns with respect to frequency issues through its Members and within the UN system including ITU and FAO.**

I/3 Progress with Electronic Bulletin Boards (EBB)

In addition to the information referred under Action Item 18.40 above, working papers EUM WP-17, Japan WP-14, and USA WP-11 were presented. Contained in the EUMETSAT and USA Working Papers were instructions for accessing the

METEOSAT and NOAA EBB's, respectively. CGMS noted that Japan would not "host" an EBB for the time being. The WMO suggested that a CGMS EBB for CGMS Members only would be very useful.

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.**

I/4 Other Related Items of Interest

The USSR presented an informal information paper describing the technical characteristics of Meteor-3M and GOMS (Annex XVIII).

REPORT FROM THE SATELLITE PRODUCTS WORKING GROUP

CGMS Working Group II met for the first time to discuss satellite products in general, the possibilities for improvements in terms of quantity and quality thus enhancing their use in numerical weather prediction schemes. A list of participants can be found in Annex XVII).

II/1 Satellite Data Calibration

Two papers were presented in this section. ESA presented WP-9 which gave a brief description of the techniques used for calibrating the infrared and water vapour channels of Meteosat. As an attachment to this paper were the results of a recent campaign to determine the absolute calibration of the Meteosat-4 visible channel. (Annex VI).

WP-15 from Japan presented a statistical analysis, using ISCCP B1 data, which showed that the sensitivity of the GMS-3 visible channel had degraded on average by more than 3% per year, probably due to degradation of the photo-multiplier tube.

CGMS expressed an interest in the IR calibration techniques used by Japan for GMS.

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

II/2 Meteorological and Other Parameter Extraction

Papers presented in this section covered a variety of topics. Firstly, three papers (from Japan, ESA and USA) described the latest techniques which had been introduced for determining wind vectors from cloud motion. These were followed by three papers (from USA, ESA and EUMETSAT) relating to the quality assessment of cloud motion winds.

Japan WP-16 (Annex VII) reported recent improvements in the accuracy of Cloud Motion Winds (CMWs). Representative heights are determined on the basis of statistical level of best fit between CMW and radiosonde winds. The operational table of statistical wind heights was updated on 1st April 1990. In the new table, heights are given for each decade of latitude and for each month. The cause of low speed bias along jet streams was also reported in the paper which indicates the possibility of improvement of accuracy in the future.

CGMS noted the report (USA WP-14) by the USA on a new method of estimating the height of satellite winds using a two channel "$C0_2$ slicing" approach. Operational implementation of this technique four times a day is scheduled to begin in early 1991. Great interest was shown in this technique, particularly as regards future satellite programmes. The Working Group noted that this paper completed Action item 18.28 from CGMS XVIII.

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

ESA working papers (WP-10, WP-11) described the new cloud motion wind retrieval scheme using infrared data and some statistics on the comparison of data with allocated radiosondes. WP-10 also provided information on studies performed to extract wind information from the water vapour and visible channel data.

It was clear from all the above papers that concerted efforts to improve the quality of the derived wind product are still being made and showing positive results. The group congratulated Japan on the recent improvement in the GMS high level wind speed bias. Some evaluation statistics are also provided in Annex VII. Two further papers relating to winds, both presented by EUMETSAT, were related to international efforts aimed at improving the wind products, namely the 1990 COSPAR Winds Meeting, an international wind campaign and an International Wind Workshop, establishing a similar group to that which already exits for TOVS processing. The meeting noted that the first international workshop will be in Washington in September 1991 (Annex VIII refers). EUMETSAT urged all Members to participate if at all possible.

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

The Group stressed the need to continue to monitor and improve cloud winds and re-iterated the need to exchange monthly wind evaluation statistics.

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

The second part of this section was dominated by a series of eight papers from the USSR describing a variety of applications using satellite data. Particularly in the Uzbek Republic, satellite data are extremely important due to the lack of conventional data from countries to the south, a region which considerably effects the weather of the Uzbekistan.

The 8 Working Papers presented by the USSR covered the following issues:

WP-1 Forecast of Cloud formation movement using the technical facilities of the Central Asian Regional Computer Centre;

WP-2 Technology of automated satellite data processing for evaluation of snow cover in the plains of Central Asia and South Kazakhstan and the rangeland vegetation in the plains of Uzbekistan;

WP-3 Application of analogue satellite data on the basis of synoptic interpretation carried out in the Uzbek Hydromet Service;

WP-4 Evaluation of snow resources in mountains using satellite data;

WP-5 Application of satellite data for the evaluation of forage reserves of desert pasture vegetation;

WP-6 Application of satellite cloud data for reconstruction of pressure fields (P_o, H_{500}) over the southern part of Central Asia on the basis of regression models of P_o, H_{500} fields and weighting functions of cloudiness.

WP-7 Application of satellite data for probabilistic analysis of snow cover extent in a mountain region;

WP-8 Remotely sensed meteorological products from "Meteor" polar orbiting satellites.

USSR-WP-1 provided a summary of satellite applications in the Uzbek region using not only data from the Meteor-2 and 3 satellites but also NOAA data (Annex IX). USSR WP-8 gave a review of meteorological parameter extraction from Meteor data (Annex X). The characteristics of temperature soundings and SST estimates from Meteor-2, 3 satellites are discussed in this paper. On the basis of the results of Meteor temperature sounding validation and accuracy estimation, which is to be performed with the participation of the ECMWF, recommendations as to distributing these data over the GTS will be made.

The USA described its recent cooperation with the USSR Marine Hydrophysics Institute. They described arrangements to exchange satellite data and in situ meteorological and SST data with the USSR Marine Hydrophysics Institute under the auspices of the Earth Sciences Joint Working Group (ESJWG) of the US-USSR Space Bilateral Agreements. The USA noted the potential benefits of Goscomhydromet participation in this Working Group.

Other papers presented in this section included a redefined Meteosat SST product (ESA WP-12) and the use of water vapour imagery for clear air turbulence identification (USA WP-13).

Japan (WP-19) reported the status of RSMC-Tokyo in which the GMS data are contributing. In this paper, aspects of the Special Experiment concerning Typhoon Recurvature on Unusual Movement (SPECTRUM) was also reported.

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

Three papers were presented in this section. Information was provided on the results on the workshop organised by EUMETSAT on "The use of Satellite Data in Nowcasting and Very Short Range Weather Forecasting" (EUM WP-20) held in July 1990. Two further papers (USA WP-15, USA WP-16) provided information on VAS and NOAA-KLM products. CGMS reviewed the list of new products for the NOAA-KLM (Annex XI) satellite series, noting that over the coming year substantial additions and changes may be made to the data processing algorithms. The Working Group noted that USA WP-15 completed Action 18.32 from CGMS XVIII.

II/4 Archiving and Retrieval of Satellite Data

The two papers in this section provided information on the archiving system for Meteosat based now on tape cartridges (ESA WP-13) and on the NOAA data archive (USA WP-17). Interest was shown in the scheme used by ESA (see Action below). Regarding data archiving, CGMS noted the need to coordinate data formats and standards. It was also noted that the recent expansion of the Committee on Earth Observation Satellites (CEOS), with its Working Group on Data, should help to facilitate such coordination (USA WP-17. This information completed Action 18.34).

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

The reader should note that an address list for the purchase of archive material can be found in Annex XIV.

<u>**Status of relevant Actions from CGMS XVIII**</u>

18.3 Meteor-3 sounding on GTS. This is addressed by USSR-WP-8; attached as Annex X. There are plans to evaluate these soundings in ECMWF. When this is completed a decision on the distribution of these data will be taken. (The action is continuing).

18.25 Typhoon CMV information over the GTS. This is addressed by Japan WP-19 and Japan WP-17. Japan already transmits Typhoon movement information to affected countries. The special winds are used within the Japanese Forecast Division mainly to define the Typhoon location and intensity. Their verification will take a long period of time but if they are found to have useful data quality Japan would, in due course, transmit them over the GTS. (This action is closed).

18.28 USA to provide details of its new wind extraction method. (This action is closed by USA WP-14).

18.31 Concerning a CGMS sponsored International Wind Retrieval Group. This action is closed by papers EUM WP-18 (report on the 1990 COSPAR meeting) and the attached invitation to a Wind Workshop in Washington in September 1991 (Annex VIII).

18.32 The USA to provide information describing VAS products. This item is closed by paper USA WP-15.

18.33 CGMS members to determine if there is a general requirement for VAS products. There have been no inputs on this subject so the action is continuing .

18.34 USA Archive details. This action is closed by USA WP-7.

H. OTHER ITEMS OF MORE GENERAL INTEREST

H.1 International Space Year (ISY)

EUM-WP-22 described the current planning of activities for the International Space Year (ISY) 1992. Full details of current and future activities can be found in Annex XII.

In US WP-18 CGMS was informed about the various activities of NOAA in connection with ISY. NOAA became a full member of SAFISY at its 1990 Plenary Meeting in Kyoto, Japan. CGMS noted in particular that NOAA, using the TOVS sounder, had developed an effective tool for detecting polar ozone holes.

CGMS also noted that WMO had been accepted as an affiliate member of the SAFISY during the Kyoto Meeting in Japan in May 1990 (WP-3 refers).

H.2 Publications by CGMS Members

Directory of Meteorological Satellite Applications

In EUM-WP-23, CGMS noted that a first version of the Directory of Meteorological Satellite Applications was nearing publication.

CGMS Members had previously expressed an interest in jointly producing a similar publication focusing on global applications and the benefits of meteorological satellite data.

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

Other EUMETSAT Publications

In EUM W-24, CGMS Members noted the current list of publications available from EUMETSAT. Two additional publications in the series of Proceedings were expected early in 1991:

EUM P07 - Proceedings of the Workshop on the Use of Satellite Data in Nowcasting and Very Short Range Forecasting, held in Shinfield Park, UK, (now distributed).

EUM P08 - Proceedings of the 8th METEOSAT Scientific Users Meeting, held in Norrköping, Sweden (see below).

8th METEOSAT Scientific Users Meeting

EUM WP-25 presented a summary report on the 8th METEOSAT Scientific Users Meeting, held in Norrköping, Sweden, from 28th to 31st August 1990. CGMS noted that the Proceedings of this conference were nearing completion and copies would be distributed to CGMS Members early in 1991.

H.3 Application of Meteorological Satellite Data in the Fields of Earth Environment Monitoring

In its WP-7 CGMS were informed by PRC how satellite images were being used for the monitoring of e.g. forest fires, floods, estimating the amount of pasture biomass, monitoring of continental snow cover, analysis of ocean flow, the identification of fishing areas and the study of silt diffusions from river mouth (selection of suitable sites for ports), (Annex XIII refers).

H.4 Search and Rescue

USA WP-19 summarized the benefit to be derived from a geostationary distress alerting system and provided an explanation of the planned US operational system beginning with GOES-I.

EUMETSAT informed the meeting that a concept for Search and Rescue was being studied at the engineering level for MSG. USA stated that EUMETSAT and other Members of CGMS considering Search and Rescue systems would be invited to the forthcoming COSPAS-SARSAT Meeting in Washington.

CGMS Members were of the opinion that the USA should continue to act as the point of liaison between CGMS and Search and Rescue activities

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.**

ACTION 19.41 **USA to provide information to CGMS Members on the COSPAS-SARSAT ad hoc meeting on geostationary Search and Rescue systems, (distributed with this report).**

H.5 Anomalies from Solar and Other Events

Japan WP-18 described the degradation of output power from the solar panel of GMS-3 during October 1989.

In response to a question from the PRC, USA informed the meeting that no unusual anomaly had occurred during the month of October 1990. Japan added that at the present time no equivalent data were available from GMS-4 (launch September 5, 1989).

USA WP-20 provided information on the database, maintained by NOAA's National Geophysical Data Center (NGDC), anomalous spacecraft behaviour attributed to environmental interactions. The paper presented comprehensive information about the database itself and its capabilities. A copy of the Spacecraft Anomaly Manager (SAM) database user documentation was distributed to Members.

In response to Action 18.49 the USA provided each CGMS delegation with a copy of the US National Geographical Data Centres SAM database and applicable software. CGMS Members were encouraged to familiarize themselves with the SAM database and to use it to provide updates on satellite anomalies with their satellites to NGDC.

J. SENIOR OFFICIALS MEETING

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 was 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 Annexes, within a few weeks for final approval prior to publication.

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

The Senior officials expressed their satisfaction at the multitude of topics addressed during CGMS XVIII and by both of the newly created Working Groups. The importance of the work of both these Groups was recognised and the Senior Officials stressed that they should continue their activities at future meetings of CGMS. They further noted that due to the urgency of some of the discussions within the Telecommunications WG and the need for some early agreements on solutions to the interference problem there might be a requirement for an ad hoc meeting before the next plenary session of CGMS. The discussion within this WG had shown the need for coordinations by all parties through meetings held at regular intervals.

The Senior Officials requested the Secretariat to foreword a report on this matter, based on the Report of the Telecommunications WG, to the Space Frequency Coordination Group (SFCG).

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).**

The Chairman of the Working Group on satellite products considered that it was extremely valuable to have a separate session dealing with these topics and expressed the wish that the work would continue in future sessions of the CGMS.

J.3 Any other business.

There was no other business.

J.4 Date and place of next meeting

The CGMS was pleased to accept an offer made by Japan to host CGMS-XX in Tokyo in February 1992. An offer to host CGMS-XXI in Beijing, China in April 1993 was noted by CGMS.

K. SUMMARY LIST 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.**
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.**
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.**
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.**
ACTION 19.5	**EUMETSAT to provide CGMS members with information on the spectral resolution requirements for its proposed advanced IR sounder and/or interferometer.**
ACTION 19.6	**EUMETSAT to inform EO-ICWG about USSR concerns over spacecraft compatibility and to request if information from the EO-ICWG CIIS can be made available to CGMS members.**
ACTION 19.7	**The USA and EUMETSAT to prepare a paper on future direct broadcast standards.**
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.**
ACTION 19.9	**WMO to provide PRC and USSR with details of the data requirements of the ISCCP and GPCP programmes.**

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.**
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.**
ACTION 19.12	**The Secretariat to make a proposal for the content of fields 6 & 7 of the exchange file format, based on inputs provided by CGMS members under Action Item 19.11, in time for the next meeting of CGMS.**
ACTION 19.13	**USA to investigate why the call sign of ship with ID A69591FA was changed without notification to JMA.**
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.**
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.**
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.**
ACTION 19.17	**Japan to provide CGMS with full details of its current WEFAX digital header information.**
ACTION 19.18	**The Secretariat to include both the Japanese and the EUMETSAT/USA versions of the WEFAX digital header in the Consolidated report.**
ACTION 19.19	**All Members of CGMS to study the preliminary definition of LRIT/LRPT, as proposed in document EUM-WP-13, and to transmit comments and proposals to the Secretariat before 1 April 1991.**

ACTION 19.20	**EUMETSAT to prepare a detailed LRIT/LRPT definition and submit it to Members 3 months before the next meeting of CGMS.**
ACTION 19.21	**All Members to come to CGMSXX fully prepared to discuss and agree the definition of LRIT/LRPT formats.**
ACTION 19.22	**EUMETSAT to study the possibilities to include Antarctic region charts and products recommended by WMO in routine MDD broadcasts.**
ACTION 19.23	**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).**
ACTION 19.24	**Once informed of the schedule of ranging operations for FY-2 by the PRC, Japan will schedule ranging for GMS-3 to avoid interference.**
ACTION 19.25	**SMA to transmit the EUMETSAT request for a cessation of interfering transmissions from FY-B to the Chinese frequency authorities.**
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 CGMSXX.**
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.**
ACTION 19.28	**WMO to request Member states to formally register meteorological satellite user stations with their national authorities.**
ACTION 19.29	**All CGMS Members to inform users to register user stations within their responsibility.**

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

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.

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 will conduct notification campaigns with respect to frequency issues through its Members and within the UN system including ITU and FAO.

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.

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

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

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

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

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

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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.**
ACTION 19.41	**USA to provide information to CGMS Members on the COSPAS-SARSAT ad hoc meeting on geostationary Search and Rescue systems (distributed with this report).**
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).**

ANNEXES TO THE FINAL REPORT OF CGMS XIX

LIST OF ABBREVIATIONS AND ACRONYMS

ACARS	Automated Communications Addressing and Reporting System
ACC	ASAP Coordinating Committee
ADC	Atlantic Data Coverage
AMDAR	Aircraft Meteorolical Data Relay
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
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)
EO	Earth Observation
ESA	European Space Agency
ECMWF	European Centre for Medium range Weather forecasts
EPS	EUMETSAT Polar System

ERBE	Earth Radiation Budget Experiment
ESJWG	Earth Sciences Joint Working Group
ESOC	European Space Operations Centre
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	WEFAX 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 (USSR)
GSLMP	Global Sea Level Monitoring Programme
GPCP	Global Precipitation Climatology Project
GTS	Global Telecommunications System
GVAR	GOES Variable (data format) (USA)
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
ISCCP	International Satellite Cloud Climatology project
ISY	International Space Year
ITU	International Telecommunications Union
JMA	Japanese Meteorological Agency
LR	Low Resolution
LRIT	Low Rate Image Transmission
LRPT	Low Rate Picture Transmission
LST	Local Solar Time
MCP	Meteorological Communications Package
MDD	Meteorological Data Distribution (Meteosat)
METEOSAT	European geostationary meteorological satellite
MIVSA	Multi-channel Microwave Scanning Radiometer (USSR)
MOP	Meteosat Operational Programme
MSC	Meteorological Satellite Centre (Japan)
MSG	Meteosat Second Generation
MSU	Microwave Sounding Unit
MTP	METEOSAT Transition Programme

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
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
PTT	National Post and Telecommunications Authority
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
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 (Peoples Republic of China)
S-VISSR	Stretched VISSR
SST	Sea Surface Temperature
SSU	Stratospheric Sounding Unit
TOMS	Total Ozone Mapping Spectrometer
TOVS	TIROS Operational Vertical Sounder
UN	United Nations
UTC	Universal Time Coordinated
VAS	VISSR Atmospheric Sounder
VHF	Very High Frequency
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 XIX, TASHKENT, USSR, 10-14 DECEMBER 1990

PLENARY SESSION

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 Comments on Consolidated Report

A.7 Terms of Reference for CGMS

B. REPORT ON THE STATUS OF CURRENT SATELLITE SYSTEMS

B.1 Polar Orbiting Meteorological Satellite Systems

B.1.1 *People's Republic of China*
B.1.2 *USA*
B.1.3 *USSR*

B.2 Geostationary Meteorological Satellite Systems

B.2.1 *EUMETSAT*
B.2.2 *India*
B.2.3 *Japan*
B.2.4 *USA*

C. REPORT ON FUTURE SATELLITE SYSTEMS

C.1 Polar Orbiting Meteorological Satellite Systems

C.1.1 *EUMETSAT*
C.1.2 *Japan*
C.1.3 *People's Republic of China*
C.1.4 *USA*
C.1.6 *USSR*

C.2 Geostationary Meteorological Satellite Systems

C.2.1 *EUMETSAT*
C.2.2 *India*
C.2.3 *Japan*
C.2.4 *People's Republic of China*
C.2.5 *USA*
C.2.6 *USSR*

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.1.1 *ESA*
F.1.2 *EUMETSAT*
F.1.3 *Japan*
F.1.4 *USA*

F.2 Ships, including ASAP

F.2.1 Japan
F.2.2 WMO

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 *Digital WEFAX*
G.1.4 *Other product Dissemination*

G.2 Dissemination via GTS or other means

PARALLEL WORKING GROUP SESSIONS

WORKING GROUP I - TELECOMMUNICATIONS - FIRST SESSION

I/1 COORDINATION OF FREQUENCY ALLOCATIONS

I/2 PREPARATION OF WARC-92

I/3 PROGRESS WITH ELECTRONIC BULLETIN BOARDS (EBB)

I/4 OTHER RELATED ITEMS OF INTEREST

I/5 PREPARATION OF REPORT TO SENIOR OFFICIALS

WORKING GROUP II - SATELLITE PRODUCTS - FIRST SESSION

II/1 SATELLITE DATA CALIBRATION

II/2 METEOROLOGICAL & OTHER PARAMETER EXTRACTION

II/3 NEW PRODUCTS & THEIR USE IN NUMERICAL WEATHER PREDICTION

II/4 ARCHIVING AND RETRIEVAL OF SATELLITE DATA

II/5 PREPARATION OF REPORT TO SENIOR OFFICIALS

PLENARY SESSION

H. OTHER ITEMS OF MORE GENERAL INTEREST

H.1 International Space Year

H.2 Publications by CGMS Members

H.3 Applications of Meteorological Satellite Data in the Fields of Earth Environment Monitoring

H.4 Search and Rescue (S&R)

H.5 Anomalies from Solar and Other Events

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

K. SUMMARY LIST OF ACTIONS FROM CGMS XIX

WORKING PAPERS SUBMITTED TO CGMS XIX

(Agenda Item in Brackets)

ESA

ESA-WP-1	Report on the Status of the Current Meteosat satellites (B.2.1)
ESA-WP-2	Meteosat support to WMO Programmes (E.2)
ESA-WP-3	Status and Problems of the Meteosat IDCS (F.1)
ESA-WP-4	Meteosat dissemination via the GTS (F.4)
ESA-WP-5	Real Time Rectification of Meteosat images (G.1.1)
ESA-WP-6	Real Time Dissemination (G.1.1)
ESA-WP-7	Performance measurements/interference of HR dissemination (G.1.1)
ESA-WP-8	HR dissemination - progress with compression and encryption (G.1.1)
ESA-WP-9	Calibration of Meteosat radiometric channels (II/1)
ESA-WP-10	Cloud motion wind retrieval from Meteosat images (II/2)
ESA-WP-11	Meteosat cloud motion wind comparisons with radiosondes (II/2)
ESA-WP-12	Redefinition of the Meteosat SST product (II/2)
ESA-WP-13	Meteosat Archiving (II/4)

EUMETSAT

EUM-WP-1	Review of Action Items (A.5)
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EUM-WP-3	Terms of Reference for CGMS (A.7)
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ANNEX IV
CGMS XIX WP-1
Agenda Item B.2.2
Prepared by India

REPORT ON STATUS OF INSAT-I SYSTEM

1. Status of INSAT-IB

i) INSAT-1B was launched on 30th Aug.1983and declared operational from 15th Oct. 1983. It has worked satisfactorily for about 7 years except for a brief loss of earth lock in Aug.1984,resulting in temporary disruption of services for about 36 hours. The Satellite was maintained in its designated orbital position(74°E ± Ø.1°).

ii) Once again on 17-10-89 and 20-10-89, there were two instances of loss of earth lock. Immediately after these events the Space craft was put on safe. Sun acquisition mode and subsequently manoevers to re-acquire earth lock and operationalise the space craft in the normal mode were carried out successfully.

iii) INSAT-1B operating from 74°E continued to be primary operational satellite till 17 July,1990 when operations were shifted to INSAT-1D.

2. Status of INSAT-C

INSAT-IC,the on orbit spare of INSAT-IB was launched by ARIANE-3 launch vehicle into a geostationary orbit on 22nd July 1988. Due to a massive short in one of the two power fuses on board the spacecraft, only about 50% of the total required power was available to operate various payloads of the satellite. It was possible to operate both meteorological pay loads(VHRR) and the DRT.

On 22nd Nov.1989 INSAT-IC experienced loss of earth lock.Currently it is not available for operational use.

3. Status of INSAT-1D

INSAT-1D, the last Satellite in the present INSAT-I services of Satellite was launched successfully on 12th June 1990 from Cape Canaveral,USA and declared operational on 17th July 1990. INSAT-1D has been placed at 83°E position and it has replaced the previously operational INSAT-IB Satellite at 74°E. All operations of earth imaging were shifted from INSAT-1B to INSAT-1D.

4. Operational use of INSAT-ID

Like previously operational INSAT-1B satellite, INSAT-1D Meteorological data are being processed on operational basis at Meteorological Data Utilisation Centre(MDUC) located in IMD, New Delhi. The 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 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 06Z 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 and are transmitted over National Meteorological Telecommunication network for utilization within India and over GTS of WMO for international utilization.

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 LONGWAVE RADIATION:

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

e) The cloud imagery data obtained from INSAT1B/IC are being transmitted every three hours in analog facsimile mode to the 20 Secondary Data Utilisation Centers(SDUCs)located at various important forecasting offices of the Department in the country, through dedicated communication links.

4. INSAT-1D also provides the following two communication service for meteorological purposes:

i) A scheme for dissemination of cyclone warnings through INSAT directly to the coastal areas likely to be affected, is in operation since January, 1986. This scheme called INSAT Disaster Warning System(DWS)has been initially implemented on an experimental basis in some selected coastal areas of India. The performance of this scheme has been found to be satisfactory on an operational basis when the cyclonic storms affected the area during 1987,1989 and May 1990. Under this scheme 100 DWS receivers have been deployed in the field for reception of cyclone warnings through INSAT.

In this scheme cyclone messages originating from the Area Cyclone Warning Centre, Madras are transmitted to INSAT from an Earth Station near Madras. The S-band transponder of INSAT receiver and relays back these signals over the Indian Territory for direct reception by DWS receivers. The signals selectively address specific DWS receivers.

ii) Scheme for Meteorological Data Dissemination (MDD) through Satellite using TV broadcast capability of INSAT-1D is also under implementation. With this scheme it will be possible to receive data at secondary location directly from the satellite.

