The Use of Satellite Data in RA-II *

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Abstract

In RA-II area (Asia), the meteorological satellite date from both geostationary and polar orbiting satellites are widely used by most Members.

The authors sent questinnaire to Members in RA-II to investigate the status of the use of satellite data. The answers to the questionnaire are summarized as :

(a) Most Members receive both geostationary and polar orbiting satellite data.

(b) For continuous operation of receiving stations, there are two fundamental factors : operator's skill and availability of back-up system.

(c) Direct broadcast pictures are used for weather forecast and for the general and specified purposes by most Members.

(d) The extracted meteorological parameter data transmitted through GTS are used for numerical weather prediction (NWP) by a few Members.

(e) A few dozens of Data Collection Platforms (DCPs) are installed in RA-II area and the observed data are collected by geostationary and polar orbiting satellites.

1. Introduction

The eighth session of RA-II held on 5-16 November 1984 decided to appoint a Rapporteur on the use of satellite data, and to invite an expert from Japan to serve as the Rapporteur(Res. 7. VIII -RAII). In accordance with the resolution, Head of Data Processing Department, Meteorological Satellite Center (MSC) was appointed the Rapporteur. Annual progress reports were submitted by I. Kubota in 1986 and by A. Kurosaki in 1987. They are reflected in the present report.

2. A summary of available satellites of interest to the Region

2.1 Geostationary satellites

Geostationary meteorological satellite of interests to the Region are GMS-3 launched by Japan and INSAT-1B by India, and to a lesser extent METEOSAT-2 by European Space Agency.

2.1.1 Geostationary Meteorological Satellite (GMS)

GMS-3 is currently fully operational. GMS-4 is now under preparation for launching in the summer of 1989. The GMS-4 mission is identical with GMS-3. The development of the GMS-5 is now starting with the aim of the launching in 1994. The JMA (Japan Meteorological Agency) decided to introduce a water vapor channel and IR split window channels into GMS-5.

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* This article is merged from two reports which were sent to RA-II *** president in April and August 1988 by an author, T. Noumi, as a Rapporteur on the use of satellite data in RA-II, and revised partially taking the latest information into account. These reports were distributed to Members at ninth session of RA-II held in Beijing on 5-16 September, 1988.

** Meteorological Satellite Center.

*** RA-II : Regional Association II (Asia).

New computer system for GMS data processing was introduced in March 1987 and new ground telecommunication facilities in March 1988. Observation schedule is as follows :

a. Hourly observation in northern hemisphere started in March 1987. Three hourly full disk observation is still kept, and

b. Hourly full disk observation started on January 5, 1989.

2.1.1.1 **Product service**

Products available from GMS are shown in Table 1.

(1) Products on direct broadcast

WEFAX (previously called LR-FAX)

- Seven-sectorized pictures for the WEFAX were replaced by four-sectorized pictures in March 1987. These are transmitted on 3-hourly basis.
- Partial pictures, H, I and J, were changed from sectorized disk images to those with polar-stereographic projection covering Far East area including Japan and contiguous sea in March 1987. These are transmitted on hourly basis.

Stretched VISSR (S-VISSR)

- S-VISSR data transmission for all observations started in March 1988. Those data are transmitted in real time to Medium-Scale Data Utilization Station (MDUS).
- The data dissemination of analogue high-resolution facsimile (HR-FAX) was quit on January 5, 1989.

(2) Products on the Global Telecommunication System (GTS)

a. Cloud Motion Winds (CMWs)

- CMWs are derived four times a day with full disk coverage at 00 and 12 UT and with half disk (northern hemisphere) coverage at 06 and 18 UT from March 1987.
- The processed area was extended to southern hemisphere, that is, full disk coverage at 06 and 18 UT on January 5, 1989.
- The derived CMWs have high-level and low-level winds. These are derived automatically and then are quality-controlled in man-machine interactive process using image display. The horizontal density of the CMW after replacing computer system is greater than before, and the reliability of the CMW increased.

b. Sea surface temperature

- Sea surface temperatures are extracted every three hours for each segment, size of which is 1 degree latitude by 1 degree longitude.
- Vertical profiles predicted by the numerical prediction model of JMA are used for an estimation of an atmospheric attenuation.
- The data distributed to the users, after quality control, are a 5-day mean of the results.

c. Typhoon analysis

Typhoon center location determination and intensity estimation are routinely processed 8 times a day and 4 times a day respectively. These data are transmitted in WMO SAREP code when typhoon is located in the area, 100°E-140°E, in northern hemisphere.