ANNEX IV
CGMS XIX WP-2
Agenda Item C.2.2
Prepared by India

REPORT ON THE FUTURE SATELLITE SYSTEM

INSAT-II SYSTEM

Based on the experience of INSAT-I Series, Govt. of India has decided to continue the Indian National Satellite (INSAT)Programme by launching a second generation of Indian National Satellite(INSAT-II) System on an operational basis from mid 1990s. The first two satellites of INSAT-II series one is being fabricated indigenously by the India Space Research Organisation(ISRO)Satellite Centre,Bangalore to meet the requirements of various user agencies. INSAT-II Satellites will eventually replace the currently operational INSAT-I Satellite Series in a phased manner. Critical design review (CDR) of INSAT-II is likely to be held shortly. The firs Satellite of INSAT-II series is expected to be launched in Nov./Dec.91 using Ariane Launch Vehicle. Like INSAT-I it will be also be a multipurpose, three axis stabilized geostationary satellite system to provide services for Meteorology, consists of the following:-

(a) Very High Resolution Radiometer VHRR and
(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 Km (visible) and 8 Kms(IR). The VHRR will image the earth's cloud cover over India and adjoining land and sea areas. The Scan angle will have the capability for full earth scan with/20°(E-W)x 4.5°(N.S.). Normally VHRR will scan 14°(N-S)x 20°(E-W)field of view for most of the day to day operations.

/20°(N-S)X20° (E-W) and Sector Scan will have

b) A Data Relay Transponder(DRT)like INSAT-I for collection of Meteorological data from the Data Collection Platforms(DCPs) located over remote and inaccessible areas.

Meteorological Satellite Data Receiving and Processing System with Personal Computer

Satellite Meteorology Center

State Meteorological A d ministration

People's Republic of China

1990

CONTENTS

CGMS XIX WP-2
Agenda Item G.1.1.
Prepared by China

Meteorological Satellite Data Receiving and Processing System with Personal Computer

Wu Rongzhang
(SMC)

China is a developing country with a vast territory. Because of the limited communication capacity of China at present, satellite image data could not be effectively transmitted from the central station (SMC) to the users out of Beijing with high speed. To meet the user's requirement, this processing system with personal computer and corresponding receiving equipment is developed for the local weather stations, institutes and other enviroment monitoring users. This system can receive and process data from polar orbiting meteorological satellite such as NOAA. FY-1B and geostationary meteorological satellite, such as GMS S-VISSR; and also FY-2 after it will be launched. With the processing functions, this system will play an important part in monotoring disastrous weather, and earth eaviroment, for instance, forest fire, crop growth, sea ice and flood. In addition, this system also has strong function on graphic processing. It can display numerical products and conventional meteorological data on screen. Conventional meteorological data can be overlapped on satellite image.

The brief introduction to our processing system are as follows:

CGMS XIX WP-3
Agenda Item G.1.1.
Prepared by China

Geostationary Meteorological Satellite Fast Map Projection by Using Processing System with Personal Computer

Wu Rongzhang and Yang Jun
(SMC)

China is located at the northwest part of GMS full disk image, while the northwest part of China is situated in the edge of the map. Edge distortion of the GMS impairs the quality of the image, therefore, the effective utilization of the image. It is necessary to make map projection of the GMS for eliminating distortion.

Usually, Lambert projection and Mercator projection are used in meteorological departments. Lambert projection is used in China as synoptic map projection and it is convenient for comparision composite analysis to conventional data. The users are accustomed to use lambert projection in weather analysis and forecast. Mercator projection does good to overlap satellite image with radar data. The users take advantage of it to forecast short-range weather. For reasons given above, map projection of GMS is an important step on effective usage of meteorological satellite image.

Map projection of satellite image needs to be converted from satellite coordinate to map coordinate. Owing to a huge amount of image data, projection conversion is a kind of work that demands a great deal of computer time. As a result, the middle scale computers are usually required to meet the needs of operation.

We have developed an algorithm of fast map projection with PC. A frame of 512X512 could be finished within 2 minutes on PC-386, which meets the demand of real time processing and has been put in operation so far. Its main steps are as follows:

1. By using interpolation with 5 degrees gird file from S-VISSR data, convertion between geographical coordinate and satellite coordinate is realized. This programme accelerates the speed of conversion and remains locating accuracy.

2. In the algorithm, this programme converts map coordinate into geographical coordinate, then turn to satellite coordinate. It searches demanded data from image file, then put the data to the map. In this way, the speed of conversion is accelerated.

3. Since the process of data reading, writing and searching takes up much computer time, we use assembler language to perform these procedures. In order to speed up the process of reading and writing, this programme takes advantage of EMM (Expand Memory Management) of PC-386 to put image data into virtual memory for reading and writing or put image data into buffer of image processing board. EMM is adopted for big images.

For the convenience of application, the projection parameters, such as standard latitude, central longitude, resolution and image size, can be changed by users.

The above method has advantage of fast speed and good accuracy.

On a PC of 33MHz (including 80387), it takes about 1'05" to finish an image of 512X512 with Mercator map projection. 1'20" with lambert map projection. On a PC-386 of 25MHz, the above projections take 1'15" and 1'40" respectively.

Image loeating error caused by projection is within one pixel. The map size could be decided by users. At present, 512X512 and 256X256 are used. The projection range is 60° N-60° S, and 70° E-120° E.

Outline of the GMS S-VISSR Personal Computer Processing System

Satellite Meteorology Center
SMA, CHINA

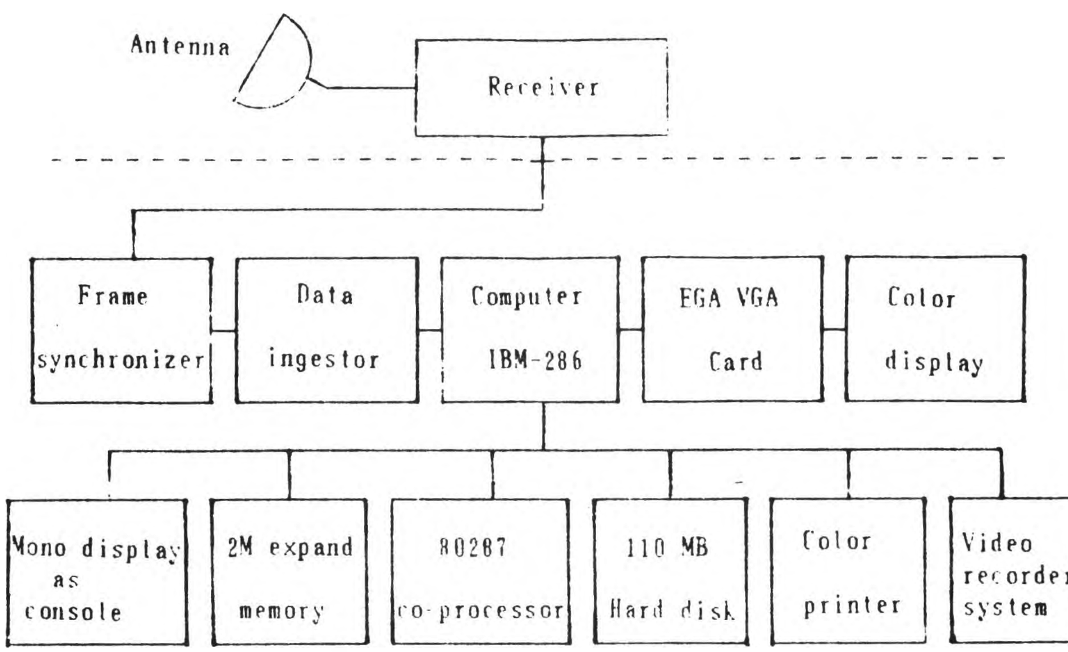
The GMS S-VISSR personal computer processing system is developed by SMC (Satellite Meteorology Center of SMA of China) for local weather stations to process and display GMS stretched VISSR digital data hourly. It is a multifunctional processing system. Besides the GMS imagery, it also processes conventional weather reports, numerical products, TOVS retrievals of NOAA satellite (if it is possible to get them) and digital radar data (in the near future). It can overlay different kinds of data on satellite images. Connected with a receiver it can ingest the S-VISSR data and display image in real time. It has capability of ingesting all (or part) pixels of a S-VISSR scan line in full (or sampled) resolution to meet users different requirements. In order to handle data easily, the system works in man-computer interactive and menu fashion. In addition, there is a batch job fashion for operation. The system can run automatically day by day. A series of systems in different levels is available, based on the IBM PC 286 (AT/XT) or compatible or 386 computers, and EGA/VGA graphic board or image board. Since the performance of the system is versatile, stable, reliable, convenient and greatly effective, it is especially suitable for a local weather station to monitor severe weather such as tropical storms convective systems, and to do operational short-range weather forecasting and research work.

The system which was put into operation two years ago, has already been installed at more than twenty weather stations, airports, research institutes etc. over China. In the operation, the system has played an important role in monitoring severe weather, forecasting etc.. It is welcomed by users as an important means for modernization of weather stations.

(1) System Configurations

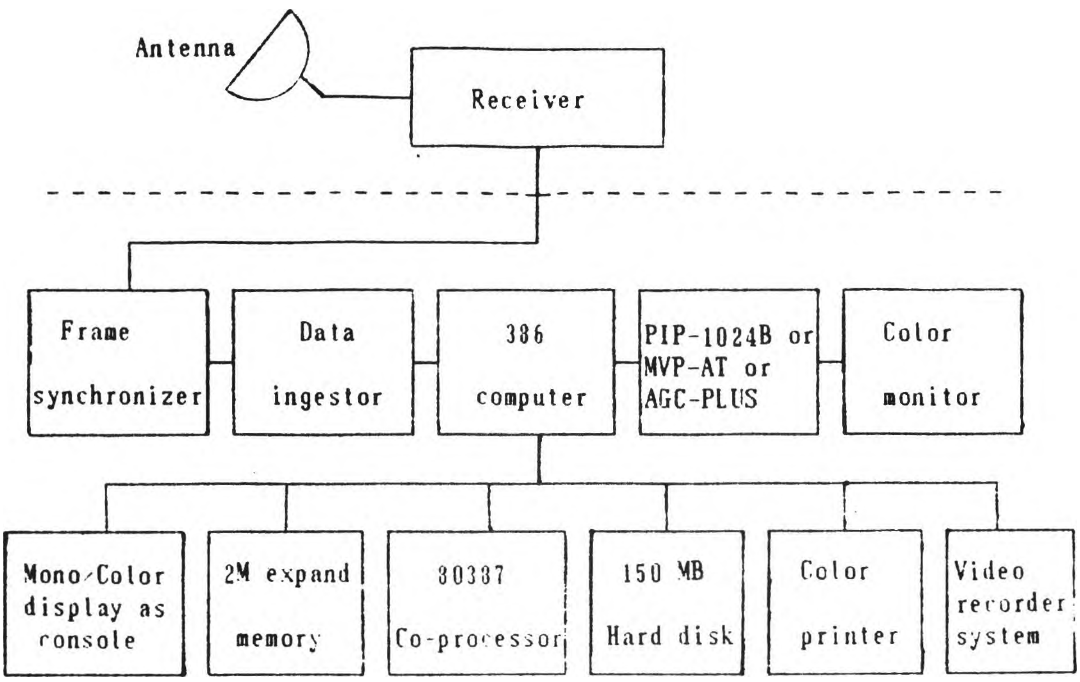
In order to meet the needs of the users, two types of configurations are provided. One is based on a 286 personal computer system, and the other on a 386 personal computer system. In both configurations, the data ingestor is used for the acquisition of S.VISSR data. It is a special interface developed by SMC/SMA of China. The synchronizer is included in the same board and connected with receiver directly. So the system can be separated apart from the receiver over 100 meters. The system uses DOS operation system version 3.30.

A. The configuration for 286 system is as follows:



- MONO DISPLAY : Used as the system console.
- GRAPHIC CARD : Image processing and displaying unit, EGA card with resolution 640 x 350 or VGA card with resolution 640 x 480.
- HARD DISK : 70 to 150 MB. The storage depends on user's needs
- EXTENDED MEMORY: 2 to 3 MB, for animation displaying.
- 80287 : A math co-processor.
- PRINTER : For getting a hard copy output.
- RS-232 PORT : For data communication.
- FACSIMILE INTERFACE : A data interface between the computer and the 121/118 facsimile made in China, for getting a hard copy output of a processed image.
- VIDEO RECORDER STORAGE SYSTEM : Option for archives.

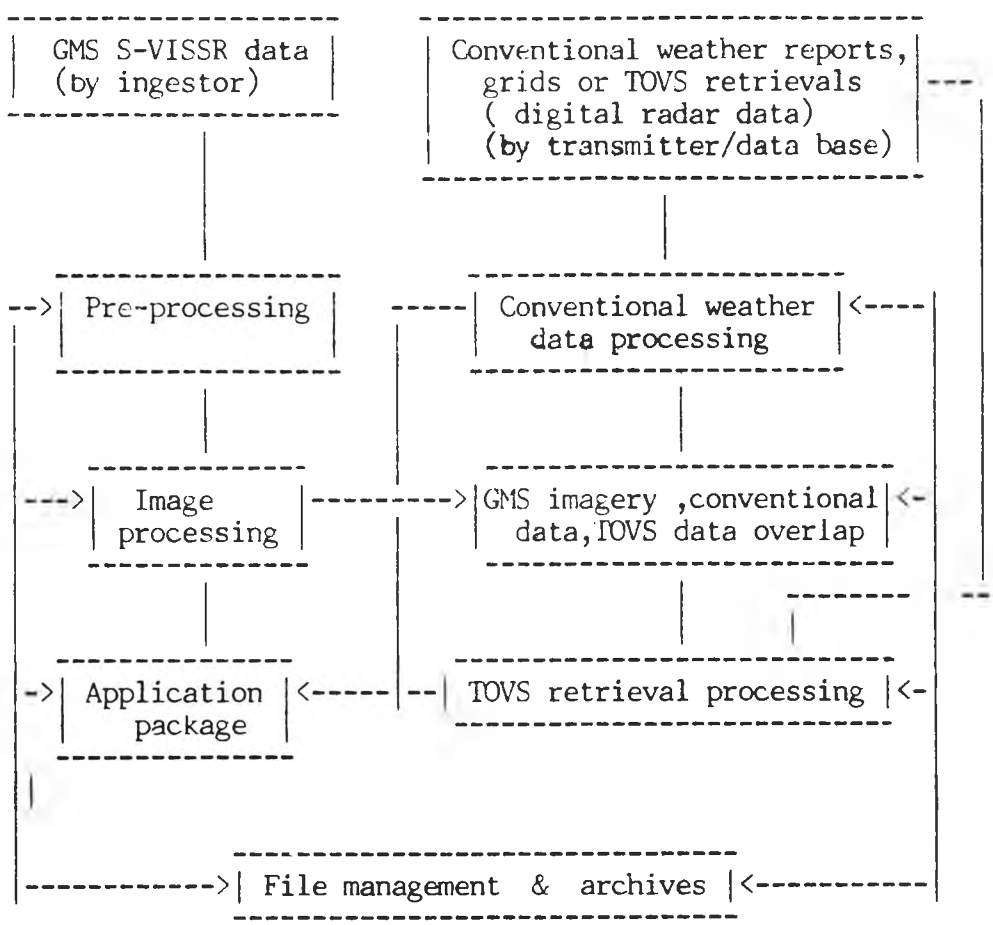
B. The configuration for the 386 system is as follows.



- AGC-plus : A high resolution graphics card, 1024x1024x8.
- PIP-1024B : A pseudo-color image board, 512 x 512 x 8.
- MVP-AT : A true-color image board with resolution of 512 x 512 x 8.
- HARD DISK : 110 to 300 MB. The storage depends on user's needs
- EXTENDED MEMORY: 2 to 3 MB, for animation display.
- 80387 : A math co-processor.
- PRINTER : For getting a hard copy output.
- RS-232 PORT : For data communication.
- FACSIMILE INTERFACE :
- VIDEO RECORDER STORAGE SYSTEM : Option for archives.

(2) Software Package Function Block Diagram

The software package is named 'SMCPPS' and shown as following.



(3) Main Menu Configuration

The SMCPPS main menu configuration is as follows.

```
---------------------
|      SMCPPS       |
|  initialization   |
---------------------
          |
-------------------------------------------
|           SMCPPS   MAIN MENU            |
|                                         |
|   F1   Routine operation                |
|   F2   Receive GMS data / pre-process   |
|   F3   Image process and display        |
|   F4   Conventional data process/display|
|   F5   TOVS data process and display    |
|   F6   Image and contour overlap        |
|   F7   Movie display                    |
|   F8   Application package              |
|   F9   Radar data display               |
|   F10  Development                      |
-------------------------------------------
```

All the function modules are connected by menu. It is easy to build up, add or change modules and to develop the system.

(4) SMCPPS Software Capabilities

A. Ingests and stores GMS S-VISSR data on disk and pre-processes the data.

* Ingests and stores part of disc in full resolution or sampled (or full resolution for IR) full disc to the hard disk, including IR,VIS and entire documentation words. Automatically adds lost lines. The fashion and data range are defined by the user.
* Displays the ingested image on screen in real time , the displayed channel, color or B/W, defined by the user.
* Generates parameter files and MANAM (time schedule table).
* Checks the qualities of parameter files.

* Creates image data files for IR or VIS in different sampling ratio,size,location.
* Generates geographic grids file (1/5 degrees).

B. Image processing and display

* Displays any part of image file in different sampling ratio at any location of screen (color or B/W).
* Image enhancement.
* Enlarges picture on screen (no limit for zoom factor).
* Split screen (2-16 pictures).
* Draws temperature contours.
* Filter.
* Repairs bad image lines .
* Histogram.
* Displays the scale of temperature or albedo on screen.
* Prints GMS image documentation on screen.
* Prints characters on screen.
* Saves picture of screen to disk.
* Restores picture on screen from disk.

C. Navigation .

* Draws geographic grids on GMS image in 1, 5 or 10 degrees intervals.
* Draws coast line , boundary, rivers on GMS image.
* Gets the position on S-VISSR image displayed on screen for a specific geographic location.
* Gets the geographic coordinate of a point on screen.
* Modifies the navigation of system using visual land marks on the GMS image.
* GMS image coordinate transformation.
  . Lambert projection.
  . Mercator projection.
  Finished in 1-2 minutes at 386 system. The projection parameters and area are changeable.

D. Loop display

* Displays 16 to 48 pieces of picture's loop (IR or VIS). The time interval is changeable.
* Displays one IR ,one VIS picture's loop.

* Displays 4 pieces of weather map loop.
* Displays 4 pieces of split screen loop.
* Compiles loop.

E. Conventional data process and display

* Requires conventional data. (weather elements reports, grids (Beijing, European, center Washington and Tokyo)
* Displays station observations.
* Displays profiles of observations.
* Station observations objective analysis, diagnostic fields calculation . Draws contours.
* Draws contours for grids data of data base.
* Prints grids values.

F. TOVS retrievals process and display

* Displays TOVS retrievals.
* Retrievals object analysis and contouring.
* Prints grids values.
* Profile overview.
* Displays water vapour image .

G. Image and contour overlap

* Conventional observations overlay on GMS image.
* TOVS retrievals overlay on GMS image.
* Conventional data contours overlay on GMS image.
* TOVS contours overlay on GMS image.

H. Application package

* Gets cloud top / surface temperature or albedo.
* Gets distance of two points of GMS image.
* Gets typhoon location,path,velocity,moving direction.
* Gets cloud top height.
* Gets cold cloud size.
* Prints the name of cities or stations on GMS image Draws air lines.
* Solar altitude angle correction for VIS image.
* Statistics(temperatures, albedos, means, deviation, maximum, minimum).

I. File management and archives

* Saves 40 sets of parameter files on disk.
* Saves 20 to 40 IR/VIS original GMS images on disk.
* Saves 40 screen copies on disk.
* Saves loop on disk.
* Archives all data files on disk to video cassette or diskette or restore the archives on system again.
* Manages all data files by menu.
* Prints screen (image or graphics) as color or B/W print-out.
* Delivers products to other user's computer through RS-232 or communication network.
* Makes facsimile copies of processed image of the system.

J. Changeable batch job, automatic operation. Automatically receiving, preprocessing, locating, projecting, displaying ,creating loop and archiving in about 20 minutes. A set of products is as follows.
  . 1024*1024 (or 512*512 or 640*350) IR and VIS images (grided or ungrided).
  . 512*512 (IR and VIS) Lambert projected images.
  . 512*512 (IR and VIS) Mercator projected images.
  . 256*256 (IR and VIS) Lambert projected pictures loop.
  . 256*256 (IR and VIS) Mercator projects images loop.
  . 256*256 (IR and VIS) original GMS images loop.
  For EGA system the picture dimension is 640*350.

K. Provides the ability for the user to develop their application package.

Polar Orbiting Meteorological Satellite Data Microcomputer Processing System

I. System Overview

Polar Orbiting Meteorological Satellite Data Microcomputer Processing System is an useful tool for weather analysis, forecast and environment monitoring.This system has been used properly in many regional weather forecast centers in China. It can be operated by meteorologists, oceanographers, hydrologists and other users. It provides the capabilities of ingesting, processing, displaying and storing AVHRR/HRPT data transmitted simultaneously by polar orbiting meteorological satellites. It is also capable of satellite data preprocessing ,quantitative processing, image processing, landmark navigation and meteorological conventional data processing. The received and processed data can be displayed on high resolution colour monitor, and archived on CCT or video cassette tape for further research and processing. The whole system is menu-driven and easy to use. This system constists of 386 PC hardware, system software and variety of application softwares. Fig. 1 is the system configuration. The founctional discription and hardware configuration are as follows.

II. Application Software

The application software of micro processing system is a comprehensive meteorological information processing software system developed in 1988. It is designed to meet the needs of real time weather forecast and meteorological or non-meteorological researches. The major functions of the system are to ingest, display and process the high-resolution data from polar orbiting meteorological satellites. It allows users to predict future satellite pass message and to track spacecraft automatically, as well as to receive and store the satellite data on disc. According to the option menu, the application software system consists of the following ten major functions:

- The HRPT data ingest and real time monitoring.
- The satellite pass message prediction and AVHRR/HRPT data preprocessing.
- The single orbit AVHRR data playback and landmark navigation.
- The image processing.
- The quantitative data processing and displaying.
- The single orbit AVHRR data stretch gridding and multi-orbit image mosaics.
- The data input/output and product archives.

- The image data base creating and management.
- The conventional meteorological data ingest and processing.
- The system test and management.

2.1 The HRPT Data Ingest and Real Time Monitoring

With the menu system, the procedures for HRPT data receiving and monitoring are very simple to follow. There are three functions.

1. To receive HRPT data from any polar-orbiting meteorological satellite.

2. To display any one or three channels of AVHRR data in real time for ingest monitoring while receiving. The image displayed here has been enhanced and geometrically corrected according to the earth curvature, and it can be black/white or colour. The images of entire orbit can be rolled up and down in either directions or halted during the rolling.

3. To store the AVHRR data on disc. The maximum number of the scan lines of data stored in this system is about 3600.

2.2 The Satellite Pass Message Prediction and AVHRR Data Preprocessing

There are two subfunctions in this part: the satellite pass prediction and the AVHRR data preprocessing.

1. The satellite pass prediction

The function of this part is to calculate the start time and the azimuth elevation for the following passes.

To pick up 6 satellite orbital parameters in the most recent TBUS(U.S.A.) and TBCI(China) message data base from GTS, and to calculate the start time and the azimuth elevation of the satellite for the next pass using the Brouwer-Lyddane method. The 6 orbital parameters are:

a: the semi-major axis of the ellipse.
e: the eccentricity.
i: the inclination of the orbit plane.
Ω: right ascension of the ascending node.
w: perigee argument.
m: mean anomaly.

2. The AVHRR data preprocessing

This founction is responsible for three items:

(1) To create the AVHRR 1A.5 data set.
(2) To create the grid file for single orbit image earth location.
(3) To create the look-up table for the image processing.

The AVHRR data preprocessing is very important for the following image and quantitative processing. In order to generate the AVHRR 1A.5 format, it has to perform the following processing to the AVHRR/HRPT raw data.

- Reading and checking the level 1A of HRPT data on the disc.
- Computing the calibration coefficients from the data in the HRPT frame header.
- Calculating the earth location information and solar zenith angles of 51 points for each AVHRR scan line.
- Determining the quality control information for each scan line.
- Packing all the information processed above with the AVHRR raw data and time message into 1A.5 format.

2.3 The Single Orbit AVHRR Data Playback and the Landmark Navigation

1. The single orbit AVHRR data playback

This displays any one or three channels image of AVHRR data which are in 1A.5 format. There are 5 subfunctions in this part.

(1) The image enhancement.
(2) Overlaying the geographical marks such as coast line, boundaries and rivers.
(3) Overlaying the latitude/longitude grid in either 1 or 5 degrees.
(4) Displaying the images in black/white or colour for the entire orbit data. The images can be rolled up and down in either directions or halted, also the interested area selected by user may be displayed or zoomed by a factor of 2,4,8.
(5) Playback the images of entire orbit data at full, 1/2 or 1/4 resolutions.

2. The landmark navigation

The navigation function features a landmark registration package which permits precise satellite navigation solutions to be obtained using the stepwise linear regression.

2.4 Image Processing

The function of this part is to perform the following image processing for any interesting part of the image data stored on disc.

1. Image enhancement.
2. Zooming by a factor of 2,4 or 8.
3. Noise filtering.
4. Arithmetic calculation of multi-spectra images.
5. One dimensional histogram statistics.
6. Colorization.
7. Calculating the area of some kinds of target in an interested part on the image.
8. Contouring the temperature or brightness for the image.
9. Annotation.
10. Image margin detecting.
11. Reading out the coordinates and the grayness value of the interested point in the image by using the cursor.
12. Film-loop and dynamic image display.

2.5 The Quantitative Processing and Display

This founction is useful for meteorological and non-meteorological applications of the AVHRR/HRPT data. The processing starts with the 1A.5 format. The following procedures must be applied to the AVHRR data for different applications, such as the data calibration, solar zenith angle correction, limb-darken correction, atmospheric attenuation correction and remapping in different projections. The interested area selected by users may be in 4*4 or 8*8 degrees latitude/longitude grids. So the resolution of the products should be either 1 km or 2 km. The products for different uses are as follows:

1. The cloud-top temperature.
2. The snow-cover monitoring.
3. The land surface temperature.
4. The land surface albedos.
5. The vegetation index.
6. The forest fire detection.
7. The flood damage monitoring.
8. The river mouth silt monitoring.
9. The sea surface temperature.