(3) Products for domestic users

The products for domestic users are listed in Table 1. Three products among them are briefly introduced here.

a. Sea-surface temperature picture (SST-FAX) (New product as of March 1987)

The SST-FAX covers the area from 53°N to 53°S and from 110°E to 170°W. The SST-FAX fundamentally shows the highest TBB without atmospheric correction at each geographical point during 4 day period (highest temperature selection method). The temperature corresponding to SST is enhanced in the facsimile chart with Mercator's projection. The cloud contamination is removed. The detailed horizontal structure of sea-surface temperature, e.g., oceanic front, meander of ocean current, can be read from the facsimile chart.

b. Sea-ice picture (Sea-ice FAX) (New product as of March 1987)

Table 1. Products of GMS

(1) Direct broadcast (Picture transmission)

WEFAX

Name	Projection	Type	Resolution	Output frequency	Output time
H	Polar stereo-graphic projection,	Infra-red	7.2 Km* (in Tokyo area)	24 times/day	5 minutes after observation
I	Scale 1 : 30,000,000 at 60° N	Visible		9 times/day (daytime)	10 minutes
J	Far East area including vicinity of Japan	Enhanced Infra-red		11 times/day (nighttime)	
A～D	Four-sectorized of full disk image	Infra-red	8.4 Km at S.S.P.	8 times/day	within 60 minutes

Stretched VISSR

Name	Projection	Type	Resolution	Output frequency	Output time
S-VISSR	Full disk digital image	Infra-red	5.0 Km at S.S.P.	24 times/day	real-time
		Visible	1.25Km at S.S.P.		

(2) Operational products

Available on the GTS

Type of data	Description	Output frequency	Output type
Cloud motion winds	Cloud motion wind data derived from time-sequential images	Every 6 hours; 4 times/day	Alphanumeric data
Sea surface temperature	Mean of the sea surface temperature in 1° latitude× 1° longitude area	1 time/5 days,	Alphanumeric data
		1 time/5 days, / month	Chart (domestic only)
Typhoon analysis	Typhoon intensity estimation	4 times/day	Alphanumeric data
	Typhoon location determination (Special hourly observation)	8 times/day (24 times/day)	

Table 1. (continued)

(2) Operational products (continued) (2/2)

For domestic users

Type of data	Description	Output frequency	Output type
Cloud amount distribution	Mean of the total, high-level cloud amount in 1° latitude× 1° longitude area	1 time/5 days	Alphanumeric data
	Mean of the total, high-level, and low-level cloud amount in 1° × 1° area	1 time/5 days, /month	Chart
Mean TBB data	Mean and standard deviation of equivalent blackbody temperature in 2.5° latitude× 2.5° longitude area	1 time/5 days 1/5d, 1/m, 1/3m	Alphanumeric data Chart
Infra-red mesh data	Minimun equivalent blackbody temperature for whole area, cloud amount in five layers, mean and standard deviation of equivalent blackbody temperatureudy for cloudy-area * in 0.5 ° latitude× 0.5° longitude area	00Z, 06Z, 12Z, 18Z: 4 times/day	Alphanumeric data
Satellite cloud information chart (Vicinity of Japan area chart)	Characteristics and temporally change of cloud distribution, equivalent blackbody temperature, and other information	8 times/day	Chart
Satellite cloud information chart (Far East (FE) area chart)	Characteristics of cloud distribution, cloud top hight	8 times/day	Chart
Satellite meteorological analysis information	Information for weather forecast (cloud distribution, characteristics and temporally change of cloud, etc.)	4 times/day (5 times/day (typhoon))	Message sent by TELEFAX or telephone
Special satellite meteorological analysis information	Information on clouds indicates severe rain/snow fall	Ocasionally	by TELEFAX or telephone
Typhoon analysis	Extraction of cloud parameters and R30/R50 Estimation of Tropical Cyclone	8 times/day	by TELEFAX
Sea-surface temperature FAX	Enhanced picture for sea-surface temperature	1 times/day	Facsimile picture
Sea-ice FAX	Enhanced picture for sea-ice detection	2 times/day	Facsimile picture

For WMO/WCRP

Type of data	Description	Output frequency	Output type
ISCCP data collection of AC data	Original spatial resolution data for inter-calibration between images from different geostationaly satellites	5 times/month	Magnetic tape
ISCCP data collection of B1 data and B2 data	Nominally 10 km spatial resolution full disk data for B1 data, 30 km for B2 data	8 times/day	Magnetic tape
GPCP data	Five day mean histogram of equivalent blackbody temperature in 16 classes in 2.5 ° latitude× 2.5° longitude area	5 times/month	Magnetic tape

· GPCP ··· Global Precipitation Climatology Project · ISCCP ··· International Satellite Cloud Climatology Project · Cloudy-area is detected by MSC's method.