2.6 The Single Orbit Stretch Gridding and the Multi-orbit Mosaics

This is another kind of image products processed from the single and multi-orbit AVHRR data. They are used for the weather analysis and forecast.

1. The single orbit stretch gridding

This process is only applied to the single orbit AVHRR data. The data is processed through the geometric correction and image enhancement, and mapped with the latitude/longitude grid, coastline, islands, rivers, lakes and boundaries. The resolution of the stretched image is either 2 or 4 km at the subpoint. The products can be displayed on the screen or output by facsimile.

2. The multi-orbit image mosaics

The image mosaics is used to map the AVHRR data together with the adjacent orbits to get large area cloud pictures for large scale weather analysis and forecast.

The AVHRR data from different orbits are processed through raw data calibration, limbing-darkening correction for infrared; sun normalizing correction for visible; image mapping, enhancement and latitude/longitude gridding for earth location. The map projections used in this system are polar stereographic, Mercator and Lambtor projections. The products are visible or infrared image mosaics from two or three orbits data in different projections.

2.7 The Data Input/Output and Product Archives

The input data in this system are AVHRR/HRPT data and conventional meteorological data. The output data are the AVHRR 1A.5 and 1B data, different kinds of the image products, digital and figures. There are several output ways for the products, such as the printout, the facsimile, the video output and display on screen.

This system uses disc, floppy disc, video and compatible tapes for the product archive.

2.8 Creation and Management of the Image Data Base

This subsection is responsible for creating various kinds of data files for the image data, digital data and figure data files on disc. It is also responsible for detecting and managing all of the data files.

2.9 The conventional meteorological data processing

The conventional meteorological data stored on disc can be processed and output on contour. They also can be overlayed on the satellite image data.

2.10 System Test and Operation Management

1. System test

The processing system provides users four kinds of system testing modules to allow customers to test the system and to evaluate its performance. The testing functions are:

- Colour bar testing signal.
- Grid-testing signal.
- Delta-wave testing signal.
- Testing program of interface working condition.

2. Operation management

The operation management in this system is designed to execute programs via a menu. The structure of the menu is like a tree. It consists of three steps: the main menu, the second menu and the third. The following is the main menu:

F1 HRPT Data Ingesting & Monitoring
F2 Orbit Forecast & Data Preprocessing
F3 Image Playback & Landmark Navigation
F4 Image Processing
F5 Quantitative Data Processing
F6 Stretch & Mosaics Processing
F7 Product I/O & Archives
F8 Data Base Management
F9 Graphic Processing for Conventional Data
F10 System Management

Each function of the main menu has its own second or third menu. All function keys used in the menu tree perform all data processing and analysis functions of the application software system. In a customer friendly environment, users may access any program by pushing any function key in the menu and interactively inputting selected parameters to perform any data processing function to get the perfect products.

III. Hardware Configuration

The microcomputer processing system consists of 386 PC, HRPT bit/frame synchronizer, data buffer of AT bus, MVP image processing card, color video monitor, videocassette archive device, digital tape unit, TV encoder, facsimile, printer etc.(See Fig.1).

3.1 The Host Processor

The host processor of the HRPT data processing system is an OLIVETTI M380-XP5 personal computer. Its basic configuration and specifications are:

- -CPU: 20MHz 80386
- -Main memory: 4MB(up to 16MB)
- -Diskette drive: one 1.2MB and one 360KB
- -Disk drive: 300MB
- -Monitor: OEC (EGA compatible) card + 12" mono monitor or 14" color monitor.
- -20MHz 80387 coprocessor
- -101/102 keys keyboard
- -1 serial port and 1 parallel port
- -7 I/O slots for users

3.2 Special Interface and Peripheral Device

1).HRPT bit/frame synchronizer

Major function:

a. Extracting bit clock and serial data from noisy PCM signals; Converting input BIO-L code to NRZ-L code.
b. Extracting frame synchronization;Converting serial data to parallel(10 bit) data; data format editing; Error code indicating.

Major specification:

a. Input bit rate: 665.4Kbps
b. Input data code: BIO-L

 data "1" definition

 data "0" definition

c. Input resistance: 75 ohm
d. Input signal amplitude: TTL
e. Frame parameters
   .Sync pattern: 60-bit PN(pseudo noise) pattern
   .Sync location: Fixed first 60 bits of frame
   .Frame length: 11090 data words
   .Word length: 10 bits/word
   .Data orientation: The most significant bit first
   .Frame window: 3 bits
   .Data inversion: Automatic correction
f. Output data code: NRZ-L
g. Out signals: FE-Frame End
   WC-Word Clock

10 bit parallel data

Principle of operation

The HRPT synchronizer consist of 2 major functional parts:bit synchronizer and frame synchronizer, as shown in Fig.2

The bit synchronizer consists of input processing circuit, phase lock loop(PLL) and sample circuit etc. The basic operational procedure is as follows: The input data are amplitude and offset normalized,filtered by match filter and pulse shaping circuit,then goes to differential circuit; The differential circuit detects the raise edge and down edge of the BIO-L code which contains bit clock information, and generates a new 1330.8kbps serial pulse sequence by the added circuit. The phase comparator of the PLL section accepts the data transition of the new pulse sequence from the input processing section and compares this transitions with free running clock,which is fed by a voltage controlled oscillator(VCO). The VCO is a free running multivibrator that generates the basic frequency from which the clock signals are derived. One VCO input port receives the I signal from the loop filter, and an error voltage representing the frequency difference between the generated clock and input PCM bit stream is then produced. This voltage is the means by which the frequency of the VCO is increased or decreased, thus establishes the tuning voltage. The other VCO input port is the basic frequency control capacitor where the frequency selection is made. When the data transitions are in the proper phase relationship to the free-running clock,the unit is lock in synchronism. The new pulse sequence produced by the filtered circuit is also sent to the sample circuit, and is sampled again by the clock produced by PLL. So far, we get NRZ-L data that without noise and the phase is same as a clock.

The frame synchronizer consists of "synchronization and timing circuit","error detection circuit", and "serial to parallel conversion circuit",etc. The sync pattern of HRPT data stream is the 60-bit PN code which is the first 60 bits of the 63-bit PN codes generated by polynome:X + X + X + X + 1. The BIO-L signals output by different receivers may have inverted phases. So when frame synchronizer accepts the NRZ-L data stream from bit synchronizer, the data are fed to a parallel correlator. If the incoming bit stream is inverted,the internal circuit will automatically re-invert the bit stream to the normal data. Meantime, the sync detection circuit compares the incoming data stream with standard PN code that produced by local PN code generator. If the incoming data stream pattern is equivalent to the standard PN code, that means it is the sync pattern of the frame, then the Frame Sync(FS) is generated. But,because the data are random, it is possible to have the PN code in any data stream position; On the other hand, during the data transmission, there might be errors produced by noise in the PN code position. For this reason, there is a "frame window(FW)" circuit in the frame synchronizer in order to control the FS signal detection. It is a 6 bits wide positive pulse that is generated by a counter under the FS control. The raise edge is produced by counter value 11090-3; The down edge is produced by counter value 11090+3; The FS, that is produced during FW period, is a true frame sync. So that means, the frame window circuit compensates for up to three missing or three extra bits in a frame of data by detecting.

The frame synchronizer also generates a "frame lock (FL)" signal controlled by FS and FW, it indicates the frame synchronizer is already in "lock" status. The word clock is produced by decimal counter driven by bit clock and controlled by FL and FW.The"frame end (FE)"is a 1.5 ms wide pulse that is produced at 100 auxiliary sync words position.

So far,the data are still serial. In order to input the data to computer, the serial to parallel circuit converts the serial data to the 10-bit parallel data.

The error detection function is implemented by auxiliary sync code generator and auxiliary sync code comparator. Auxiliary sync code is the first 1000 bits of the 1023-bit PN code generator. Then this PN code is compared with auxiliary sync code in the data stream,and the different is the error code.

2).Data buffer of AT bus

The data buffer of AT bus is a PC standard card which occupies a single I/O slot. The major functions are:

To stretch the gap between the 2 frames of HRPT data,and to make PC has enough time to do such I/O operations: As data receiving, image monitoring on screen, disk recording etc. It is a key whether the high rate HRPT data can be ingested to the 386 PC correctly, or not.

The gap between two HRPT frames is only 1.5ms, and it is too short to do so many I/O operations(it is 60ms for disk recording only). But with a data buffer between HRPT synchronizer and PC, the data coming from the synchronizer can be stored in the buffer first,and then to be transferred to the PC in DMA mode. So,the HRPT data ingesting time can be reduced to minimum, and PC will have enough time to do the other I/O operations.

The basic configuration of data buffer is shown in the Fig.3. It consists of buffer A, buffer B, control circuit and I/O buses. The 10-bit parallel data coming from the synchronizer is transferred to the buffer A at the raw data rate of 0.6654 mbps first, after the whole frame data (about 22KB) is stored in the buffer A completely, the buffer A begins to send the data to the PC at a rate of 18 times than the raw data rate(the DMA rate of 386 is 1.2MB/S), and the buffer B turns to receive the second frame data coming from the synchronizer. For the third frame, the data is received by buffer A again, and buffer B turns to send the second frame data to the PC,etc. It goes round and round until the whole pass is completely received. It is controlled by the control circuit which generates a variety of control signals based on the FE,WC of synchronizer and ACK,IOR of PC. In this way, it needs 18ms only for one frame data ingesting. So the PC now has enough time to do the display, disk recording concurrently with the data ingesting during one frame cycle(166.7ms). Accurately, the three types of I/O operations are time sharing the AT bus cycle time during one frame data ingesting. The time for each I/O operation type is shown in Fig.4.

3).MVP-AT full color image processing card and color video display

The MVP-AT full color image processing card is a product of MATROX company of Canada. It is a standard PC-AT card that occupies 2 I/O slots. The major functions of MVP-AT with the software support package IMAGER-AT are:

a. Real-time imaging:
   - .Frame averaging -- A picture is digitized a number of times, the images are added together at video frame rates(1/30th of second) and divided in one frame time. It is used to enhance an incoming image for human viewing by eliminating random noise.
   - .Convolutions -- It is a class of neighborhood operations which enhance a particular feature of an image at expense of other less important features.
   - .Image combinatorial operations -- ADD, SUB, XOR and OR
   - .Histograms
   - .profiles
   - .Area of interest processing

b. Pan,scroll and Hardware zoom(x2,x4,x8).

c. The input image gray-scale values modification with input look up tables.

d. True color mode and false color mode operations.

e. Three different display formats: interlaced, non-interlaced and EGA. The display resolution is:
   512 x 512 (European standard);
   512 x 480 (American standard);

640 x 512 (multiple buffers are combined);

f. The capability of overlaying a processed image with non-destructive text, graphics, and cursors.

The application program of the image processing is developed on the functions above-mentioned.

The color video monitor is a basic image display device of the system. Usually, it receives R, G, B signals from MVP-AT card. The monitor has two sync modes according to the scan type of it:interlace and multi-sync. It is better to select the multi-sync monitor because it has both interlace and non-interlace scan types. With the non-interlace monitor,we can get the fine and smooth, stable, without flicker picture on the screen.

4).The 118 facsimile interface card

The 118 facsimile interface card is a PC standard single slot card, that is developed mainly on the 118 facsimile made in China. The major functions of it are to accept the image from PC, to store it in the buffer, and to do the manipulation such as D/A conversion, signal format arrangement etc. in order to get a signal that can be accepted by 118 facsimile. The pictures output by 118 facsimile are monochrome. It can be a sectorization picture of raw resolution or a full view picture with the reduced resolution. So, we can treat it as a facsimile transmitter.

The major specifications are:

.Maximum pixel numbers of the picture:

762 x 762 (the facsimile recording density is 3.3)

1811 x 1811 (the facsimile recording density is 8.1)

.Output signals: 2.4kHz AM;

.Output resistance: 600 ohm;

.Output voltage: >100mV(the load is 600 ohm);

.The frequency stability and accuracy: 5 x 10

.It can operate at the speeds of 120 RPM and 240 RPM, as well as the densities of 8.1 line/mm and 3.3 line/mm;

the basic block diagram of the 118 facsimile interface card is shown in the fig.5. The 8-bit parallel image data from PC's output is written down to the buffer in DMA mode first. As we mentioned before, there are two buffers in the card as "data buffer of AT bus". Then the data is transferred to the D/A converter slowly at facsimile speed. This is controlled by PC interface circuit and read/write circuit of the card. The analog image signals from the D/A converter and 2Hz square wave(120 RPM) or 4Hz square wave(240 RPM), 300Hz square wave etc. from the line format generator are fed to the multiplexer to form a baseband FAX line signals(see fig.6). Finally, the output of the card is an AM signal with the subcarrier of 2400 Hz.

5).The videocassette archive device

The videocassette archive device contains the videocorder and PC-videocorder interface card. The functions of it are: to read out the data from the PC, and store them to the normal videocorder/player in the digital format.

Storage capacity: 100MB-160MB/cassette.

Storage rate: 12KB-40KBps

6). The data streaming tape unit

This is another type of digital archive device. Its function is same as videocorder system except that the data recorded on the tape can be read and processed by other computers with the industry standard tape drive.

recording density: 1600/3200 bpi

recording rate: 100IPS

storage capacity: 40MB-80MB/roll

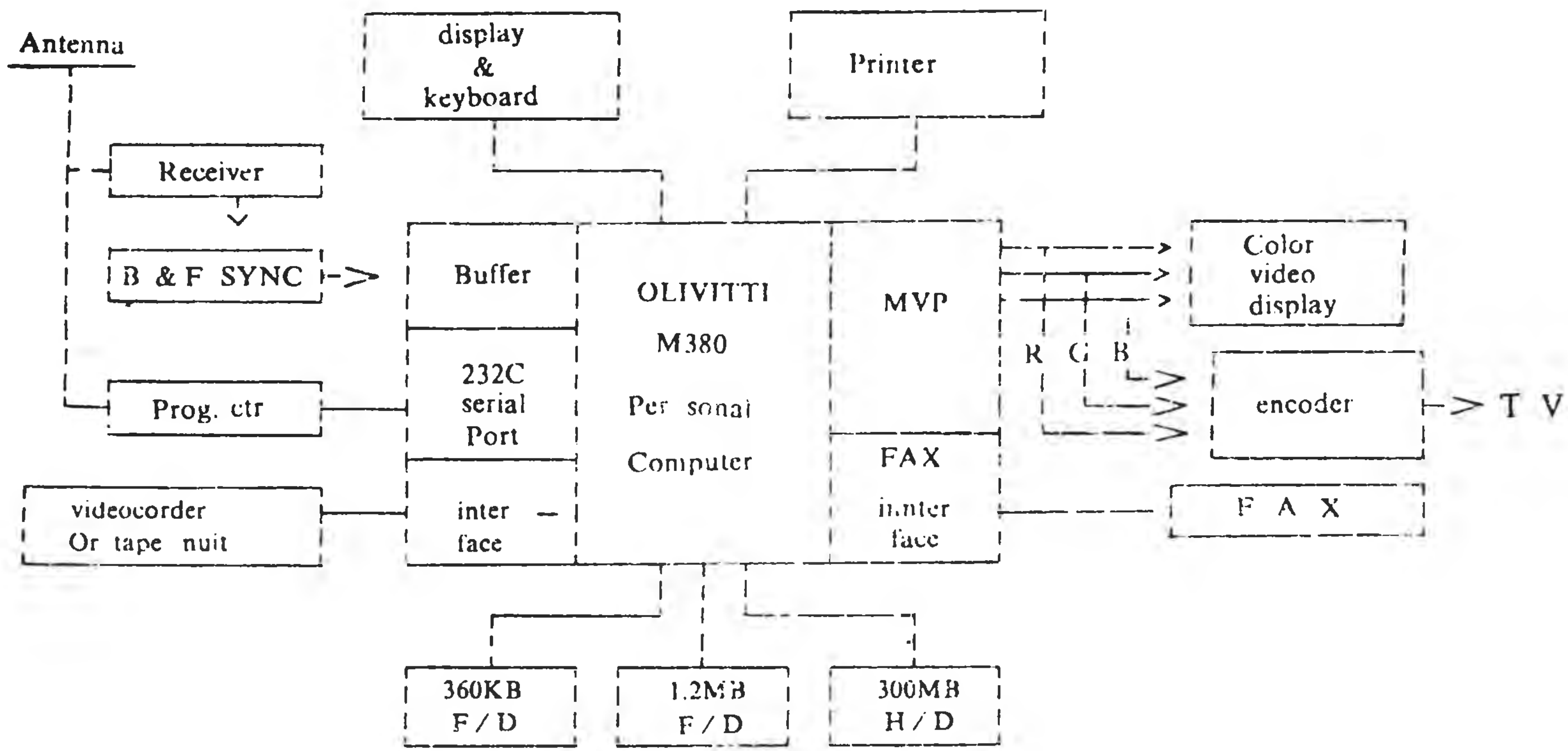


Fig . 1 Block diagram of HRPT data PC Processing system

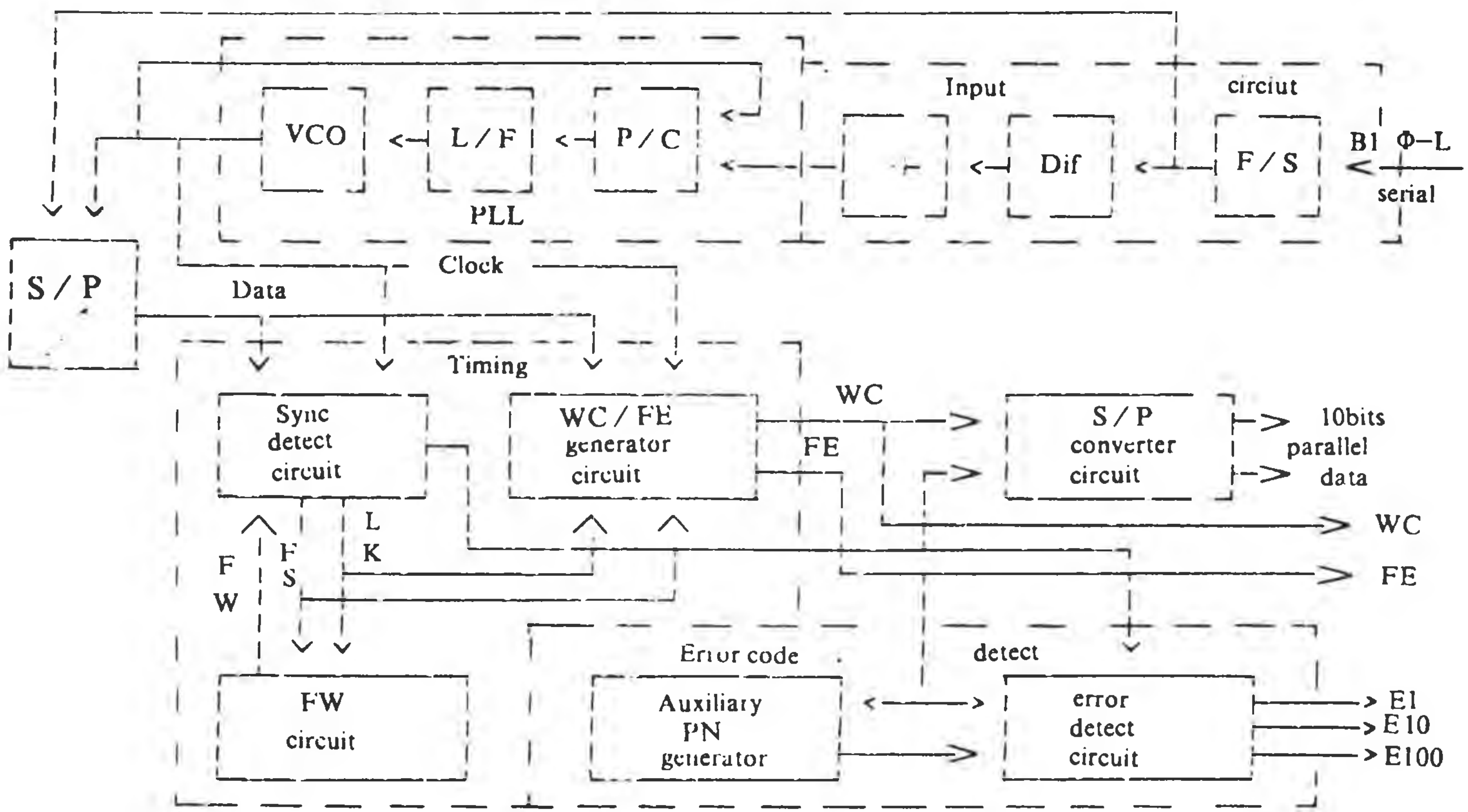


FIG 2 Block diagram of HRPT bit / frame syncronizor

NOTE: F / S -- Filter and shaping
Dif -- Diferential
P / C -- Phase Comparator
L / F -- Loop Filter
VCO -- Voltage Control Oscillator
S / C -- Sample Circuit
S / P -- Serial to Parallel
E -- error

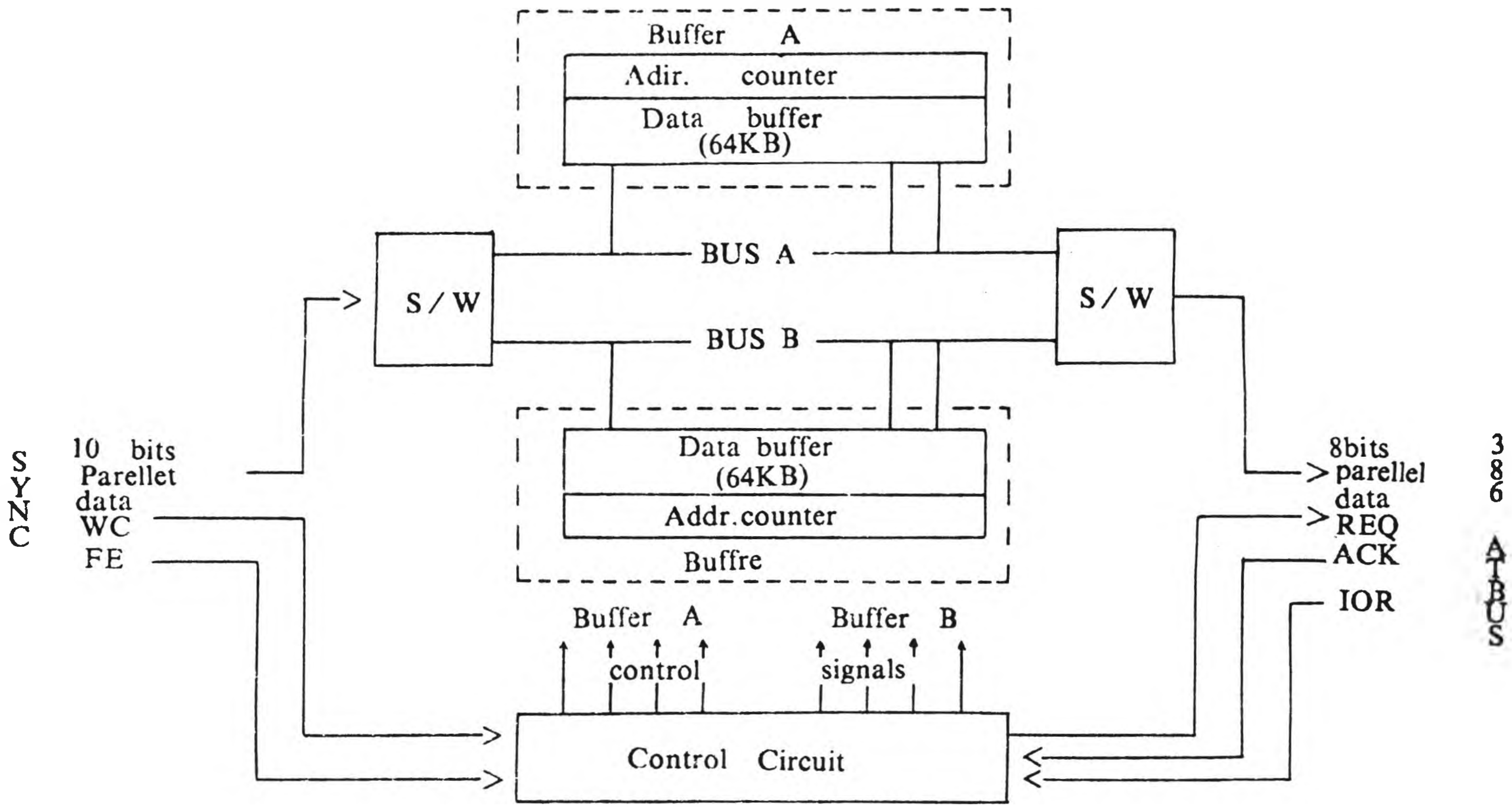


Fig . 3 Block diagram of HRPT

AT-bus data buffer

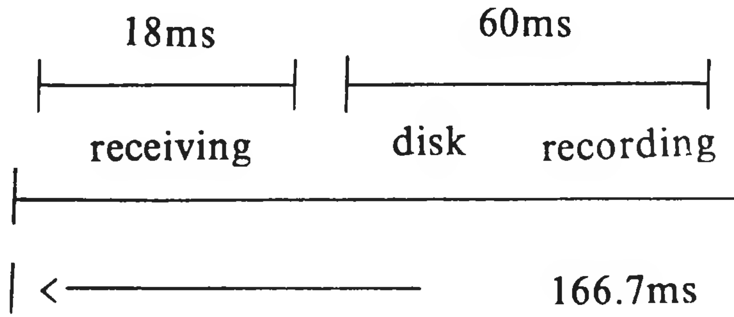
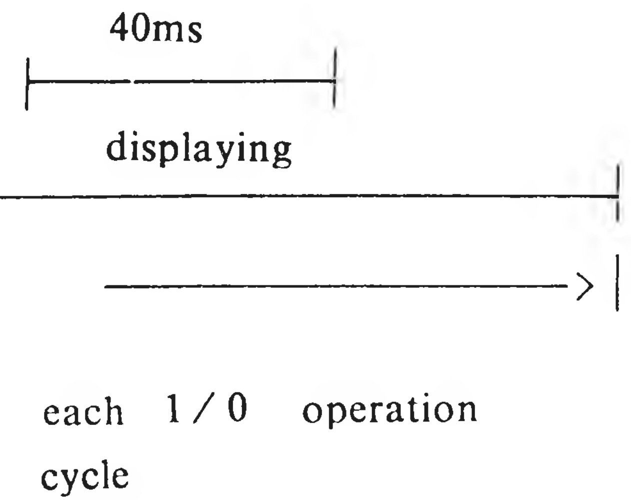


Fig. 4 The time for
in one frame


40ms
displaying
each 1/0 operation
cycle

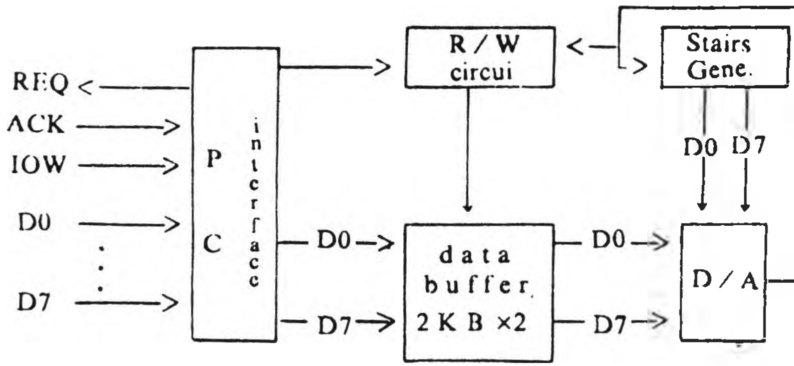
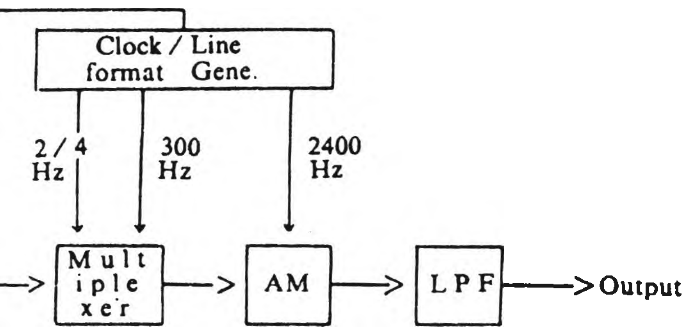


Fig . 5 B lock diagram of

interface card


Clock / Line
format Gene.
2 / 4
Hz
300
Hz
2400
Hz
Mult
iple
xer
AM
LPF
Output

118 FAX

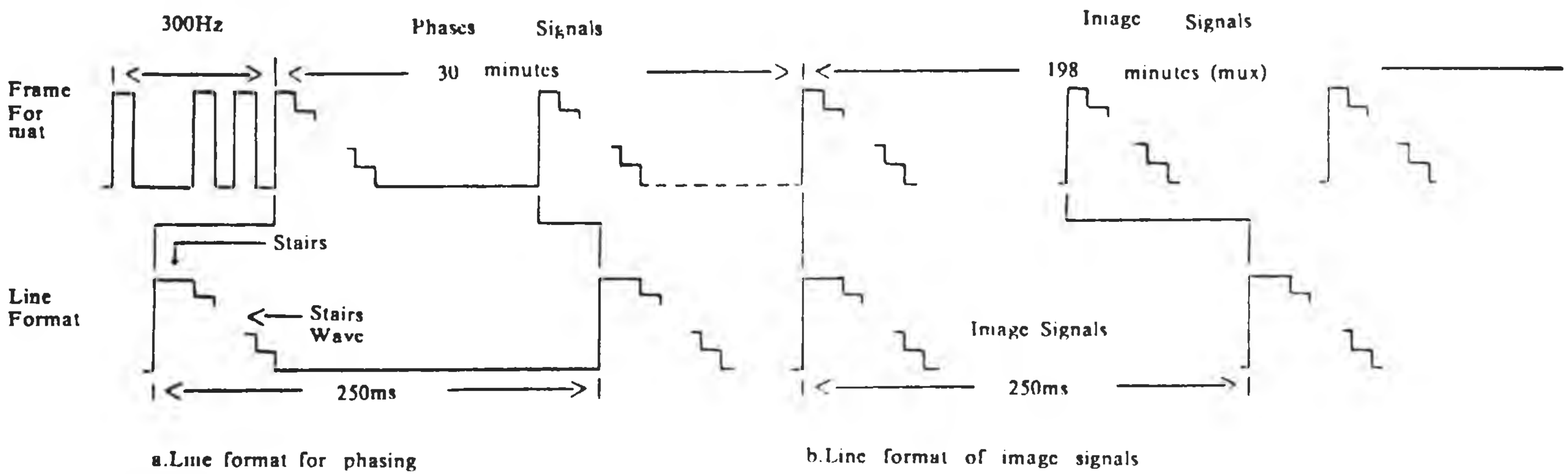


Fig . 6 Block diagram of 118 FAX intrface card
outputs signals format (240RPM)

ANNEX VI

CGMS-XIX ESA WP9
Prepared by ESA
Agenda Item: WG II/1

WORKING GROUP II - SATELLITE PRODUCTS

II/1 Satellite Data Calibration

Calibration of the METEOSAT radiometric channels

CALIBRATION OF THE METEOSAT RADIOMETRIC CHANNELS

Introduction

The METEOSAT series of satellites carry no onboard instrumentation which permits an absolute calibration of their radiometric channels. A black body device is available for obtaining some measure of relative calibration of the infrared channels and in particular to help determine any degradation in the performance of these channels (it should be noted that black body calibration of the water vapour channel only became possible starting with METEOSAT-4). Therefore alternative methods of calibrating the spectral channels have had to be found.

Black Body Calibration

A black body mechanism contained internally within the radiometer can be viewed by the infrared (IR) and water vapour (WV) detectors. The calibration mechanism onboard METEOSAT-4 consists of two black bodies, one at the ambient spacecraft temperature and a second which is heated such that the temperature difference between the two is approximately 50 K. The two black bodies are successively brought into the field of view of the detectors by means of mirrors, mounted on a turning bracket, introduced into the radiation path. Whilst this mechanism is a distinct improvement over that contained on the earlier METEOSATS it still suffers from two main disadvantages:

- the main telescope optics are not calibrated;
- the mirrors included in the black body radiation path are not in the optical path of a nominal image scan.

Thus the black body calibration mechanism is not suited to absolute calibration of the radiometer but provides useful information on the performance of the radiometer. Unfortunately black body calibration has not been possible for most of this year due to anomalous behaviour of the mechanism during a calibration sequence on 27 February 1990. On this occasion the turning bracket of the calibration mechanism became stuck in the calibration position for about seven hours. It eventually freed itself, however, since with the mirror in this position it is not possible to perform imagery, no further risks in operating the black body mechanism have been or will be taken.

IR channel calibration

Calibration of the infrared channel is performed eight times per day. A radiance at the top of the atmosphere is calculated for each corresponding count determined as emanating from the sea surface. The radiance calculation uses a radiation scheme which has as its input temperature and humidity profiles obtained from ECMWF and a sea surface temperature obtained from the NMC global sea surface temperature product. The calculated radiance and its associated count are then used in the following relationship to determine the calibration coefficient:

$$R = \alpha_{11}(C - C_0)$$

where:

R = radiance ($W.m^{-2}.sr^{-1}$),

α_{11} = calibration coefficient,

C = count,

C_0 = space count.

Although calculated eight times per day the operational calibration coefficient is only updated when the change in calibration exceeds a certain threshold. Outside of the eclipse period checks are made on the calibration coefficient twice per day by using a regression relationship on the last eight available calibration coefficients and extrapolating a new coefficient for the following twelve hours. During eclipse periods a similar process is used, however, the regression is based on the last eight values determined for a given image slot.

WV channel calibration

Water vapour channel calibration is performed twice daily. The process is similar to that for the IR channel whereby the radiance at the top of the atmosphere is calculated for locations where an upper tropospheric humidity value (UTH, one of the standard METEOSAT products) has been determined. The WV count associated with this UTH value, and its corresponding radiance, are then used in an identical relationship to that for the the IR channel, to calculate the calibration coefficient.

Updating of the WV calibration coefficient is performed as required. Twice per day a mean of the last ten values of the calculated calibration coefficient is derived; if this deviates by more than one cent from the currently used operational value an update is made.

Visible channel calibration

Calibration of the visible channel is not performed operationally, however, under the auspices of EUMETSAT, a calibration campaign for METEOSAT-4 was organised in conjunction with the Deutsche Luft und Raumfahrt Organisation (DLR). The results of this calibration exercise are presented in the attached paper.

ABSOLUTE CALIBRATION OF THE METEOSAT-4 VIS-CHANNEL

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ABSTRACT

Vicarious calibration of the METEOSAT-4 VIS-channel has been performed by means of airborne comparison measurements. The radiance seen by the METEOSAT radiometer has been measured by an absolutely calibrated radiometer onboard a high altitude aircraft which has an identical but rectangular spectral sensitivity and looks into the same direction as does the METEOSAT radiometer. Corrections for the atmosphere above the aircraft have been made. Comparison measurements have been taken over two land surfaces, the ocean, and over clouds. The calibration factor for the two land surfaces is 1.12 $\pm$ 0.04 W$m^{-2}sr^{-1}$count^{-1}, for the ocean it is 1.40 W$m^{-2}sr^{-1}$count^{-1}, and for cloud it is 0.99 W$m^{-2}sr^{-1}$count^{-1}. The accuracy is estimated to $\pm$ 5 %.

1. INTRODUCTION

Absolute calibration of the VIS-channels of meteorological satellite imagers is presently not performed onboard the satellites. For the NOAA series there is a preflight calibration, whose accuracy if applied to in-orbit measurements, is still questioned. With the geostationary satellite METEOSAT an overall preflight calibration has not been performed. On the other hand, calibrated VIS data are rarely used in operational meteorology up to now, but are essential in scientific research, especially in climate research. Recent results obtained from AVHRR data (Kriebel et al., 1989) indicate the possibility of using quantitative cloud information to help initialize regional models which will be used for short range forecasting.

After launch of a satellite radiometer, absolute calibration is only possible by vicarious calibration. This denotes the determination of the radiance received by a satellite radiometer, e.g. the METEOSAT imager, by means of an independent measuring device. The calibration factor is defined as the ratio of this radiance to the count which is simultaneously produced by the satellite radiometer. The VIS-channel of METEOSAT-4 geostationary satellite has been calibrated this way by using high altitude aircraft comparison measurements. In the following, the method is described to obtain the top-of-atmosphere radiance received by METEOSAT-4 VIS-channel, then the results obtained from the measurement campaign in August/September 1989 are given, and some quality check of the results by means of additional independent spectral radiance measurements is presented.

2. METHOD

Vicarious calibration requires independent measurement of the radiance received by the satellite. This is only possible exactly by putting an identical instrument at the same place and comparing simultaneous measurements. In practise, compromises and assumptions have to be made concerning location, field of view, spectral sensitivity, time coincidence and absolute calibration.

The location of the comparison radiometer should be as close to the satellite radiometer as possible to obtain similar pixel sizes at a similar field-of-view. At low altitudes, either the field-of-view has to be increased to cover the same pixel size which requires knowledge about anisotropy, or a smaller pixel has to be assumed to be representative for the large pixel, i.e. homogeneity is required, or all small pixels inside the large pixel are measured which requires time and, hence, the assumption of a radiation field being constant within this time. In addition, the lower the comparison instrument is located, the more precise the correction for the atmosphere above the instrument has to be. The field-of-view of the comparison radiometer is about 5° giving about 1 km pixel size from 10 km altitude. This requires cross track homogeneity of the surface target in the order of a few METEOSAT pixels, i.e. 10 to 20 km at least. Along track homogeneity is not required due to the possiblity of data averaging.

For the vicarious calibration reported here, the comparison radiometer is placed into a high altitude aircraft, which is the meteorological research aircraft Falcon E of DLR. It flies in 10 to 11 km altitude leaving only about 20% of the total atmosphere above the aircraft. Therefore the accuracy requirement for the atmospheric turbidity to compute appropriate correction factors can be relaxed. This means in practise that the turbidity can be estimated because it turned out that the correction factors depend only very little on the atmospheric turbidity provided that the solar elevation is high enough, i.e. >50°. This is about the case between spring and fall equinox at geographic latitudes <40° Therefore the calibration campaigns have to be performed within the above constraints, because atmospheric turbidity data are usually not available for the time and the location of the calibration measurements. The correction factors are obtained by relating computed directional radiances in the flight level and on top of the atmosphere. The comparison radiometer looks downward through a large window in the fuselage with known transmission.

The spectral sensitivity of the METEOSAT-4 VIS-channel can hardly be reproduced by another instrument. Therefore a rectangular sensitivity was chosen which covers essentially the spectral bandpass of the METEOSAT-4 VIS-channel. This could be realized due to the fact that both are silicon detectors which defines the bandpass. The comparison radiometer detector is equipped with a specially matched interference filter cutting off about 2/3 of the total sensitivity but the remaining sensitivity has a nearly rectangular shape. A consequence of this approach is independence of the comparison radiometer from the spectral radiance distribution, in contrast to the METEOSAT-4 VIS-channel which can produce different counts with the same input energy if the latter has different spectral distributions. Therefore the calibration factor varies with scene type.

The absolute calibration is maintained by means of a spectral radiance standard which fills the aperture of the comparison radiometer with a homogeneous diffusing plate which is irradiated by a regulated quartz-halogen lamp. This calibration device is stable in time. It is absolutely calibrated by the Physikalisch-Technische Bundesanstalt (PTB) in Braunschweig, Germany. The absolute accuracy is ±5 %. Vicarious calibration requires simultaneous measurements of both radiometers. In practise there is no dependence on the time of the measurement as long as a linear interpolation of the measured counts between the two nearest METEOSAT images is used for the comparison.

3. CALIBRATION CAMPAIGN

DLR has performed several calibration campaigns with METEOSAT-1 and -2 (cf. Kriebel 1981, 1984). Due to the homogeneity requirements only two land sites could be identified so far to be usable for the vicarious calibration. They are an agricultural area, called La Mancha, southeast of Madrid, Spain, and a flat sand desert west of Djerba, Tunisia. A cloud free water surface has to be included into the set of targets because of its unique spectral behaviour, i.e. a decrease of reflectance with increasing wavelength due to the strong wavelength dependence of atmospheric scattering. Finally, a homogeneous cloud deck should be included because its reflectance is nearly constant over the entire bandpass of the METEOSAT-4 VIS-channel.

The METEOSAT-4 VIS-channel calibration campaign took place from August 30 to September 6, 1989. Successful measurements could be performed on 6 days as is shown in Table 1.

Date	Site	Calibration Factor in $W m^{-2} sr^{-1} count^{-1}$
1 September	La Mancha, Spain	1.16
5 September	Sand Desert, Tunisia	1.08
31 August	Atlantic Ocean between Portugal and Morocco	1.40
2 September	Mediterranean Sea between Spain and Algeria	1.40
30 August	low clouds (not very homogenous)	1.07
6 September	high clouds	0.95
6 September	low clouds	1.03

Table 1. Vicarious calibration measurements 1989

All measurements took place between slot 22 and slot 28 of the METEOSAT images which is close enough to local noon to have a high solar elevation angle. La Mancha measurements are an average of two flight legs of about six minutes each, Sand Desert measurements are an average of four flight legs of about two minutes each, Atlantic Ocean masurements are an average of two flight legs of about seven minutes each. Cloud measurements are of limited reliability because the homogeneous extent of the fields was of very limited size in all three cases. Particularly the result from 30 August is questionable because of the large inhomogeneity of the satellite data which indicates thin clouds allowing the surface to contribute to the signal. The individual calibration factors are also shown in Table 1. In Table 2 a comparison is shown between the results for METEOSAT-2 VIS and METEOSAT-4 VIS-channels. The values are not very different. Again it turns out that the calibration factor is roughly 1.1 $Wm^{-2}sr^{-1}count^{-1} \pm 10\%$ for all surface types except for water where it is much higher. The water calibration factor for METEOSAT-4 VIS-channel is much more reliable because of the 8-bit digitization of the satellite count instead of the 6-bit digitization of METEOSAT-2. An obvious difference is the low value for clouds with METEOSAT-4 VIS. This is a first hint of the different spectral sensitivity of the METEOSAT-4 VIS-channel. It has a higher sensitivity on the short wave side than the METEOSAT-1 and -2 VIS-channels.

Surface Type	METEOSAT-2 May 1982	METEOSAT-4 Aug./Sept.1989
La Mancha	1.10	1.16
Desert	1.06	1.08
Clouds	1.16	0.99
Ocean	1.8	1.40

Table 2. Calibration factors for the METEOSAT-2 and METEOSAT-4 VIS-channels in units of $Wm^{-2}sr^{-1}count^{-1}$

4. QUALITY CHECK

Simultaneously to the comparison radiometer measurements described above, independent spectral radiance measurements were taken in five narrowband spectral channels centered at 0.45 μm, 0.55 μm, 0.67 μm, 0.76 μm, 0.81 μm which about cover the bandpass of the METEOSAT VIS-channel. As a first consistency check the radiance obtained from a wavelength integration of these five channels was compared with the radiance obtained from the comparison radiometer. The wavelength integration was approximated by $\sum_{i=1}^{5} L_{\lambda i} \Delta \lambda$ with $\Delta \lambda = 0.1 \mu m$. The ratio of this radiance to L_{VIS}, the radiance obtained from the comparison radiometer, is shown in Table 3. The agreement is as good as could be expected, the values lie in the interval 0.96 ± 0.04.

	$\sum L_{\lambda} \Delta \lambda / L_{VIS}$
Ocean	0.93, 0.94, 0.92
La Mancha	1.00, 0.95
Desert	0.99, 0.99, 0.98, 0.98
Clouds	0.95

Table 3. Ratio of the METEOSAT-4 VIS-channel radiance simulated from the measured spectral radiances to the one measured by the comparison radiometer

The calibration factors obtained for the various scenes can be simulated by using the spectral radiance measurements. To do so, the spectral sensitivity curve of the METEOSAT-4 VIS-channel is divided into five parts. Each part is multiplied with the corresponding normalized spectral radiance. After adding, a reciprocal normalized calibration factor is obtained. Qualitatively the results are as expected: high values for land surfaces, not quite as high values for clouds and lower values for ocean. Quantitatively, the results are different for the two sensitivity curves of VIS 1 and VIS 2. The range of the reciprocal normalized calibration factor is less than $\pm$ 10% of the mean value for all scenes with VIS 1 and less than $\pm$ 20% for VIS 2. The VIS 2 results agree with the results of the comparison radiometer, the VIS 1 results do not. There is an obvious difference in the spectral sensitivity curves of VIS 1 and VIS 2 (METEOSAT-4 Annex to the Calibration Report, July 1989) on the shortwave side. This stems from the lack of preflight measurements below 0.45 μm. The curves have been extrapolated by ESOC according to the slope at 0.45 μm. Because these slopes are different, also the extrapolation is different. The suggestion is that the preflight sensitivity measurements are not precise enough to allow for a reliable extrapolation. Anyway those preflight sensitivity measurements are highly recommended to be conducted over the entire bandpass at least down to 5% relative sensitivity on both sides of the bandpass.

5. CONCLUSIONS

The vicarious calibration of the METEOSAT-4 VIS-channel has been successfully performed. Calibration factors have been obtained for two land surfaces, clouds and ocean. The calibration factors are still scene dependent, however, due to the different spectral sensitivity of the METEOSAT-4 VIS-channel as compared to previous METEOSAT VIS-channels, the variability is somewhat different. Any application of these calibration factors requires some knowledge on the scene type to select the most appropriate calibration factor. As a rule of thumb, i.e. in the $\pm$ 10 % range, it can be stated that 1 count of the METEOSAT-4 VIS channel is equivalent to 1.1 $Wm^{-2}sr^{-1}$ for all scene types with the exception of water surfaces. It could be shown that the spectral sensitivity curves of the VIS 1 and VIS 2 detector are not consistent to the measured data. Preflight sensitivity measurements over the entire bandpass is highly recommended.

This measurement campaign was equally sponsored by EUMETSAT and DLR. The authors wish to thank the Flugbereitschaft of DLR for their cooperation.

6. REFERENCES

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ANNEX VII

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

Current Status of GMS Wind Derivation

Summary and Purpose of the Document

In order to improve the accuracy of GMS high-level cloud motion winds, two studies were done at the MSC. From these studies,

1. The height assignment table for high-level cloud motion winds was revised on April 1, 1990.
2. The causes of low-speed bias around jet stream are provided in the attachment. We have a plan to make reflect the results to manual quality control of high-level cloud motion winds.

No action is required

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

Current Status of GMS Wind Derivation

In order to improve the accuracy of GMS high-level cloud motion wind (CMW), two studies were done at the MSC. One is on the difference between the high-level CMWs and radiosonde winds for the purpose of revising the assignment table which was determined in 1981. Another is on the low-speed bias of the high-level CMWs around jet stream. From the results, the causes of the low-speed bias were provided.

1. The height assignment for GMS high-level wind

Representative heights are assigned to the resultant high-level cloud motion winds. Those representative heights were determined on the basis of statistical level-of-best-fit between CMWs and radiosonde winds.

The table of statistical wind representative heights was revised from Table 1 to Table 2 on April 1, 1990. The comparison results between CMWs and radiosonde winds since 1988 are shown in Fig. 1 and Table 3 where the improvement since April 1990 is evident.

2. Revised table of wind representative height

The old table(Table 1) was determined using one month data representing four seasons respectively from 1980 to 1981. In order to improve the accuracy of high-level CMW, it was revised using 1988 data. The revised table(Table 2) was statistically determined in every tens of latitude belt zone for every month.

For the comparison of these two tables, the vector difference between CMWs and radiosonde winds in 1988 is shown in Table 4 which indicates the efficiency of the revised table especially in 20°S zone. However, the improvement of the RMS in 40°N and 30°N zones is smaller than that in the others. Two reasons can be considered; (a)the changes of representative heights in 40°N and 30°N zones are small, and (b)there often exists a large wind shear. In this region polar-front jet stream and sub-tropical jet stream exist and often join at the east side of the Asiatic Continent in winter and spring. Therefore, even if the CMWs are estimated correctly, the difference from radiosonde winds is bigger than that in another region.

3. High-level CMWs around jet stream

For the purpose of further improvement in mid-latitude region, height-level CMWs around jet stream have been investigated at the MSC. Its summary is described in the attached paper.

From the results of this investigation, the accuracy of CMW around jet stream can be improved if suitable height is assigned or erroneous CMW is rejected in manual quality control.

SEASON	WINTER	SPRING	SUMMER	AUTUMN
35°N	400 mb	300 mb	250 mb	300 mb
25°N NORTHERN HEMISPHERE	200 mb	200 mb	200 mb	200 mb
EQ				
SOUTHERN HEMISPHERE 25°S	200 mb	200 mb	200 mb	200 mb
35°S	250 mb	300 mb	400 mb	300 mb
SEASON	SUMMER	AUTUMN	WINTER	SPRING
	DEC 14/15	MAR 14/15	JUNE 14/15	SEP 14/15 – DEC 14

Table 1. Wind representative height table for high-level CMWs used before April 1990.

Latitude	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
40 ° N	400	400	400	300	300	300	300	300	300	300	400	400
30 ° N	400	400	400	300	300	250	250	250	250	300	400	400
20 ° N	300	300	300	300	300	250	250	250	250	300	300	300
10 ° N	250	250	250	250	250	250	250	250	250	250	250	250
EQ.	250	250	250	250	250	250	250	250	250	250	250	250
10 ° S	250	250	250	250	250	250	250	250	250	250	250	250
20 ° S	250	250	300	300	300	300	400	400	400	300	300	250
30 ° S	300	300	300	300	300	300	400	400	400	400	400	400
40 ° S	300	300	300	300	300	300	400	400	400	400	400	400

Table 2. Revised wind representative height table used since April 1990.

(2) HIGH-LEVEL WINDS

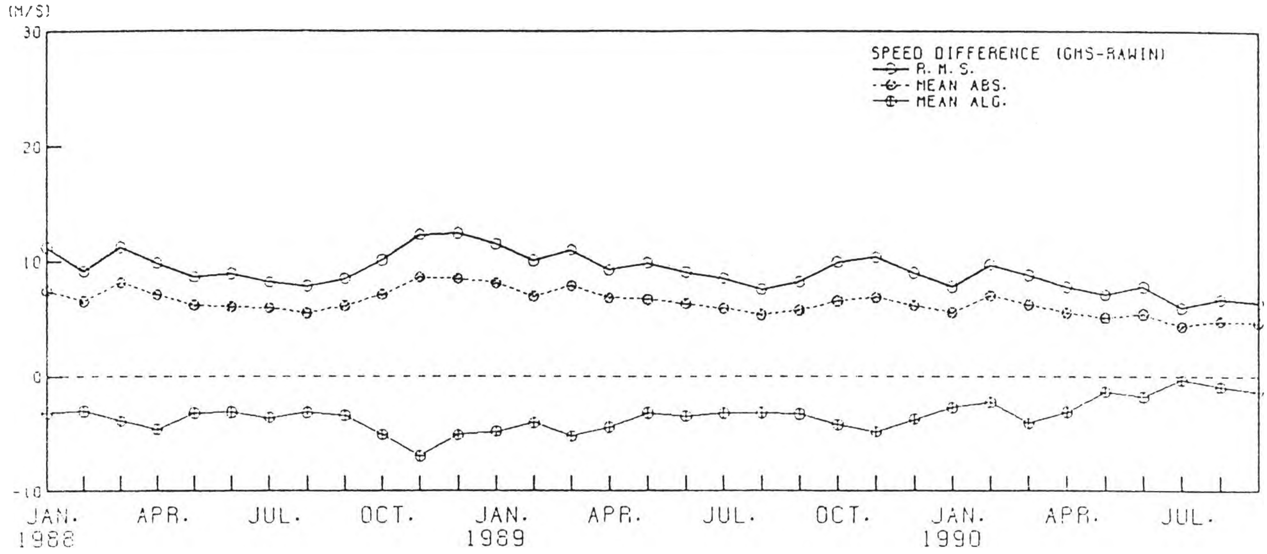
MONTH		SPL NO.	MEAN SPEED SAT.	RWN.	VECTOR DIFF. ABS.M	RMS	SPEED DIFF.(M/S) ALG.M	ABS.M	RMS
1988	JAN.	776	22.7	25.9	9.9	13.3	-3.2	7.4	11.2
	FEB.	772	22.2	25.2	9.2	11.9	-3.0	6.5	9.2
	MAR.	1087	27.8	31.7	10.5	13.1	-3.8	8.1	11.3
	APL.	1336	22.4	27.0	9.5	11.9	-4.6	7.1	9.9
	MAY	1622	20.0	23.2	8.9	11.1	-3.2	6.2	8.6
	JUN.	1789	17.3	20.4	8.8	11.3	-3.1	6.0	8.9
	JUL.	1780	14.6	18.2	8.7	10.7	-3.6	5.9	8.2
	AUG.	2506	12.6	15.8	8.2	10.1	-3.2	5.5	7.8
	SEP.	1723	17.7	21.1	8.9	11.1	-3.4	6.1	8.5
	OCT.	1261	17.0	22.1	9.7	12.4	-5.0	7.1	10.1
	NOV.	904	20.3	27.2	11.5	14.7	-6.9	8.6	12.3
	DEC.	777	19.7	24.8	11.3	14.6	-5.1	8.5	12.4
1989	JAN.	1081	21.4	26.1	11.1	14.0	-4.8	8.1	11.5
	FEB.	861	20.2	24.2	9.8	12.5	-4.0	7.0	10.1
	MAR.	1123	20.4	25.6	10.6	13.1	-5.2	7.9	11.0
	APL.	1367	22.7	27.1	9.4	11.5	-4.4	6.8	9.2
	MAY	1363	23.1	26.3	9.3	11.9	-3.2	6.7	9.9
	JUN.	1651	17.8	21.2	9.0	11.4	-3.5	6.3	9.1
	JUL.	1780	14.9	18.1	8.8	11.2	-3.2	5.9	8.5
	AUG.	1666	13.3	16.5	8.1	10.0	-3.2	5.4	7.6
	SEP.	1552	17.2	20.5	8.4	10.6	-3.3	5.7	8.2
	OCT.	1074	19.4	23.5	9.2	12.0	-4.2	6.5	9.9
	NOV.	1096	19.9	24.7	9.6	12.5	-4.8	6.8	10.4
	DEC.	759	18.3	22.0	8.7	11.1	-3.7	6.2	9.0
1990	JAN.	929	20.9	23.6	8.0	10.2	-2.7	5.5	7.8
	FEB.	1111	23.4	25.7	9.6	11.9	-2.3	7.0	9.8
	MAR.	1003	18.8	22.9	8.8	11.0	-4.1	6.2	8.8
	APL.	998	20.9	24.0	8.0	10.0	-3.1	5.5	7.8
	MAY	1121	19.0	20.3	7.5	9.1	-1.3	5.1	7.1
	JUN.	1060	17.0	18.8	8.0	10.0	-1.8	5.4	7.8
	JUL.	1281	13.6	13.9	7.0	8.4	-0.4	4.4	5.9
	AUG.	1270	13.3	14.2	7.6	9.2	-0.9	4.8	6.6
	SEP.	1330	15.5	16.8	7.1	8.7	-1.3	4.6	6.4

Table 3. Comparison results between CMWs and radiosonde winds since 1988.

Latitude	Old Table RMS (m/s)	Revised Table RMS (m/s)	Num. of Data
40 ° N	12.51	11.31	2016
30 ° N	10.63	9.57	2658
20 ° N	10.36	8.77	1463
10 ° N	7.49	6.98	1530
EQ.	8.93	7.25	521
10 ° S	7.38	6.34	365
20 ° S	14.03	9.99	217
30 ° S	12.60	10.49	303
40 ° S	13.00	11.42	142

Table 4. Zonal RMS of vector difference between CMWs and radiosonde winds in 1988.

HIGH LEVEL WINDS



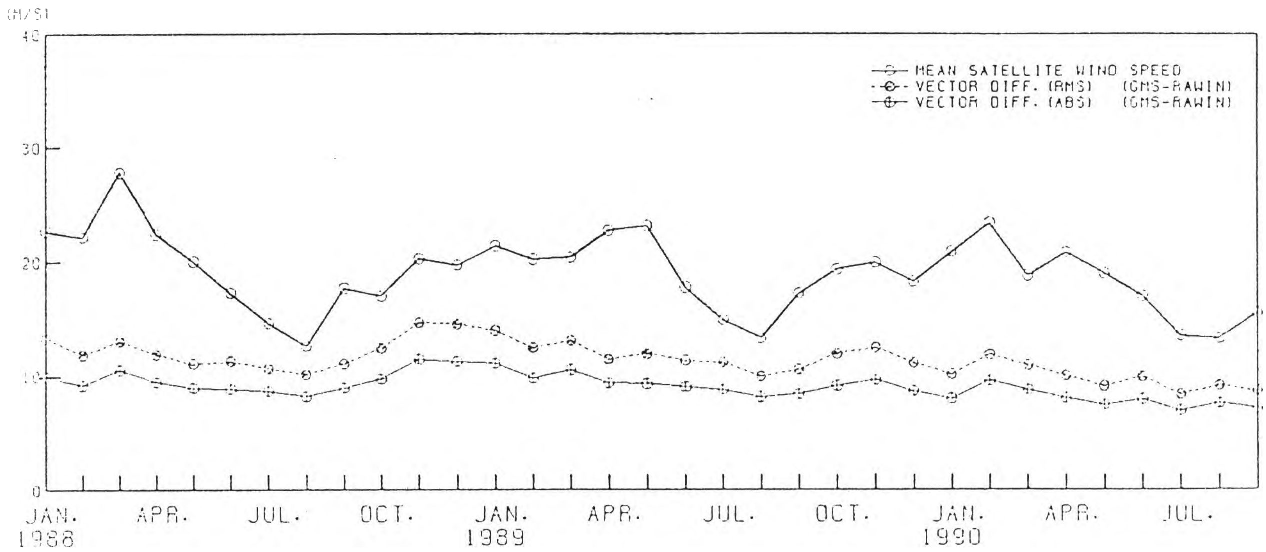


Fig. 1. Comparison results between CMWs and radiosonde winds since 1988.

ATTACHMENT

The low-speed bias of Cloud Motion Winds (CMWs) from GMS

The low-speed bias of high-level CMWs (Cloud Motion Winds) from GMS

October 1990

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and Takao Imaizumi
Meteorological Satellite Center, Kiyose, Tokyo

It is well known that high-level CMWs derived at mid-latitude have the low-speed bias compared to radiosonde wind or airep wind. In order to solve the cause of the low-speed bias, some studies are being carried out intensively. Brief summaries of two case studies and one statistical study are provided in the followings.

1. Comparison between CMWs and radiosonde winds. (cases in spring 1990)

Comparison between CMWs and radiosonde winds was performed for three cases in May 1990. These cases were chosen because there existed high-level clouds which we could trace easily and the terget clouds located over land area where many data of winds observed by radiosonde were available. The CMWs were obtained by manual method using loop movie images prepared for study use on TV-display. Radiosonde winds were chosen at the level of the mandatory surface where the wind direction was best-fit to that of CMWs near the radiosonde observation. The scatter plot of the CMWs and radiosonde winds is shown in Fig. 1. CMWs are fairly coincident with radiosonde winds in the range not only of low-speed but also of fast-speed.

2. Where do rogue CMWs derived ? (case in winter 1989)

The distribution of wind speed at 200 hpa and tropopause height and the minimum temperature of cloud top are shown in Fig. 2. The virtical cross section of wind speed, CMWs and thick cloud tops is shown in Fig. 3. The height of CMW is assigned to the level where the wind speed is same as the radiosonde wind speed. The CMWs are obtained by the same method as case study (1).

In this case cloud top temperature gradually becomes warmer from north to south and an isothermal layer corresponding to a frontal boundary between polar and subtropical air keeps cloud tops under. Jet stream core stays above the isothemal layer where a strong wind shear exists. Therefore, small error of height assignment of CMWs around the isothemal layer causes a large speed difference between CMWs and radiosonde winds.

The representative heights determined by statistical method are assigned to GMS winds. Because 400 hpa is routinely assigned to the high-level CMWs according to region and season, the CMWs which locate around 'A' (about 500 km from the cliff of tropopause.) have about 40 knots minus bias from radiosonde winds at an altitude of 400 hpa.

From above two case studies it is presumed that the cloud movement does not delay from fast speed wind (jet stream), and that strong virtical wind shear which stays under jet stream causes. rogue CMWs.

3. Statistical study of rogue CMWs. (data in 1988, 1989)

CMW was compared with radiosonde wind which located within 100 km from CMW. The rogue CMW which had a vector difference from radiosonde wind greater than 15 m/s was chosen from CMWs data in 1988 and 1989. The frequencies of the rogue CMWs in every 100 km around jet stream are shown in Fig. 4. The rogue CMWs are distributed around jet stream and southward from the cliff of tropopause. This distribution of the rogue CMWs is not inconsistent with the result of case study (2).

4. Results

(1) A cloud motion represents a wind speed fairly well, if suitable wind height is assigned.

(2) Small upward level difference from suitable one derives large low-speed bias around jet stream because of strong wind shear existing in the isothermal layer (below jet stream) which limits cloud top height.

(3) Since lots of rogue CMWs are derived around jet stream, it is possible for manual QC to reduce them or to correct the level (by the aid of numerical forecast data).

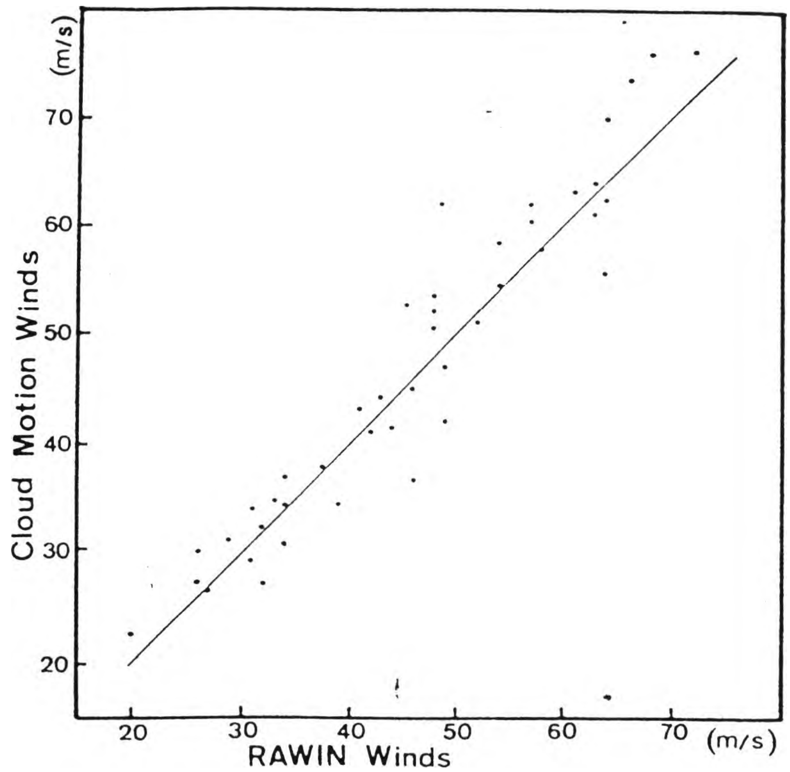

Fig.1 Comparison between CMW and radiosonde wind speed for the three cases in May 1990.

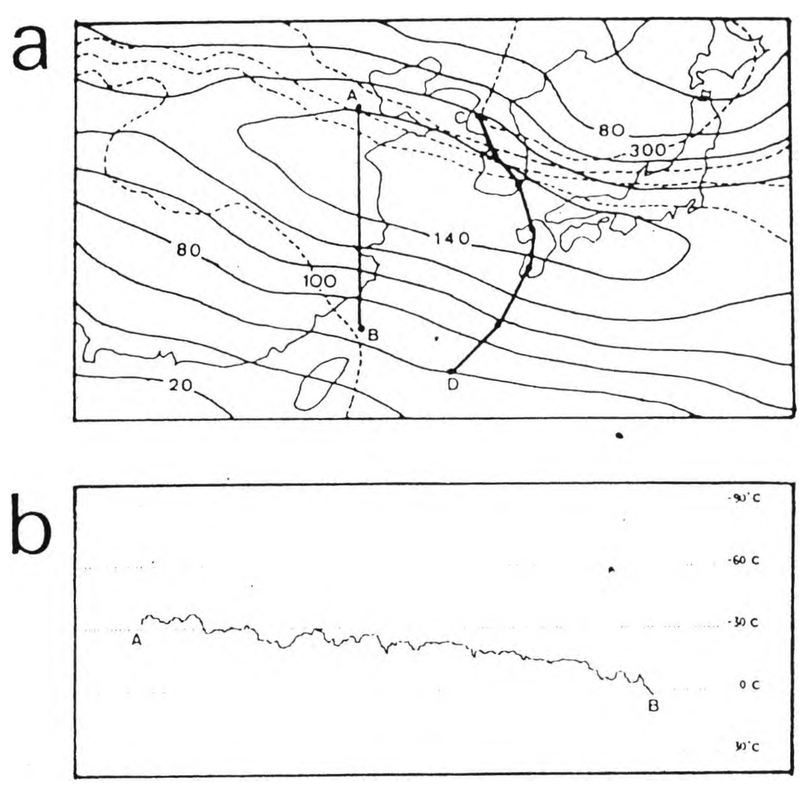

Fig.2 (a) Objective analysis for numerical forecasting at 12 UTC on January 21, 1989. Dashed and solid lines show the height of tropopause (every 50 hpa) and wind speed (every 20 knots) at 200 hpa, respectively.
(b) Minimum temperature of cloud top along A-B (heavy solid line in (a)).

ANNEX VII

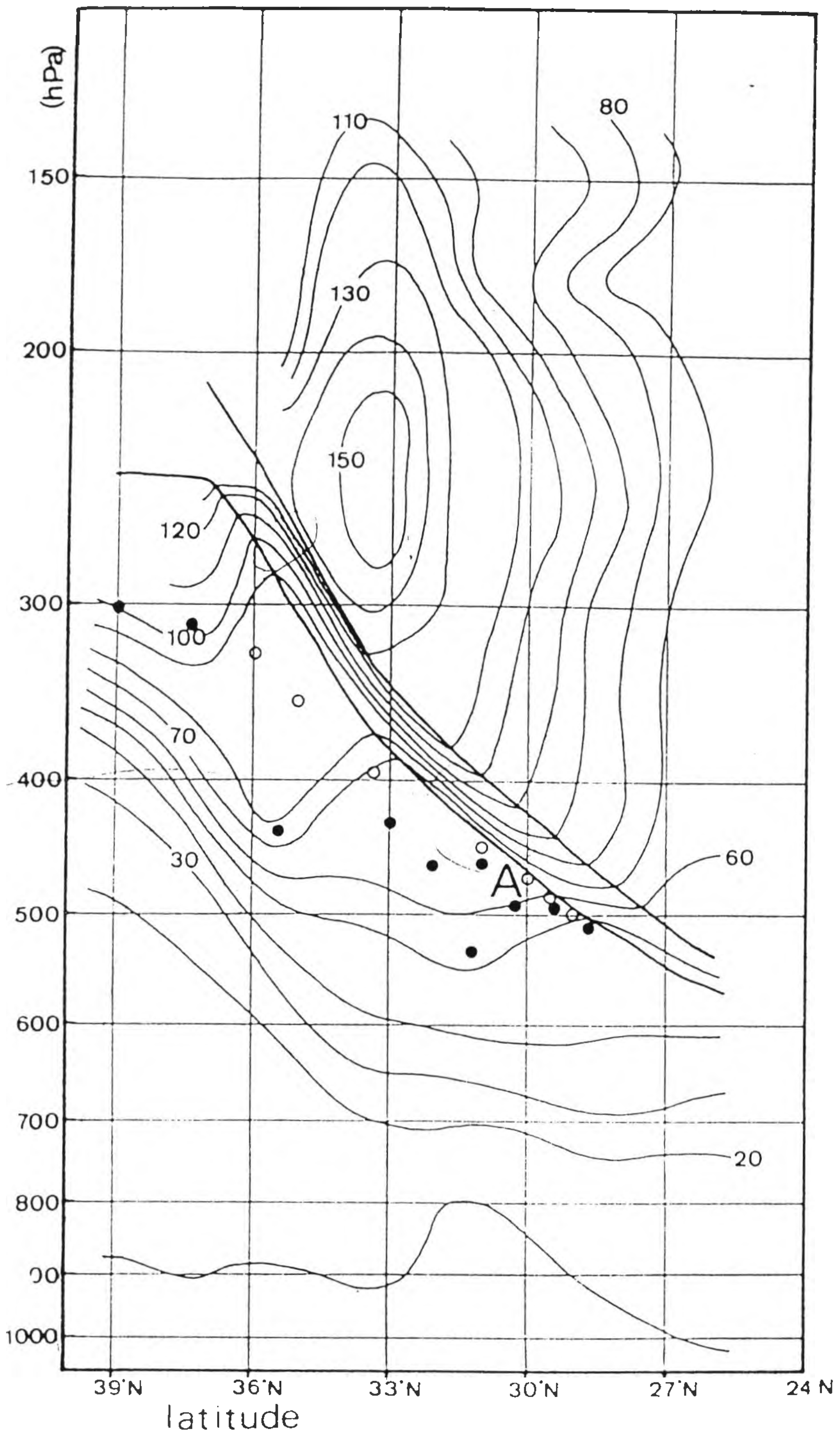

Fig.3 Cross section along C-D (heavy solid line in Fig.2(a)) of wind speed (knots, thin solid line) at 12 UTC on January 21, 1989. Heavy solid lines indicate the boundary of the polar front. Cloud tops (open circle) stay under frontal boundary. The CMWs (solid circle) are plotted at the altitude corresponding to radiosonde winds.

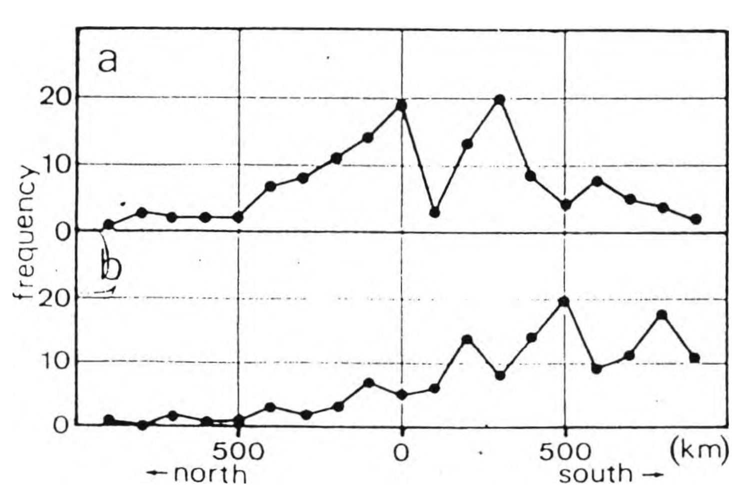

Fig.4 (a) The frequencies of rogue CMWs in every 100 km from jet stream core. Most rogue CMWs distribute within 500 km from jet stream core.

(b) Same as (a), but for from northern edge of tropopause. cliff. most CMWs distribute south side of the cliff.

WMO *EUMETSAT* *NOAA*

FIRST ANNOUNCEMENT

WORKSHOP ON

WIND EXTRACTION FROM OPERATIONAL METEOROLOGICAL SATELLITE DATA

Washington D.C., USA

September 1991

A Workshop on wind extraction from operational meteorological satellite data is provisionally planned to be held in Washington D.C., USA, during the month of September 1991. It will be sponsored by NOAA, EUMETSAT and WMO. The purpose of the Workshop will be to improve the exchange of expertise in this area between current and future operators of geostationary meteorological satellites.

The primary subject will be wind extraction from current generation meteorological satellites with particular emphasis on operational use within the World Weather Watch system.

Presentations will normally last 20 minutes, including discussion, except for some invited keynote presentations of 45 minutes each. The overall duration of the workshop would be around 3 days.

It is foreseen that the meeting will have the following five sessions:

Operational Extraction of Cloud Motion Winds

METEOSAT
GOES
GMS
INSAT

Wind Tracking From Absorption Channel Data

Verification and Impact Studies of Operational Wind Data

Future Studies and Development

Panel Discussion

Participation in this Workshop is invited from:

1. Current and future providers of operational satellite wind data

2. Institutes carrying out research in this field

3. Users of satellite wind data

A registration form is attached to this Announcement. Presenters are kindly asked to indicate the subject of their presentation on the registration form which should be returned to EUMETSAT, together with a brief abstract, as soon as possible and no later than 15 March 1991.

Further information about the Workshop programme, registration, hotels and transportation will be provided in a Second Announcement within a few months. An Abstract Brochure will be prepared in advance of the meeting, and the Workshop Proceedings shortly thereafter.

Limited funds may be available to support travel costs and per diem for some selected speakers.

WORKSHOP ON WIND EXTRACTION FROM OPERATIONAL METEOROLOGICAL SATELLITE DATA

Washington D.C., USA, September 1991

I wish to participate in the above Workshop, and make a presentation on the following topic:

AUTHOR(s)/NAME:

AFFILIATION AND FULL POSTAL ADDRESS:

Telephone: Telefax: Telex:

TITLE OF PRESENTATION:

A separate sheet should be used for the **ABSTRACT**, taking the attached model into consideration (one page maximum).

Please indicate if you wish to participate, but not make any presentation.

Please return this registration form, as soon as possible and no later than the 15th March 1991, to:

Mrs. Mireille Onssels,
EUMETSAT
Am Elfengrund 45,
6100 Darmstadt-Eberstadt
Federal Republic of Germany

EUMETSAT numbers: Telephone: (intnl code 49) 6151 539213 Telex: 4197335 emet d
Telefax:(intnl code 49) 6151 539225

TITLE TITLE TITLE TITLE

Author(s)

Affiliation Affiliation
Address Address
Country

ABSTRACT

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FORECAST OF CLOUD FORMATIONS MOVEMENT MADE WITH APPLICATION OF TECHNICAL FACILITIES OF THE CENTRAL ASIAN REGIONAL COMPUTER CENTER

The below method of presenting cloud formations movement is based on computation of trajectories of air particles movement (1 - 3) for pressure fields topography (AT-500). The forecast earliness of the pressure fields is the forecast earliness of trajectories. Time steps of trajectories are used to compute locations of cloudy systems.

PUTTING AND REALIZATION OF PROBLEM

Geopotential values at some moment in the points of regular grid (A, B, C, D) being available (Fig. 1.) we can compute both the values of geopotential H_{t_i} in the intermediate point E by the method of bi-linear interpolation and values of derivatives $\frac{\partial H}{\partial x}, \frac{\partial H}{\partial y}$. Velocity components of geostrophic wind at any point are presented as

$$U = -\frac{9.8}{\ell}\frac{\partial H}{\partial y},$$

$$V = \frac{9.8}{\ell}\frac{\partial H}{\partial x}$$

where $\ell = 2\omega \sin\varphi$ is Coriolis parameter, and resultant velocity is:

$$C = \sqrt{U^2 + V^2}$$

Then coordinates' increment from point E to point L is:

$$\Delta x = -2.15\, V \cdot \Delta t$$

$$\Delta y = 2.15\, U \cdot \Delta t$$

where $\Delta t = t_{i+1} - t_i$ is time step, U, V - are the components of geostrophic wind in the point E. As a result one can define the coordinates of the point t_{i+1} at the time moment L, where the air particle displaces from the point E with the velocity

$$X_L = X_E + \Delta X,$$

$$y_L = y_E + \Delta y,$$

and geopotential values

$$H_{t_{i+1}} = H_{t_i} + (H_{T_2} - H_{T_1})/(T_2 - T_1) \cdot \Delta t,$$

where H_{T_1}, H_{T_2} - are the geopotential fields prescribed at two successive time moments T_1 and T_2.

As to forecast earliness n, T successive time steps Δt are performed. Indirect accounting for atmospheric processes in computation of air particles trajectories is made using prognostic values of geopotential.

The forecast scheme of the cloud formations movement (Fig.2) is realized on the technical facilities of the interactive image processing with preliminary preparation of initial information on EC computer (transformation of satellite images from NOAA into the stereographic projection, data samples of AT-500 in GRID code in the points of regular grid of the Central Asian territory). The computational scheme requires following information:

- the image of cloudiness over Central Asian territory transformed into stereographic projection and recordered in video-memory;
- pressure fields topography AT-500 (of analysis and forecast) recorded on magnetic tape. This information serves as initial one for programmes operation; contouring of cloudiness and recording of contour points coordinates on a magnetic disc, forecast of cloudiness movement.

Operator prescribes manually characteristic points of cloudiness contours on the image. Following values are computed automatically for every point:

- initial geographic coordinates φ , λ ;
- geopotential H ;
- derivatives $\frac{\partial H}{\partial x}$, $\frac{\partial H}{\partial y}$;
- components U , V of geostrophic fields velocity;
- increment of coordinates for the initially selected points after $n\Delta t$ hours, of points' geographical coordinates in $n\Delta t$ hours.

Computation of future cloudiness contours positions can be carried out by means of the time steps from 1 up to 12 hours (3 hours, as a rule). The earliness of the movement forecast depends on the availability of pressure fields (of analysis and forecast) AT-500. For example, having available analysis for 00 hours and 24-hours forecast we can compute 24-hours forecast of the cloud formations position.

THE RESULTS OF THE TESTS

Testing of a set of programmes on shifting of cloud formations was made on the actual material in two stages: from January up to May and from August up to December 1989. Totally about 30 cases of cloud formations movement in various synoptical situations were computed. The results of computations were transmitted to the group of reception and analysis of satellite analog data. Testing results were used to obtain an estimate of accuracy of cloud formation movement which is of the order of 80% with allowable error up to 200 km. The estimate is comparable with manual method. In future the technique for hydrometeorological and satellite information processing should be improved for implementation of the forecasts of cloud formations movement into operational practice.

The presented material is prepared by Gaganov K.D., Kurbanov B.R. (CARCC)

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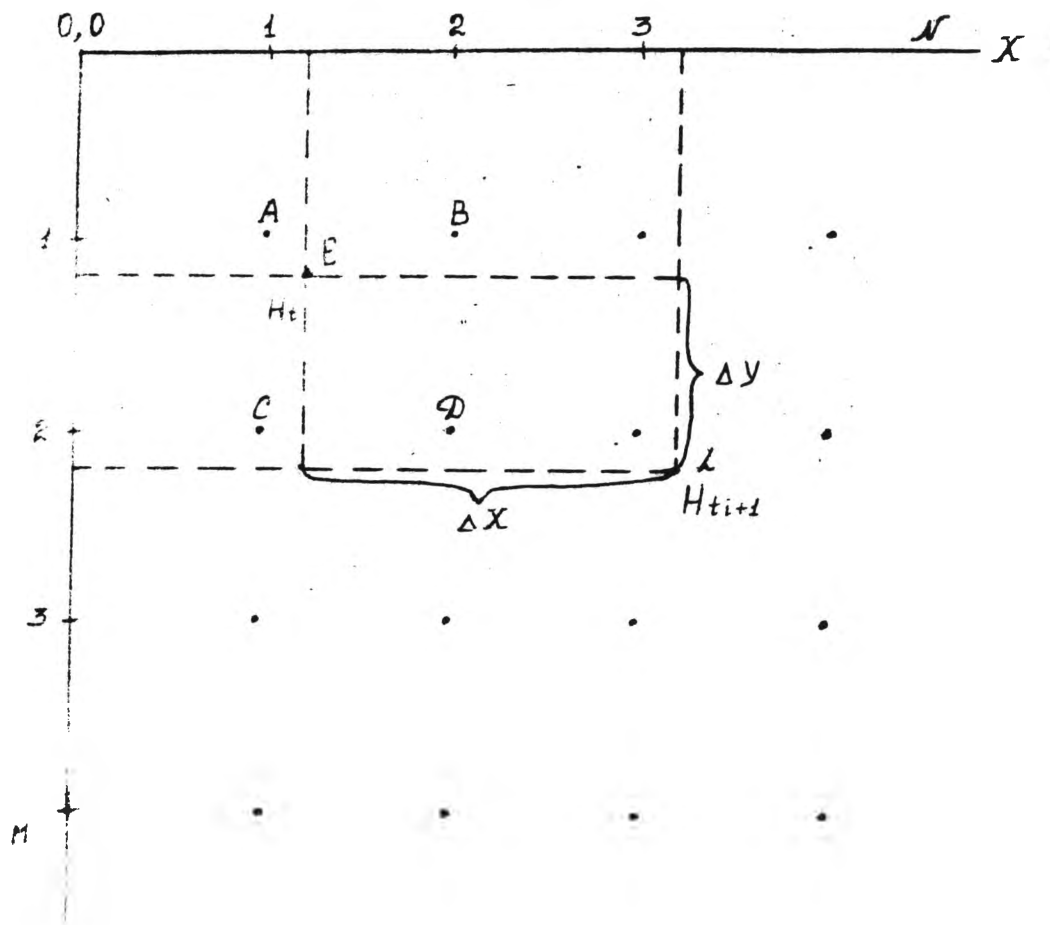

Fig.1. Scheme of geopotential data presentation

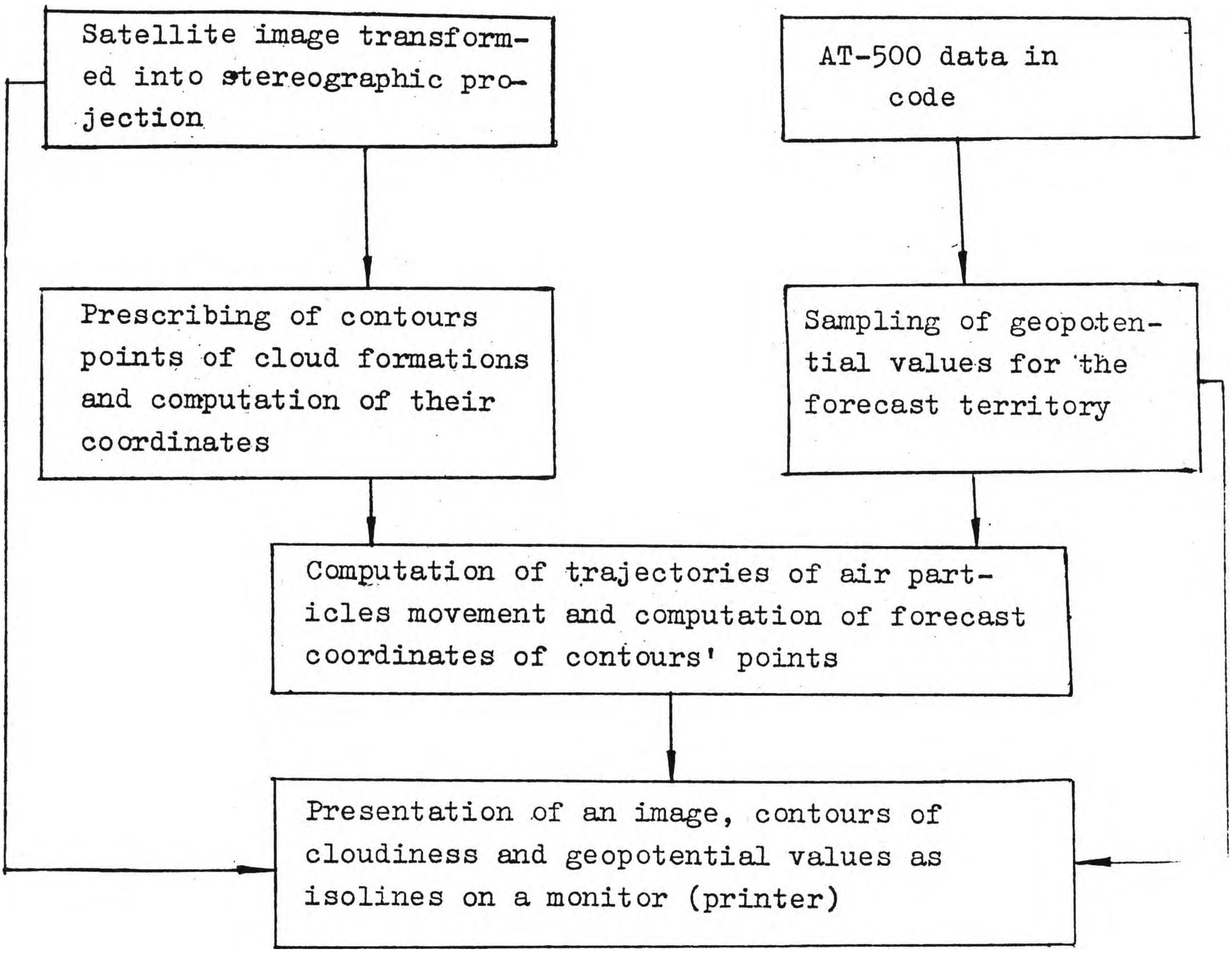

Fig.2. Stages of the forecast scheme for the cloud formations movement

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CGMS-XIX
Attachment
Coscomhydromet WP 8
Prepared by
Hydrometeorological Centre
of the USSR
Agenda Item: WG II/2

WORKING GROUP II - SATELLITE PRODUCTS II/2 Meteorological and other Parameter Extraction

Remotely sensed meteorological products from "Meteor" polar orbiting satellites

Summary

The review of meteorological parameters extraction from "Meteor" data is presented. The characteristics of temperature soundings and sea surface temperature estimates from "Meteor-2", "Meteor-3" satellites are discussed.

ANNEX X

Remotely sensed meteorological products from "Meteor" polar-orbiting satellites.

1. Introduction

At present the Meteorological Service of the USSR (Goscomhydromet) operates a meteorological Satellite system called "Meteor-2". The system is composed of two to three permanently operated near polar orbiters at an average altitude of about 900 km with orbital inclination of 82,5° and of data receiving and processing centres at Moscow, Novosibirsk and Khabarovsk. In 1986 the fourth centre was organized in Tashkent. The onboard sounding payload includes multichannel scanning IR radiometer, providing with the temperature sounding of the atmosphere and one-channel scanning IR radiometer providing with the sea surface temperature (SST) measurements and information on clouds.

Simultaneously with already deployed "Meteor-2" system meteorological satellite "Meteor-3" system is tested. These satellites are flown on near-circular orbits at the altitude of about 1200-1250 km. Orbit inclinations are 81° to 83°. "Meteor-3" system after being operational will be composed of 2-3 satellites. The major objective of "Meteor-2" substitution by "Meteor-3" system is further improvement of extracted meteorological parameters quality. List of "Meteor-2", "Meteor-3" instruments and their key characteristics can be found in the Report of CGMS XVIII meeting. The purpose of this short review is to describe the characteristics of meteorological products available from "Meteor" and to provide with information on how to obtain data.

2. Sounding products

2.1. Temperature sounding of the atmosphere

Derivation of temperature sounding products is based on the outgoing IR radiance measurements by filter scanning IR radiometer (FSIRR). The "Meteor-2" satellite-borne FSIRR instrument has 10 channels (in 11.1-18.7 mm spectral band) and resolves a circular area of 40 km diameter (angular resolution of one pixel is 2° x 2°) at the subsatellite point. Each FSIRR scan line has 25 fields of view with a linear extent of 1000 km. The distance between adjacent scan lines is equal to 400 km, see [1] for details . The modified FSIRR (developed for "Meteor-3") has also 10 channels in 9,65-18,7 microns spectral band.

The observed FSIRR radiances from "Meteor-2" and "Meteor-3" are transformed to vertical temperature profiles by means of processing algorithms being developed in the satellite meteorology branch of Hydrometeorological Centre in Moscow (HMC). The development of software package included the elaboration and testing of some original algorithms and programs providing with: suitable parameterization and linearization procedures: - detection of clouds; - regularised linear estimates for unknown parameters; - dynamic correction and adjustment of radiance model and data. Details of these algorithms can be found in [3-6].

The experimental run of processing scheme in 1986-1987 have shown that it is possible to retrieve temperature profiles on the base of FSIRR observations in situations without clouds (using so called clear column radiances). As a result software package for FSIRR data processing was implemented in above mentioned receiving and processing centres. It provides with:

- preprocessing of the FSIRR raw data (decoding, earth location, calibration);
- temperature profile retrievals in "clear" conditions (without clouds);
- SATEM messages formation for transmitting via communication links.

The quality of sounding products depends strongly on initial guess profiles incorporated into retrieval procedures. In general it is possible to use different kinds of such apriori information: - clymatology guess for temperature T(p) and mixing ratio q(p) profiles;-"nearest" RAOB data{ T(p), q (p) } or analysis of HMC;- forecast profile guess. The last type of information has evidently higher priority. For the sake of unification and simplicity the software package with minimal information support has been realised in processing centres: the catalogue of monthly means { $T^{c}(p)$, $q^{c}(p)$ } for $5^{0} \times 5^{0}$ latitude/longtitude bins was used.

The results of temperature profile retrievals being transformed into heopotential thicknesses and presented in the form of SATEM messages are transmitted via links and are collected in the HMC data base. During 24 hours it is possible to receive sounding products from 6-9 orbits (2-3 orbits at each of three centres). One sounding is produced for 5 adjacent pixels (5 soundings for one scan line in the absence of clouds). Total number of soundings is approximately 150-200 for one orbit. To estimate the quality of satellite soundings quantitative intercomparison studies using HMC analysis and colocated RAOB data have been made. The basic statistics (δ =mean, σ =standard deviation) for the differences $\hat{T} - T^a$ between retrievals $\hat{T}$ and analyses T^a are given in table 1. The results of soundings validation against RAOB data are summarized in table 2. In analyzed cases we used data for northern hemisphere only and from individual orbits.

Table 1

Biases (δ) and standard deviations (σ) between FSIRR temperature soundings and HMC analyses for "Meteor-2", "Meteor-3"

P(hPa)	850	700	500	400	300	250	200	150	100
	27.05.87; N=500; "Meteor-2"								
δ	1.1	0.6	-0.1	0.9	0.0	-1.0	0.6	2.0	0.9
σ	3.0	2.5	2.6	2.7	2.3	2.6	2.6	2.7	3.0
	17.06.87; N=333; "Meteor-2"								
δ	1.7	0.2	-0.1	1.5	0.9	1.2	1.3	0.7	-1.1
σ	3.1	2.6	2.5	2.5	2.1	2.3	3.0	2.8	2.8
	01.12.89; N=59; "Meteor-3"								
δ	2.4	0.5	-0.6	0.3	-0.1	0.5	-0.8	0.3	1.6
σ	2.9	2.0	1.6	2.1	2.0	2.2	1.8	3.2	2.8
	02.12.89; N=69; "Meteor-3"								
δ	1.9	-0.4	-0.8	-0.1	-0.3	0.4	-0.4	1.5	2.6
σ	2.2	1.3	1.2	1.6	2.1	2.6	2.7	2.2	2.4

Table 2

Biases ($\hat{\delta}$) and standard deviations (σ) between geopotential heights from "Meteor-2" and RAOB data (The values $\hat{\delta}$, σ are given in metres)

P(hPa)	700	500	250	100	50
	10.11.90; N=354				
$\hat{\delta}$	-5	-5	5	-69	-56
σ	34	54	83	74	77
	19.11.90; N=102				
$\hat{\delta}$	16	39	75	-16	-65
σ	0	30	78	76	99
	21.11.90; N=246				
$\hat{\delta}$	1	12	28	-33	-70
σ	34	55	84	82	79

According to table 2 the systematic and random components of error are rather high and we need the special procedure to correct erroneous soundings (to remove biases) or to reject them.

Some comments to the results of intercomparisons and accuracy estimates should be done . The quality of retrievals suffers from the contamination of the sounding radiances by clouds (errors of cloud detection procedures). Secondly, the level of measurement errors (noise) is not stable: it can change from orbit to orbit. Due to these facts it seems reasonable to derive and to implement some supplementary procedures of data filtering before disseminating SATEM messages through GTS.

2.2. Derivation of SST estimates

Since the beginning of 1980 th Goscomhydromet has been deriving global SSTs from "Meteor-2". The SSTs are obtained from satellite IR measurements in atmospheric window spectral band (8-12 μm for "Meteor-2" and 10,5-12,5 μm for "Meteor-3" instruments). The "Meteor-2" instrument being one-channel scanning radiometer (hereafter SR.8-12) resolves a pixel of 8 km diameter at the subsatellite point. Each SR.8-12 scan line has 399 pixels with a linear extent of 2600 km. The distance between adjacent scan lines is 12 km. The "Meteor-3" instrument has improved characteristics: more transparent spectral band, more high resolution (3 km at the subsatellite point). Satellite measurements in terms of radiance temperatures T_{χ} are transformed to SST estimates and values of cloud tops h_{ct} by means of special software package implemented in the same three processing centres. This package provides with:

- preprocessing of raw SR data (decoding, earth location, calibration);
- derivation of SSTs and h_{ct} ;
- preparation of SSTs digital charts for given regions.

These charts are distributed to the users by facsimile.

We apply the threshold procedure for selecting clear fields of view and clymatology guess profiles $T^c(p)$, $q^c(p)$ for corrections of atmospheric radiance attenuation (the effects of water vapor and ozone absorption).

The intercomparison studies using "Meteor-2" SSTs and colocated HMC analysis data (for 5 day period) demonstrate that the accuracy of SST estimates is not worse than 2°C for clear cases.

Validation of "Meteor-3" SSTs against HMC analyses for several days in May-June 1990 indicates small systematic biases and rms differences of 1.5°C.

Matchups of satellite and ships of opportunity observations indicate rms differences of the same order (≤ 1.5°C).

Taking into account this study in seems reasonable to recommend the experiments on the use of satellite SSTs (the incorporation of SST data from "Meteor-3" into the analyses).

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ANNEX XI

CGMS-XVIII USA WP-#16
Prepared by USA
Agenda Item II/3

NESDIS NEW PRODUCTS FOR NOAA KLM

Summary and Purpose of Document

The document contains the NESDIS approved NOAA KLM product list. The paper also discusses aspects of the major product changes from the current product list.

Action Proposed

NESDIS New Products from NOAA KLM

Patricia Mulligan, NOAA/NESDIS et. al. [1]

Introduction

Since this paper was prepared for last year's meeting there has been only one change to the NOAA KLM product list. That change is discussed in the section on Aerosols. However over the coming year substantial additions and changes may be made to the algorithms discussed in this paper. Final delivery of algorithms for System 92 is due in September of 1991, and all the science supporting atmospheric soundings will be reviewed and updated before that time. Additionally, the design of software processing NOAA KLM data is expected to be influenced by NOAA's participation in the Climate and Global Change Program. Product Advisory Teams recently made their recommendations for the processing of various suites of products, and several of those recommendations will be presented for decision to NESDIS in coming months. A report on these changes will be made to next year's meeting.

When NOAA K is launched it will be carrying a new twenty channel microwave sounding instrument, the Advanced Microwave Sounding Unit (AMSU), and an improved Advanced Very High Resolution Radiometer (AVHRR) with a 1.6 um channel, time shared with the present channel 3. At that same time an entirely redesigned product generation system will have been brought on line. Several new products will be generated in this time frame, and many others will be improved. Product changes will result from sensor changes, improved science, software upgrades, and even changes in the preprocessing system such as new calibration techniques.

Appended to this paper is the NESDIS NOAA KLM Product List. Products designated "primary" are approved, and funded, for development; "secondary" products are likely candidates for development in the future. On the system level, much of the new software will be installed by late summer in 1991, and will be used to process data from the current NOAA polar satellites. Software specific to the new microwave data will be implemented at the launch of NOAA K. Several documents are available on request on the science foundation of the products and on the software system design.

Atmospheric Sounding Products

The NOAA KLM System will be capable of delivering a slightly increased quantity of improved products in late 1991, and both new and improved products at a higher quantity in the mid-nineties

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[1] B. Banks, H. Drahos, N. Shellman, N. Grody, J. Sapper, D. McGinnis, H. Jacobwitz, M. Weaks, L. Stowe, NOAA/NESDIS, Suitland, MD; and R. Ferraro, S.M. Systems and Research Corp., Landover MD

(dependent upon the actual launch of NOAA-K). The Microwave Sounding Unit (MSU) and Stratospheric Sounding Unit (SSU) instruments are replaced by the AMSU, but the existing High Resolution Infrared Sounder (HIRS) instrument will be retained. New science techniques will be applied to both microwave and infrared data.

Sounding system changes are being implemented in two phases in order to separate in time the check out of new software, new science, and a new sensor's data. The first phase, "System '90 will incorporate the AVHRR Global Area Coverage (GAC) data at the HIRS Field of View (FOV) and will use improved infrared science to generate the same sounding products as the existing TOVS system.

Improvements are anticipated in the products due to better cloud identification and clearing using AVHRR data and improved science techniques (N* improvements), and due to the repositioning of the global limb correction to just prior to the retrieval process. Additionally, the third path products should benefit because of the improved coefficient generation system that utilizes cloudy retrievals for the first time. The retrieval technique will retain the physical solution now used in TOVS, but a different first guess may be incorporated. A small increase in the number of retrievals generated is possible because of more efficient use of all data, and science improvements. A by-product of the System '90 architecture will be horizontal gradient information. User demand for these fields may result in their being designated as products in the future. Considerably more quality control (Q/C) of all science processes and trend analysis of specific parameters are also being incorporated into the system. There are no plans at this time to change the user interface through the implementation of System '90.

The second phase, "System '92" will be implemented at the time the NOAA-K spacecraft is launched. AMSU data will permit the generation of some completely new products such as cloud liquid water and cloud composition. All existing products will continue, except that considerably more accuracy in both temperature and water vapor profiles is anticipated especially in the tropospheric cloudy regions due to the greatly increased horizontal and vertical resolution of the AMSU instrument. All previous infrared science will be retained in the new system. Unfortunately, because the AMSU does not view as high in the atmosphere as the SSU, the height of useful retrieval products will fall from 1mb to around 2mb (45 km), for the data from NOAA K's sensor. However, additional microwave channels peaking higher in the atmosphere will be included as soon as possible on following satellites. The product resolution will increase from about 80 km to 50 km at nadir in the horizontal with a corresponding increase in the number of products available (before filtering) of about a quarter million per spacecraft per day. This represents almost an order of magnitude increase in products and therefore substantial filtering (reductions of products in uneventful meteorological areas, where redundancy can be eliminated and bad or dubious quality products are removed), and renovation of the user interface software (format and content) is planned between the implementation of System '90 and System '92.

Image Products

New Products - Global polar stereographic masters will be generated from selected channels of instrument data. The AMSU sensor has two components, AMSU-A containing channel 1-15 with an FOV approximately 50 km, and AMSU-B containing channels 16-20 with an FOV of approximately 15 km. AMSU channels 1,2,3,4,5,15,16 and 17 will be mapped. The map resolution will be 47.6km and 23.8km for the AMSU-A and AMSU-B respectively at the 60 degree north and south latitudes with a prime longitude of 80 west. In addition to the instrument data; the scan time, scan angle, solar zenith angel and the satellite azimuth angle will be mapped. These products will be produced daily and used to derive other environmental products such as quantitative precipitation, snow cover and ice products.

Improved Products - Global polar stereographic maps generated from AVHRR channels 1 and 4 are produced as part of the current daily routine operation. For NOAA KLM all six AVHRR channels will be mapped as well as solar zenith angle and the satellite azimuth angle. These maps will have a resolution of 23.8 km to at the 60 degree north and south latitudes and a prime longitude of 80 west. The data will be mapped as 8 bit bytes. Several products such as quantitative precipitation, snow cover, and global vegetation index products will be mapped.

Precipitation and Sea Ice

As part of System '92, the AMSU data will be gridded to the master maps at two resolutions: 1/8 mesh for the AMSU-A window channels and 1/16 mesh for the AMSU-B window channels. These will be used to generate products of precipitation intensity (both resolutions), and sea-ice type and concentration. Other products which could be generated from this data might in the future include:

1. Rain areal coverage (percent)
2. Snow cover water equivalent (mm)
3. Oceanic cloud liquid water (kg/m**2)
4. Oceanic total precipitable water (kg/m**2)
5. Global surface type

Snow Cover

The new near-infrared (1.6 um) channel on the AVHRR will permit the separation of clouds from snow. At this wavelength, cloud reflectivity (except possibly cirrus) remains bright (white), but snow reflectivity becomes very low (black). This new operational capability will further enhance existing procedures by aiding in the mapping of snow in frequently cloudy areas. An algorithm to provide this improvement is in final testing. Once in place, the accuracy of snow cover maps should show noticeable improvement.

The new technique will essentially automate a product that now requires extensive human interaction in its creation. Snow cover will later be generated from master maps of AMSU data.

Earth Radiation Budget Products

The Earth's radiation budget has been derived from narrowband channels on the NOAA operational satellites since 1974, but in the era of the NOAA K, L, and M satellites (hereby referred to as KLM) or earlier, a number of positive changes will take place. These changes cover not only how the data will be processed to generate the standard products, but the addition of new products that will greatly enhance our ability to interpret the data. The scientific community is being greatly challenged to come up with answers as to how and why our climate is changing in response to sizeable changes in the carbon dioxide concentrations in our atmosphere, as well as what are the long term effects of ozone depletion. The role that clouds play must be understood, which requires us to study the interactions of the clouds with the atmospheric radiation.

For years the data system for generating the Earth radiation budget products was closely tied to the data system which extracts sea surface temperature. Now, a new stand-alone data system is being developed for both with error checking capabilities, well-documented code, and increased processing efficiency. Modules are being designed to have a single purpose so that their unique relationship to other modules is easily defined. This will permit easy modification of the code should a major change to an algorithm be required.

While the current data system uses one channel of AVHRR data to estimate the outgoing longwave radiation (OLR), the new system will utilize at least four channels of the HIRS/3 instrument. This has been demonstrated to significantly reduce the RMS error from that obtained with the AVHRR channel, as well as greatly reducing regional bias errors. The OLR will continue to be generated from the AVHRR as well for an unspecified period of time because of the requirements of a number of users of the data. Although not as accurate as that derived from the HIRS/3, some utilize the data as an index of change. A sudden shift to that produced from the AVHRR could be sufficiently approximated from the OLR generated from HIRS/3. Histograms of the OLR and the shortwave fluxes (SW) will planned. While currently three-level histograms re produced separately for the OLR and SW, the new system will generate two-dimensional (5X5 or 6X6) histograms of OLR and SW.

Although improvement to the OLR products comes primarily from use of the HIRS/3 instrument, improvement to the SW is derived principally from improvements to the algorithms. Recently, the anisotropy of the radiation was taken into account by the implementation of angular distribution models. These models are applied to the "so-called" isotropic albedos. Originally, the albedo was that computed from channel 1. Now, a broadband estimate of this albedo is made from channels 1 and 2 using a linear model derived from an analysis of broadband and AVHRR radiances. Further improvements are expected soon as a result of simultaneous observations of broadband (ERBE) and narrowband (AVHRR) radiances on the NOAA-9 satellite.

While much of the discussion above was devoted to the improvement of current products, a number of new, not yet approved, products might be anticipated. Already, on an experimental basis, statistical products derived from the OLR and SW fluxes are being produced and studied. One of these is the spatial standard deviation, which is obtained by computing the square root of the monthly mean variance for each grid point. Another is the temporal standard deviation obtained by computing, for each grid point, the standard deviation of the daily values in a month. These products are expected to enhance our interpretation of the radiation budget. Other products that have been proposed are the clear-sky flux (LW and SW) and the cloud forcing. These products will be useful in obtaining the surface radiation budget and understanding the interaction of the radiation with clouds.

Ocean-Feature Products

A new ocean product is planned for the NOAA KLM era - high resolution mapped sea surface temperature (SST) images. These SST images will be generated by software within Products Systems Branch (PSB) using HRPT/LAC digital data. The software will automatically calibrate, map and calculate SST from digital HRPT/LAC data for selected ocean regions on a pass-by-pass basis. Besides SST images, several other mapped images will be transferred electronically to NOAA's Ocean Products Center (OPC) where they will be interactively analyzed on the PC-based Interactive Digital Image Display and Analysis System (IDIDAS) to produce ocean feature products. The mapping software is expected to be operational by mid-1990.

Also under development for the NOAA KLM era are interactive software programs for the IDIDAS system which detect and mask clouds on HRPT/LAC based SST images. These programs were adapted from the cloud test originally developed by Dr. Paul McClain for the GAC-based multichannel SST (MCSST) system. Testing of the interactive tests will begin in late 1989; operational use is expected in early 1990. Several of the programs are expected to be incorporated into the automated SST mapping routine in PSB by the middle of 1991.

Aerosol Products*

*Aerosol Products are currently listed as secondary products on the NOAA KLM Product List. However as aerosol products are introduced into current NOAA operations they will be moved to the NOAA KLM Primary Product List. In this past year NOAA began producing and archiving several aerosol products using the Griggs one-channel algorithm and data from AVHRR channel 1. These products are:

- 100 KM analyzed field of optical thickness at .5 microns.
- 100 KM monthly mean analyzed field of optical thickness.
- daily summary file: statistics of optical thickness at .5 microns summarized by day in 10 by 10 degree latitude, longitude squares.
- extreme events observation file: 35-day archive of all observations with optical thickness greater than a threshold value (currently .3 microns).
- 8-day aerosol observation file. An 8-day archive of all aerosol optical thickness observations at .5 microns.

Aerosols are tiny particles, usually less than one micron in radius, which are suspended in the atmosphere. The number of particles, their size distribution and absorptivity are of considerable interest from the aspect of satellite remote sensing and detection of global climate change. Remote sensing coupled with computer modeling of the effects of aerosols on reflected sunlight can provide some of this information. The radiance of visible and near-infrared sunlight reflected from a cloud-free ocean surface contains information about these aerosol properties.

The current aerosol system incorporated in the Oceanographic Products System software uses the DAVE (1972) radiative transfer model with an inverse power law aerosol size distribution and different indicies of refraction to compute the radiance of reflected sunlight at appropriate values of solar and satellite zenith angles, solar-satellite azimuth angle, wavelength, and total number of aerosol particles. The radiative transfer theory uses ozone, water vapor, and carbon dioxide and assumes a Lambertian ocean surface. Radiance look-up tables are created as a function of the independent variables for channel 2 of AVHRR.

For NOAA-K these tables will be produced for all three reflectance channels of AVHRR. If only one channel is used, as is currently done in the NOAA-11 algorithm, only the total number of particles in the atmospheric column can be determined. Later, AVHRR channels 1 and 2 will be used to determine the effective size distribution of the particles. Further advances will use channels 1, 2, and 3a to add a measurement of an absorption parameter to the two parameters measured by System 90. Other parameters will be computed and mapped from these retrieved parameters. This will provide global aerosol products in contour map form. The following is a list of these proposed retrieved and derived parameters. The first three are the retrieved parameters.

- Total number of Particles
- Size Distribution Parameter
- Absorption Parameter
- Total Optical Thickness @ 0.38 UM
- Angstrom Beta Parameter
- Linke Turbidity Factor
- Chemical Species (e.g. Smoke, Dust)

- Total Aerosol Mass
- Albedo of Single Scattering
- MCSST Aerosol Correction
- HIRS Sounding Aerosol Correction

TABLE V-2. NOAA-K, L, M PRODUCTS LIST

I. PRIMARY

OBSERVATION	ACCURACY	HORIZONTAL RESOLUTION	VERTICAL RESOLUTION	SENSORS	COVERAGE	FREQUENCY
A. CLOUD PARAMETERS						
TATZ01 Cloud Liquid Water (non-precipitating clouds)	±0.1 milimeter	50 km at nadir increasing with scan angle	N/A	AMSU	GLOBAL	Every Orbit
B. Mapped and Gridded Data						
TBTZ01 Polar Stereographic Mapped Mosaics Visible, Day IR, Night IR	±5 km	1024x1024 Mesh/Hemishere	N/A	AVHRR/3	GLOBAL	Daily
TBTZ02 Mercator Mapped Mosaics -Visible, Day IR, Night IR	±5 km	Equatorial Strip 360 deg Longitude 80 deg latitude	N/A N/A	AVHRR/3	GLOBAL	Daily (Shared Processing)
TBTZ03 Stretched Gridded Single Orbit Visible, Day IR, Night IR	±5 km	4 km	N/A	AVHRR/3	GLOBAL	Every Orbit (Shared Processing)
TBTZ04 Polar Stereographic AMSU Mapped Mosaics, Channels 16 and 17		1024 X 1024 (See Appendix D)	N/A	AMSU	GLOBAL	Daily
TBTZ05 Polar Stereographic Full Resolution Mapped Images	1.4 km 5.8 km	8192 X 8192 4096 X 4096	N/A	AVHRR/3	LOCAL AREA	Daily
C. ATMOSPHERIC PARAMETERS						
TCTZ01 Vertical Temperature Profiles (Point Temperatures)	Surface -700mb,±2.5 700mb-Trop.,±2.0 Trop.-2mb,±2.5 2mb-0.1mb,±3.0 OVER WATER Surface-Trop.,±2.0 Trop.-2mb±2.5 2mb-0.1mb±3.0	50 km at nadir increasing with scan angle	Minimum of 40 levels; sfc-0.1 mb	AMSU/HIRS/3 AVHRR/3	GLOBAL	Every Orbit

TABLE V-2. NOAA-K, L, M PRODUCTS LIST (CONTINUED)

I. PRIMARY

OBSERVATION	ACCURACY	HORIZONTAL RESOLUTION	VERTICAL RESOLUTION	SENSORS	COVERAGE	FREQUENCY
C. ATMOSPHERIC PARAMETERS (CONTINUED)						
TCTZ02 Vertical Water Vapor Profiles (g/Kg)	Surface -700 mb, ± 2.5 700mb-Trop., ± 2.0 Trop.-2mb, ± 2.5 2mb-0.1mb, ± 3.0 OVER WATER Surface-Trop., ± 2.0 Trop. -2mb ± 2.5 2mb-0.1 mb ± 3.0	50 km at nadir increasing with scan angle	Minimum of 15 levels; sfc-0.1 mb	AMSU/HIRS/3 AVHRR/3	GLOBAL	Every Orbit
TCTZa2 Total Precipitable Water (cm)	±0.6 cm over land ±0.3 cm over water	50 km at nadir increasing with scan angle	N/A	AMSU/HIRS/3 AVHRR/3	GLOBAL	Every Orbit
TCTZb2 Layer Precipitable Water (mm)	±20% - Land ±10% - Water	50 km at nadir increasing with scan angle	3 layers sfc-300 mb	AMSU/HIRS/3 AVHRR/3	GLOBAL	Every Orbit
TCTZ03 Quantitative Precipitation (None, Light, Medium, Heavy)	4 Categories (TBD)	15-30 km	N/A	AMSU/AVHRR	GLOBAL	6-12 Hours (Shared Processing)
TCTZ04 Clear Equivalent Blackbody Temperatures for 20 HIRS, 20 AMSU and 3 AVHRR Channels (deg K)	± 1 Deg K	50 km at nadir increasing with angle	N/A	AMSU/HIRS/3 AVHRR/3	GLOBAL	Every Orbit
TCTZa4 Thickness Values (M) Byproduct of I.4C	Equivalent to accuracy goal for Layer Mean Virtual Temperature	50 km at nadir increasing with angle	Maximum of 20 layers sfc - 0.4 mb	AMSU/HIRS/3 AVHRR/3	GLOBAL	Every Orbit

TABLE V-2. NOAA-K, L,

I.

OBSERVATION	ACCURACY	HORIZONTAL RESOLUTION
C. ATMOSPHERIC PARAMETERS (CONTINUED)		
TCTZ05 Layer Mean Virtual Temperatures (Deg. K)	0.25 Deg K more accurate than Vertical Temperature profile layers given under 1C	50 km at nadir increasing with angle
D. OCEAN SURFACE PARAMETERS		
TDTZ01 Global SST Observations	0.5 Degree C.	8 km spaced 8-25 km Apart
TDTZ02 Local SST Observations	0.5 Degree C.	2 km spaced 2-11 km Apart
TDTZ03 Monthly Mean SST	0.5 Degree C.	1.0 Degree Lat/Long
TDTZ04 Semi-Monthly Mean SST	0.5 Degree C.	1.0 Degree Lat/Long
TDTZ05 Global SST	0.5 Degree C.	0.5 Degree Lat/Long
TDTZ06 Regional SST	0.5 Degree C.	1/16 - 1/32 Degree Lat/Long
TDTZ07 Local SST	0.5 Degree C.	1 - 4 km
TDTZ08 Ocean-Feature	1 km location	1 - 4 km

* Produced by Ocean Products Center

M PRODUCTS LIST (CONTINUED)

PRIMARY

VERTICAL RESOLUTION	SENSORS	COVERAGE	FREQUENCY
Maximum of 20 layers sfc - 0.4 mb	AMSU/HIRS/3 AVHRR/3	GLOBAL	Every Orbit
N/A	AVHRR/3	GLOBAL	Every 6 Hours (Shared Processing)
N/A	AVHRR/3	U.S. coastal waters and selected areas	Every 6 Hours
N/A	AVHRR/3	GLOBAL 75 S - 80 N	Monthly
N/A	AVHRR/3	GLOBAL 75 S - 80 N	Twice/Month
N/A	AVHRR/3	GLOBAL 75 S - 80 N	Twice/Week
N/A	AVHRR/3	U.S. coastal waters and selected areas	Twice/Week
N/A	AVHRR/3	U.S. coastal waters	Twice/Week
N/A	AVHRR/3	U.S. coastal	Twice/Week

ANNEX XI

TABLE V-2. NOAA-K, L, M PRODUCTS LIST (continued)

I. PRIMARY

OBSERVATION	ACCURACY	HORIZONTAL RESOLUTION	VERTICAL RESOLUTION	SENSORS	COVERAGE	FREQUENCY
TDIG09 Edge	1 km	Line Position	N/A	AVHRR/3 AMSU	GLOBAL	Weekly (Shared Processing)
TDIG10 Cover	$\pm$5%	100 km^2	N/A	AVHRR/3 AMSU	GLOBAL	Weekly (Shared Processing)
TDIG11 Type: New, First Year, Multiyear, Melting	(TBD)	1000 km^2	N/A	AVHRR/3 AMSU	GLOBAL	Daily (Shared Processing)
TJTZ02 Snow Cover Area	$\pm$ 10%	25 km	N/A	AVHRR/3 AMSU	GLOBAL	Weekly
F. DAILY RADIATION BUDGET						
TFTZ01 Albedo	TBD	2.5 Degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Daily
TFTZ02 Daytime Outgoing Longwave Radiation	TBD	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Daily
TFTZ03 Nighttime Outgoing Longwave Radiation	TBD	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Daily
TFTZ04 Daily Average Outgoing Longwave Radiation	TBD	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Daily
TFTZ05 Available Solar Energy	TBD	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Daily

* Produced by Joint Ice Center

TABLE V-2. NOAA-K, L, M PRODUCTS LIST (CONTINUED)
I. PRIMARY

OBSERVATION	ACCURACY	HORIZONTAL RESOLUTION	VERTICAL RESOLUTION	SENSORS	COVERAGE	FREQUENCY
F. DAILY RADIATION BUDGET (CONTINUED)						
TFTZ06 Absorbed Solar Radiation	TBD	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Daily
TFTZ07 Net Radiation	TBD	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Daily
G. MONTLY MEAN RADIATION BUDGET						
TGTZ01 Daytime Outgoing LongwaveRadiation	5.0 w/m2	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Monthly
TGTZ02 Nighttime Outgoing Longwave Radiation	5.0 w/m2	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Monthly
TGTZ03 Absorbed Solar Energy	5.0 w/m2	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Monthly
TGTZ04 Available Solar Energy	5.0 w/m2	2.5 degree Mercator & 125x125 Polar Stereo	N/A	AVHRR/3	GLOBAL	Monthly
TGTZ05 Albedo	0.005%	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Monthly
TGTZ06 Daily Averaged Out-going Longwave Radiation	5.0 w/m2	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Monthly
TGTZ07 Net Radiation	7.0 w/m2	2.5 degree Mercator 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Monthly

TABLE V-2. NOAA-K, L, M PRODUCTS LIST (CONTINUED)
I. PRIMARY

OBSERVATION	ACCURACY	HORIZONTAL RESOLUTION	VERTICAL RESOLUTION	SENSORS	COVERAGE	FREQUENCY
F. DAILY RADIATION BUDGET (CONTINUED)						
TFTZ06 Absorbed Solar Radiation	TBD	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Daily
TFTZ07 Net Radiation	TBD	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Daily
G. MONTHLY MEAN RADIATION BUDGET						
TFTZ08 Daytime Outgoing LongwaveRradiation	5.0 w/m^2	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Monthly
TFTZ09 Nighttime Outgoing Longwave Radiation	5.0 w/m^2	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Monthly
TFTZ10 Absorbed Solar Energy	5.0 w/m^2	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Monthly
TFTZ11 Available Solar Energy	5.0 w/m^2	2.5 degree Mercator & 125x125 Polar Stereo	N/A	AVHRR/3	GLOBAL	Monthly
TFTZ12 Albedo	0.005%	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Monthly
TFTZ13 Daily Averaged Out-going Longwave Radiation	5.0 w/m^2	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Monthly
TFTZ14 Net Radiation	7.0 w/m^2	2.5 degree Mercator & 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL	Monthly

TABLE V-2. NOAA-K, L, M PRODUCTS LIST (CONTINUED)
I. PRIMARY

OBSERVATION	ACCURACY	HORIZONTAL RESOLUTION	VERTICAL RESOLUTION	SENSORS	COVERAGE	FREQUENCY
I. OZONE						
TTTZ01 Total Ozone (Dobson Units)	±15 % Tropical ±30 % Polar	50 km at nadir increasing with scan angle	N/A	HIRS/3	GLOBAL	Every Orbit
TTTZ02 Total Ozone (Dobson Units)	± 1.0%	200 km sub-satellite	N/A	SBUV/2	GLOBAL	Daily
TTTZ03 Level Ozone (Mixing Ratio)	± 5%	200 km sub-satellite	16 levels	SBUV/2	GLOBAL	Daily
TTTZ04 Layer Ozone (Dobson Units)	± 5%	200 km sub-satellite	11 layers	SBUV/2	GLOBAL	Daily
J. Land Surface Parameters	TBD	15 km	N/A	AVHRR/3	GLOBAL	Daily
TJTZ01 Vegetation Index						
TJTZ02 Snow Cover Area	+10%	25 km	N/A	AVHRR/3 AMSU	GLOBAL	Weekly

TABLE V-2. NOAA-K, L, M PRODUCTS LIST
II. SECONDARY

OBSERVATION	ACCURACY	HORIZONTAL RESOLUTION	VERTICAL RESOLUTION	SENSORS	COVERAGE	FREQUENCY
A. CLOUD PARAMETERS						
TATZ02 Cloud Top Temperature (Deg K)	1.0-5.0 Deg K increasing with decreasing cloud amount	50 km at nadir increasing with scan angle	N/A	AVHRR/3 HIRS/3 AMSU	GLOBAL	Every Orbit
TATZ03 Cloud Top Pressure (mb)	15-60 mb increasing with decreasing cloud amount	50 km at nadir increasing with scan angle	N/A	HIRS/3 AVHRR/3 AMSU	GLOBAL	Every Orbit
TAZ204 Cloud Amount (%)	±10% increasing with decreasing cloud amount	50 km at nadir increasing with scan angle	N/A	AVHRR/3 AMSU HIRS/3	GLOBAL	Every Orbit
TATZ05 Cloud Composition (Type)	TBD	50 km at nadir increasing with scan angle	N/A	AVHRR/3 AMSU	GLOBAL	Every Orbit
C. ATMOSPHERIC PARAMETERS						
TCTZ06 Tropopause Temperature (Deg K)	±1.5 Deg K - ±2.5 Deg K	50 km at nadir increasing with scan angle	N/A	AMSU/HIRS/3 AVHRR/3	GLOBAL	Every Orbit
TCT207 Tropopause Pressure (mb)	±40 mb	50 km at nadir increasing with scan	N/A	AMSU/HIRS/3 AVHRR/3	GLOBAL	Every Orbit

TABLE V-2. NOAA-K, L, M PRODUCTS LIST (CONTINUED)
II. SECONDARY

OBSERVATION	ACCURACY	HORIZONTAL RESOLUTION	VERTICAL RESOLUTION	SENSORS	COVERAGE	FREQUENCY
K. AEROSOL						
TKTZ01 Optical Depth at 0.5 Microns	±0.02%	50 km	N/A	AVHRR/3	GLOBAL (Ocean Only)	7 Days
TKTZ02 Size Distribution	TBD	50 km 125x125 Polar Stereo.	N/A	AVHRR/3	GLOBAL (Ocean Only)	7 Days

INTERNATIONAL SPACE YEAR 1992

1. Introduction and objectives

The International Space Year 1992 is a world-wide initiative to enhance international collaboration in the field of space research and to increase public awareness of the benefits of space research for a better understanding of the burning problems of our Earth's environment.

This initiative was initially suggested by the late US Senator Spark Matsunaga of Hawaii as early as 1985 and has since grown to a truly global activity supported by space agencies around the world, as well as by organisations - national and international ones - involved in the use of space techniques in scientific research and applications. This initiative has also been welcomed by the United Nations which formally endorsed the ISY initiative at a meeting of the UN General Assembly in January 1990.

The International Space Year will be celebrated in 1992, the 500th anniversary of the discovery of America by Christopher Columbus and the 35th anniversary of the International Geophysical Year (IGY) from which a great impact has been felt up to now in the preparation and planning of global space research.

The main theme of the International Space Year is

"Mission to Planet Earth"

The activities focus therefore on the monitoring of all facets of our planet's environment. They aim at a better knowledge of the important changes and the fundamental phenomena and processes which govern the behaviour of the Earth's environment.

Apart from remote sensing with space-borne means, and the corresponding scientific applications research, the extra terrestrial research and manned space activities are also included in the International Space Year. This concerns for example the interaction of the Earth's atmosphere and magnetosphere with the solar activities and interplanetary research in general. The other elements in the ISY process are microgravity and life science research in space.

2. Organisation

In order to organise the ISY activities and to properly coordinate the contributions made to the ISY, the **Space Agency Forum on International Space Year (SAFISY)** was created in a meeting held at Durham, New Hampshire, USA early 1988. At this meeting of SAFISY, the objectives of the International Space Year and the Terms of Reference of this Forum were agreed. At present SAFISY has 28 members and 8 affiliates. The USSR, China, the United States of America and the major European countries are represented in SAFISY through their appropriate organisations. The IAF and COSPAR are among the affiliates.

SAFISY has since met at Frascati (Italy) and at Kyoto (Japan) in early 1989 and 1990 respectively and will hold its next annual meeting in the USSR early 1991.

The Forum is supported by three Panels of Experts:

- **the Panel of Experts on Earth Science and Technology (ES&T)**
- **the Panel of Experts on Education and Applications (E&A), and**
- **the Panel of Experts on Space Science (SS).**

The 1st Panel (ES&T) met in Abingdon (UK) and Bad Ischl (Austria) in early 1989 and 1990 respectively and will meet for the next time in Canada early 1991.

The 2nd Panel (E&A) met for the first time in Deauville (France) early 1990 and plans to hold its next meeting beginning of 1991 in Kourou (French Guyana).

The 3rd Panel (SS) has been organised by COSPAR and met for the first time mid 1990 at the occasion of the COSPAR meeting in The Hague, Netherlands.

These Panels of Experts advise, make specific recommendations and propose scientific projects of international collaboration to SAFISY.

Two associations have been created to complement the ISY scientific and applications activities with Public Relations activities, in the preparation and implementation of ISY. These Associations are:

- **the US ISY Association in Washington DC, USA**
- **the European ISY Association (EURISY) in Paris, France**

In general, the ISY activities are based on voluntary contributions from its members and affiliates. Each specific undertaking is led by one or two members who already have a significant activity ongoing in that specific area, which is complemented by contributions from other members active in the same field.

Lead agencies provide complementary funding to fill, where necessary, identified gaps in the proposed research and applications.

3. The Earth Science and Technology (ES&T) Projects of ISY

This Panel has proposed a total of 12 projects which have been suggested by international experts and accepted by SAFISY. Fundamentally, they fall into two categories. The first category of project comprises "Space Date for Global Change" and "Global Information System Tests" activities. The second category covers "Global Change Outreach" activities. The projects of this category are aimed to reach, with global information, the public and the political decision makers.

It can be seen that by these undertakings the most important problems of the global change of our environment are addressed.

<u>Category 1 Projects</u>

- Global Consequences of Land Cover Change (LCC)
- Enhanced Greenhouse Experiment Detection Experiment (GEDEX)
- Ocean Variability and Climate (OVC)
- Polar Stratospheric Ozone (PSO)
- Productivity of the Global Ocean (PGO)
- Rate of Deforestation (ROD)
- Global Sea Surface Temperature (GSST)
- Polar Ice Extent (PIE)
- Global Satellite Image Mapping (GSIM)
- Space Disaaster and Mitigation (SDM).

The Working Groups of six of these projects have met successfully and identified all details for their implementation. Two further Working Groups (LCC and GSIM) will meet in the near future. The meetings of the two remaining Working Groups (PSO and SDM) are under preparation. It is expected that the result of these joint international efforts will provide significant contributions to the 1992 deliberations of ISY.

<u>Category 2 Projects</u>

- Global Change (Electronic) Encyclopedia (GCE)
- Global Change Atlas (GCA)

Several meetings of the corresponding Working Groups have taken place and the implementation of these projects is well advanced. In addition, there are firm plans by some SAFISY members to add a third Global Change Outreach project which will be entitled "Global Change Video" (GCV).

4. Education and Applications (E&A) Projects

The number of projects proposed by experts at the first meeting of the Panel of Experts on Education and Applications is far bigger than the number of projects in Earth Science & Technology. In total, 39 projects have been suggested.

The main emphasis of the E&A activities is on the introduction of the results of Earth monitoring and space science related to environmental research into the education process. Furthermore, emphasis is given to world-wide training in remote sensing applications to promote the use of these new techniques and to provide at the same time for the participation of lesser developed countries in ongoing application projects are undertaken in many locations of our planet by the most advanced SAFISY members. Fundamentally, the E&A activities are covered under two themes:

Theme A : "Training in Remote Sensing Applications", guided by CNES with 12 proposed projects

Theme B : "Space and Education", guided by NASA with 27 proposed projects.

The Working Groups have been created for the "Training in Remote Sensing Applications", which cover the following fields:

- Vegetation Resources: Monitoring and Management
- Geology: Natural Hazards
- Urban and Environmental Planning

The three Working Groups created for "Space and Education" discussed projects in the following areas:

- Earth Observation in Education
- Space Science in Education
- Space Communications in Education.

A large number of the projects of "Training in Remote Sensing Applications" are linked to the already ongoing bilateral or multilateral ventures in South East Asia, the Pan Amazonia region, semi-arid and tropical zones, as well as in highly industrialised countries.

A number of the "Space and Education" projects have similar forerunners and do not require large investments. However, the process of identifying the lead and contributing organisations of each project has not yet been completed. It seems that not all projects will be retained for final implementation.

5. Space Science (SS) Products

The activities covered by the 1st Panel of Experts on Earth Science & Technology above are largely concerned with "Mission to Planet Earth". It is acknowledged, however, that environmental conditions on Earth can be influenced by physical phenomena within our planet's wider environment, that of the magnetosphere and the heliosphere beyond.

A third ISY Panel of Experts - on "Space Science" - has been set up by the international Committee on Space Research (COSPAR). This panel, using the COSPAR Commission structure, met in June 1990 in the Hague and made a number of proposals for international collaboration to be considered by SAFISY members.

These proposals fall essentially into three categories:

- to undertake investigations which clearly demonstrate the value to environmental science, of research into magnetospheric and heliospheric physics, the structure and physical state of the sun and our other solar system companions and the problems associated with living and working in space

- to take action to improve the timely and deficient acquisition, processing and distribution of data, as well as to demonstrate the feasibility of such action

- to bring the results of space science research to the widest possible public audience.

These above activities will give breadth and depth to our treatment of the wider aspects of our planet's environment.

As this Space Science panel only met in June 1990 and the final report has not yet been issued and distributed to SAFISY members, no discussion and decision has yet taken place at the level of SAFISY concerning the final implementation of these proposed complementary and very valuable ISY undertakings.

6. Special events 1992

The ISY activities will culminate in a number of special events at which the results of the joint international science and applications research will be presented. Similar to the International Geophysical Year (IGY) the ISY will also discuss problems and trends for future research and provide recommendations from key expert panels.

These special events in 1992 will include panel sessions with media and key political figures as well as exhibitions related to the main emphasis of the International Space Year.

The events considered and under preparation are:

- **an ISY Conference on "Data Information Systems in San Francisco, California, USA in February 1992**

- **a European ISY Conference on "Space in the Service of the Changing Earth"**

in Munich, Germany, March 30 - April 5 1992

- **an ISY Conference on "Global Deforestation" in Brazil, Summer 1992**

- **a "World Space Congress" in Washington DC, USA, August 28 - September 9 1992**

- **an Asian/Pacific ISY Conference with a possible theme: "Remote Sensing in Denselv Populated Areas of the Earth" (to be confirmed), possibly in Japan (under consideration).**

There will, however, be other events prior to 1992 in order to prepare for 1992.

One example is the:

- **European ISY Symposium organised by EURISY "The Earth's Environment - an Assessment from Space". in Venice, Italy, 2 davs end February/March 1991.**

7. Conclusions

The ISY initiative has received a broad, worldwide support as can be seen from the proposed and agreed undertakings described above. It could not be expected that SAFISY members of lesser developed countries would be able to make very large contributions. However, we can already predict that through both, bigger and smaller contributions, the objectives of the International Space Year will be met and that the activities will have a similar stimulating impact on the future space activities as the International Geophysical Year had some 30 years before.

Many of the activities under the International Space Year will continue in one way or another beyond 1992. Some of the planned undertakings will only provide the final results after 1992. The enthusiasm of the many participants to contribute to ISY is very encouraging which augers well for the success of the International Space Year 1992.

ANNEX XIII

CGMS XIX WP-7
Agenda Item H.2
Prepared by China

APPLICATION OF METEOROLOGICAL SATELLITE DATA IN THE FIELDS OF EARTH ENVIRONMENT MONITORING

Xu Jianmin
(SMC)

China began to receive and utilize cloud images from meteorological satellite in early 1970s. The cloud images were used in the meteorological research and the operation of synoptic analysis and forecasting. In 1978, with the development of satellite technology and the transformation of data transmission methods, HRPT and GMS receiving stations set up in NMC and provincial forecast centers. In 1983, under the funding of UNDP/WMO and the Chinese Government, a TIROS-N/GMS receiving and processing system, comprised of a receiving subsystem, a computer subsystem and an image subsystem, was established. With the ability of digital data receiving and processing, products from meteorological satellite have been used not only in weather analyis and forecast, but also in the fields of earth environment monitering.

1. Montoring of forest fire. The variation of radiation intensity with the temperature of different blackbody at various temperature indicats clearly that Ch3 is sensitive for temperature. Ch3 image and the imagery combinations of three channels (Ch1, Ch2 and Ch3) were used to monitor forest fire, including to identify burning area and to estimate the extent of burned area.

In May to Jurn 1987. Da Xing An Ling Forest experienced a severe fire and caused a big disaster. The satellite images show the process of fire event.

2. Monitoring flood. The AVHRR near infrared channel (CH2) has a very low reflectance over water surface, and a relative high reflectance over land. This feature can be used to discriminate their boundary. The Ch-2 and Ch-4 data were employed to monitor the flood and to estimate the area flooded. The information about the flooding situation is very helpfull to show the local government, to protect perple from danger, and to move some important facilities from dangerous area to safe area.

In the summers of 1985 and 1986, there were floods in the provinces of northeast China, caused by continuous and heavy raining of typhoons and frequent activities of mid-latitude weather systems. The enhanced images and the false colour pictures with the combination of multichannel data were successfully used to monitor those floods.

3. Estimating the amounts of pasture biomass. As is well known by amount of groundmass spectral measurements, the 0.68 μm region corresponds strongly to the vivo red region of chlorophyll absorption and is inversely related to the chlorophyll density. The 0.05-1.1 μm region corresponde to the region of spectrum where reflectance is proportional to the green leaf density. Ratio combination of these two wavelength regions are thus related to the chlorophyll-green left interaction. In recent years, using these two bands for estimsting biomass has been confirmed by many cases, such as using LANDSAT's and NOAA's data to estimate soybeen and winter wheat grain yield, to predict agricultural crop production and pasture or range biomass.

For estimating pasture biomass with the AVHRR data of NOAA, an applied model, green left Normalized Difference (ND) namely,

$$ND = \frac{CH2-CH1}{CH2+CH1}$$

was calculated as vegetation index. It is clear that the ND reflects the difference between absorption of green leaf matter for red and reflection for near infrared. The more the chlorophyll density is, the bigger this difference will be. Therefore, it is referred as a spcific value to estimate green leaf biomass. The greenness was used for estimating the production amounts of winter wheat and other crops.

4. Monitoring of Continental snow cover. The continental snow cover in the wast part of China is the major source of water supply. As an earth surface feature, snow cover has a large impact on the agriculture, hydrology, outgoing longwave rediation and climate. Snow / cloud discrimination and snow cover determination are important for snow cover information extraction from AVHRR data.

For the snow / cloud discrimination, we use time composites that is produced by saving the lowest observation value at each location on the polar stereographic mapped mosaic data bases over week-long periods. Composites to form minimum brightness from visible data and maximum brightnass temperature from infrared data eliminate the transitory featured such as cloud cover and reveal the more stable features such as snow and ice cover.

For determination of snow cover, the double channel threshold values are used to identify the snow ares

$$Rz = Rs + \Delta R$$

$$Tbz = Tbs + \Delta T$$

where Rz is the threshold value of reflectance for VIS.

Rs the initial threshold value for VIS, $80\% < Rs < 85\%$ for new snow, $50\% < Rs < 60\%$ for old snow.

Tbz the threshold value of brightness temperature of IR.

Tbs the intial threshold value for IR. $Tbs = -9°C$ was used in winter over plateau.

ΔR and ΔT are corrected values of threshold. These values are empirically determined for different illumination conditions and types of ground cover.

5. Analysing ocean flow and identifying fishing fields. The intensity, stretching or shrinking of the warm current of Yellow sea in winter and spring time is closely related to the location of the fishing fields in the Yellow sea.

Infrared image (channel-4) from NOAA satellite shows the distribution characteristics of the ocean current of Yellow sea in the spring time. The warm current in Yellow sea and the cold current along the coast line of Korea can be detected from such image.

The fishing company in Shandong province used the diagrams of sea surface temperature distribution and enhanced images from NOAA/HRPT data. The amount of fishing production increased remarkably.

6. Studying the silt diffusiongs out of river mouth and proyiding criteria for port site selection. The distribution characteristecs of sea surface silt can be watched by the satellite visible images. It played an important role in the feasibility studies for construction of the new ports at Hang-Hua county, Hebei province; Xiaoginghe, Shandong province and Huaxia, Shengli oilfield. It also freed the apprehensions of the direct affection to the ports from the silt of the Yellow River. In the mean while, it provided some new knowledges about the silt source of Xingan port, Tianjin.

ADDRESSES FOR PROCURING ARCHIVE DATA

ESA (for specific requests for METEOSAT imagery and data tapes)

METEOSAT EXPLOITATION PROJECT - Data Service,
ESOC,
Robert Bosch Str. 5,
6100 Darmstadt
Germany

EUMETSAT (for general requests for METEOSAT archived material)

The Director
EUMETSAT
Am Elfengrund 45
6100 Darmstadt-13
Germany

INDIA

India Meteorological Department
Attention: Director (Satellite Service)
Lodi Road
New Delhi
110003 India

JAPAN

Japan Meteorological Agency,
Department of Data Service
1-3-4, Otemachi
Chiyoda-ku
Tokyo, Japan

USA

Satellite Data Services Division (E/CC6)
Room 100, World Weather Building
NOAA/NESDIS
Washington DC 20233
U.S.A.

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CO-ORDINATION GROUP FOR

GEOSTATIONARY METEOROLOGICAL SATELLITES (CGMS)

XIXth Meeting held in Tashkent, USSR

10 - 14 December 1990

LIST OF PARTICIPANTS

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WMO	Mr. D. Hinsman (Chairman)

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Mr. H. Hanwen	CAST, PRC
Mr. X. Jian Ming	SMA/SMC, PRC
Mr. N. Veltishchev	HMC, USSR
Mr. A. Yu. Trudovoi	NPO "PLANET", USSR
Mr. V.A. Zagrebaev	NIIRC, USSR
Mr. Yu.V. Ispravnikov	NIIRC, USSR
Mr. D. Hinsman	WMO, SWITZERLAND

MEMBERS OF WORKING GROUP II

SATELLITE PRODUCTS

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Mr. B. Mason	ESA/ESOC, GERMANY
Mr. T. Fukui	MSC, JAPAN
Mr C. Cripps	NOAA/NESDIS, USA
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Mr. A. B. Uspenski	HMC, USSR
Mr. Yu. V. Plokhenko	HMC, USSR
Mr. V. M. Stutovski	HMC, USSR
Mr. V. I. Martemjanov	CARCC, USSR
Mr. L. A. Anikeeva	HMC, USSR

ANNEX XVIII

I N F O R M A T I O N

on technical characteristics of Meteor-3M satellite system prepared in accordance with Appendix 3 of the Radio Communication Regulations

GENERAL CHARACTERISTICS

1. Period of the system operation: 15 years
2. Brief information on a satellite orbit:
   - circular, H = 950 km
   - inclination angle 82°
3. Number of satellites in a system: 2-3

Transmitting Space Station

1. Adopted frequency band: 1690 ± 20 mHz
2. Class of the station and the character of maintainance: EM, CO
3. Duration of transmitter operation in emitting regime: 24 hours
4. Maximum value of isotropic antenna amplification: 3.6 dB
5. Notation of emission: 15 MOG 7 D
6. Total peak power: 13 dBW
7. Maximum power density: - 58.6 dBW/Hz

Recieving Ground Station

1. Adopted frequency band: 1690 ± 20 mHz
2. Class of station and character of maintainance:
3. Points of stations location: Moscow, Tashkent, Novosibirsk, Khabarovsk, stationary and movable APTs
4. Maximum value of isotropic antenna amplification:
   G_m = 37 dB, beam width 2.5°
   G_m = 26.4 dB, beam width 8°
5. Diagramm of antenna emossion corresponds to the Annex III of Appendix 29 of the Radio Communication Regulations
6. Noise temperature of the recieving system:
   200°K for antenna with G_m = 26.4 dB
   2000°K for antenna with G_m = 37 dB
7. Notation of emission: 15 MOG 7 D

USSR

SPACE SYSTEM WITH GEOSTATIONARY METEOROLOGICAL SATELLITE

(G O M S)

VNIIEM
(The All-Union Research Institute of Electromechanics)
NPO "Planeta"

Moscow
1990, November

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I. System outline, status and plans.

1.1. System outline.

The space system includes a geostationary operational meteorological satellite (GOMS) located in orbit at the stationary point over 76°E.

The ground data receiving and processing complex consists of the Main data receiving and processing centre (Moscov) and regional receiving and processing centres (Tashkent and Khabarovsk).

1.2. Status and plans.

The first GOMS flight model is completed and undergoes ground qualification tests. The satellite is scheduled to be put into orbit by the carrier rocket "Proton" for the end of 1991 or the beginning of 1992. The ground centre equipment has been installed, and the system debugging is carried out now.

The space system structure with GOMS is shown in Fig.1.

2. Space system objectives:

- to acquire, in real time, television images of the Earth surface and cloud cover within a radius of 60° centred at the sub-satellite point in the visible and IR regions of the spectrum;
- to measure temperature profiles of the Earth surface (land and ocean) as well as cloud cover;
- to measure radiation state and magnetic field of the space environment at the geostationary orbital altitude;
- to transmit via digital radio channels television images, temperature and radiation and magnetometric information to the Main and regional data receiving and processing centres;

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СОВЗОНД

- to acquire the information from Soviet and international data collections platforms (DCPs), located in the GOMS radio visibility, and to transmit the obtained information to the Main and regional data and processing centres;

- to retransmit the processed meteorological data in the form of facsimile or alphanumerical information from the receiving and processing centres to the independent receiving stations via satellite;

- to provide the exchange of high-speed digital data (retransmissions via the satellite) between the Main and regional centres of the USSR State Committee for Hydrometeorology;

- to call for the data collection platforms to transmit the information to the satellite.

3. Satellite and equipment characteristics:

Satellite mass	- 2400 kg
including payload	- 800 kg
Satellite orientation	- three-axis (to the Earth and along the velocity vector) with the error not more than 2 arc.min
Angular velocity stabilization accurace	- not more than 0,0001°/s
Power (average, per day)	- not less than 1500 W
including payload power consumption up to 900W	
Lifetime	- not less than 3 years

Fig.2 shows the common GOMS structure.

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3.2. Information system components and their characteristics.

3.2.1. Scanning television radiometer (STR)

Spectral bands:

- visible	0,46 - 0,7μm
- Infra-red I	10,5 - 12,5μm
- Infra-red II	6 - 7μm (beginning from GOMS2)

Number of scan lines per frame

- visible	8000
- Infra-red	2500

IFOV:

- visible	31,5μrad
- Infra-red	160μrad

Ground resolution:

- visible	1,25 km
- Infra-red	6,5 km

The imaging session frequency is not less than 30 min, and the length of one take (frame time) is 15 minutes.

Direct data transmission rate is 2,56 Mbps.

3.2.2 Radiation-measuring and magnetometry system.

The system is disigned to control the penetrating radiation spectra and density in the near-Earth space and the Earth magnetic field state.

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The system records the following heliogeophysical information (HGI):

- the density of electron fluexs with energies in four bands from 0,04 MeV to 1,7 MeV;
- the density of proton fluxes with energies in four bands from 0,5 MeV to 90 MeV;
- the density of alpha particles with energies from 5 MeV to 12 MeV;
- intensity of the galactic cosmic radiation with energies greater than 600 MeV;
- solar X-ray radiation intensity with energies from 3 keV to 8 keV;
- intensity of solar UV radiation in four wave bands up to 1300 mm;
- magnetic induction vector component quantities along the three axes with ± 180 nT interval.

3.2.3. Satellite communication links characteristics.

Radio channels I and II - transmission of television images and heliogeophysical information from the satellite to receiving and processing centres (RPC);

carrier frequencies	1685 MHz and 7465 MHz, respectively
data transmission rate	2,56 Mbps

Radio channel III - transmission of information from fixed and mobile data collection platforms (DCPs) to the satellite;

spectral band - 401 - 403 MHz;

transmission of data is possible through 33 international and 100 Soviet channels at rates of 100 b/s.

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Radio channels IY and Y - retransmission of the information obtained from PCD to receiving and processing centres via the satellite:

spectral bands 1697±1 MHz and 7482±1 MHz, respectively.

Radio cannels YI and YII - transmission of facsimile information in standard WEFAX format and alphanumerical data from receiving and processing centres to the satellite:

spectral bands 2115±1,5 MHz and 8155±1,5, respectively

data transmission rate 1200 b/s.

Radio channel YIII - retransmission of facsimile and alphanumerical data from the satellite to independet receiving stations:

spectral band 1691±1,5 MHz

Radio channel IX - transmission of high-speed digital information from RPC to the satellite:

spectral band 8190±5 MHz

data transmission rate up to 0,96 Mbps.

Radio channel X - transmission of high-speed digital information from the satellite to the RPC:

spectral band 7465 ± 2,5 MHz

transmission rate up to 0,96 Mbps.

Radio channel XI - calling for DCP from the satellite:

spectral band 469 ± 1 MHz.

Radio channel XII - transmission of DCP request from RPC to the satellite:

spectral band 2119 ± 1 MHz.

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3.2.4. Data receiving and transmitting modes.

The channels I and II operate 24 - 48 times a day, and each session lasts for 15 minutes.

The channels III, IY and Y operate under the commands to call for the DCP information.

The channels YI, YII and YIII operate continuously.

The channels IX and X function in the interval when channels I and II are not active.

The channels XI and XII operate when needed.

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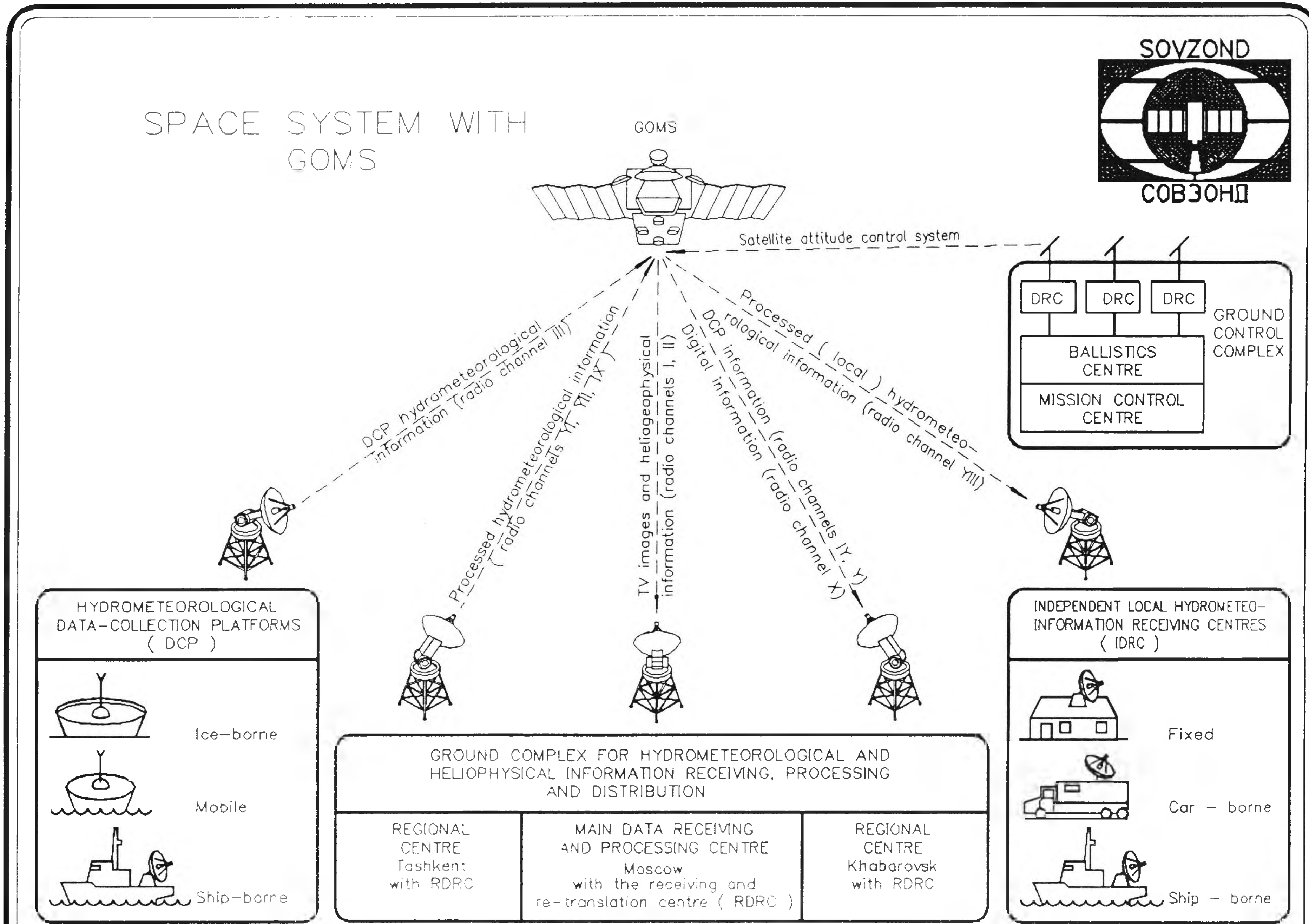

Fig.1

ANNEX XVIII

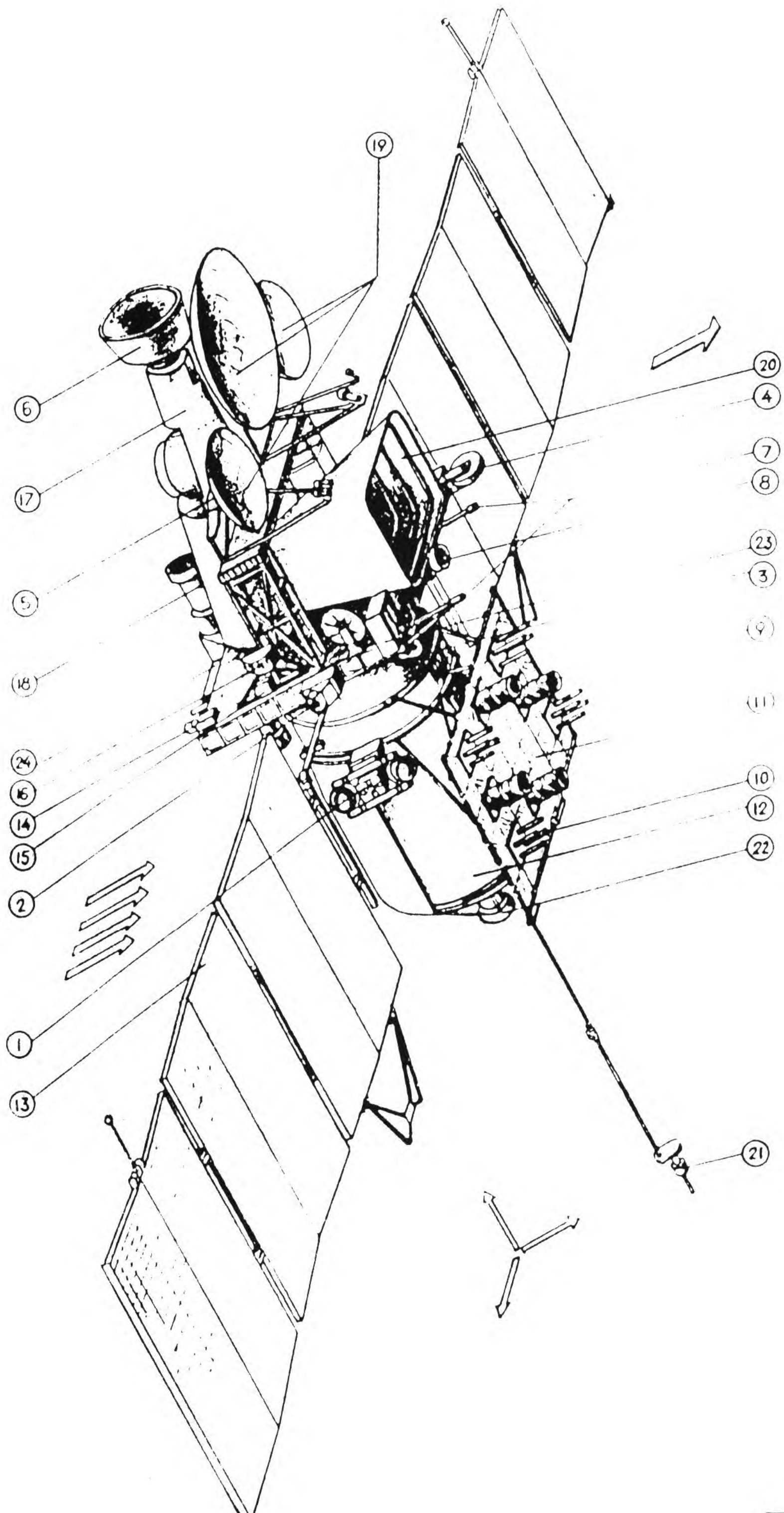

Fig. 2

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1. Electric jet system (EJS)
2. Sun-angle sensor of the attitude control system
3. Instrument platform
4. Flywheel engine of the attitude control system
5. Two-coordinate drive of the antenna-feeder system (AFS)
6. OTVS radiation cooler
7. AFS of the command-measuring system (CMS)
8. Local vertical reference (LVR)
9. AFS of the DCP data collection and transmission system
10. AFS of the retranslation and transmission DM-radiocentres
11. Array platform
12. Hermetically sealed module
13. Solar array
14. UV sensor (sun UV radiometer-SUVR)
15. Coarse sun sensor
16. X-ray sensor
17. On-board TV system (OTVS)
18. Polar star tracker (PST)
19. AFS of the retransmission CM-MM radiocentres
20. OTVS blend
21. Magnetometer
22. Thermal screen, thermal screen drive
23. Proton & electron sensor
24. Low energy particles spectrometer

DRAFT CHARTER COVER NOTE

1. The draft CGMS Charter, as amended during CGMS XIX, is attached for the consideration of Members.

2. Changes from the draft distributed at the meeting on 10 December 1990 are marked by a side-line or underline.

3. The objective concerning data policy [formerly paragraph (b)] has been dropped on the grounds that CGMS is a technical and operational group and should leave general policy matters to other groups or discussions.

4. CGMS XIX proposed to adopt this charter as a draft working document on a provisional basis. It will be placed on the agenda of CGMS XX and will be discussed again following internal review by CGMS members and following evolving discussions within the IPOMS and other groups.

DRAFT 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 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 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 opera- tors world-wide, so that a more effective utilisation of these operational systems, through the coordination and standardisation of many services provided, can be assured,

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

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

AGREE

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

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

OBJECTIVES

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

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

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

MEMBERSHIP

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

e) The status of observer will be open to representatives of international organisations or groups who have declared an intent, supported by detailed system definition studies, to establish a meteorological satellite observing system. Once formal approval of the system is declared, membership of CGMS can be requested by the observer. Within two years of becoming an observer, observers will report on progress being made towards the feasibility of securing national approval of a system. At that time CGMS Members may review continued participation by each Observer.

f) The current Membership of CGMS is listed in Annex 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 shall, on a voluntary basis, 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), 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 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. Also 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 USSR	-	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, by ESA (with EUMETSAT) and NASDA (with Japan).