The GMS visible picture and the infrared picture of AVHRR data (the channel four) of NOAA series are used routinely to identify the sea-ice area in the seas of Okhotsk and Pohai during the season from December to May. Application of the enhancement technique allows the users to make the sea-ice area detection easy.

c. Estimation of storm force and gale force areas of tropical cyclone

The estimation of storm-force (R50 : sustained wind is more than 50 knots) and gale-force (R30 : sustained wind is more than 30 knots) areas started on Oceober 1, 1987. This estimation procedure is performed in case a tropical cyclone locates within 100-180°E and north of the equator.

R30 and R50 are estimated by the regression method using cloud parameters extracted from satellite images. The regression coefficients were determined from the relationship *between* a set of cloud parameters extracted from satellite images *and* R50/R30 issued by JMA during 1982-1986. The R30 and R50 are used for the warning in the north-western Pacific area.

2.1.1.2 **Data collection service**

GMS has a total of 133 telecommunication channels dedicated to the collection of environmental data from automatic or semiautomatic Data collection Platforms (DCPs). Presently one hundred channels are assigned for regional purposes, and the remaining channels are assigned for a part of the International Data Collection System (IDCS). Those DCP data are received at the CDAS and then transmitted to world-wide users through GTS.

2.1.2 **INSAT-1 system**

INSAT-1b is currently operational. This satellite is a multipurpose spacecraft. Meteorological earth observation and data relay are included in the objectives of the satellite.

2.1.2.1 **Product service**

(1) Products on direct broadcast

Low resolution dissemination

The Meteorological Data Utilization Center (MDUC) processes the cloud imagery data, which are transmitted to 20 Secondary Data Utilization Centers (SDUCs) using communication links between MDUC and SDUC. These data are not transmitted to the users other than India's.

(2) Products on the GTS

Cloud motion winds (CMWs) are derived over India and adjoining oceanic areas at 06 UT from INSAT-1b Very High Resolution Radiometer (VHRR) data. The CMWs are transmitted to world-wide users through GTS.

2.1.2.2 **Data collection service**

The INSAT-1 system collects and transmits meteorological data from 100 land-based and 10 ocean-based DCPs.

2.1.3 **METEOSAT**

METEOSAT is stationed at 0° longitude. It usually takes images every 30 minutes, and WEFAX services are available.

The first Meteosat Operational Program satellite (MOP-1) will be launched in early 1989. MOP-2 and MOP-3 will be launched in 1990 and 1991. These satellites will incorporate the MDD (Meteorological Data Distribution) mission which is concerned with the transmission of meteorological information to Africa and the Middle East.

2.1.3.1 **Product service**

(1) Products on direct broadcast

Low resolution (WEFAX) dissemination

Low resolution images are transmitted to Secondary Data User Station (SDUS). The formats of low resolution transmission are nine-sectorized visible, infrared and water vapor image and twenty-four sectorized visible image. Furthermore, GOES images which are reformatted and relayed via the Lannion station are transmitted to SDUS.

High resolution dissemination

High resolution digital images are transmitted to Primary Data User Station (PDUS). The formats of high resolution transmission are full disk image, European sector image and GOES infrared image.

(2) Products on the GTS

a. Cloud Motion Winds (CMWs)

- The product is derived routinely at 00, 06 and 12 UT. The derivation of an addi-

and 12 UT. The derivation of an additional set of winds at 18 UT is now under consideration.

- The processed area extends to 55 degrees great circle arc from the sub-satellite point.
- The wind field received from ECMWF (European Center for Medium Range Weather Forecasts) is used for an automatic wind quality control of CMW.

b. Sea surface temperature (SST)

- Sea surface temperature is calculated every three hours for each segment the size of which is about 200 km×200 km.
- A weighted mean of the results over 36 hours is distributed to users after quality control.
- SST is distributed via the GTS in WMO SATOB code on a 12 hourly cycle at 00 and 12 UT.

c. Cloud analysis (CA)

- Cloud analysis provides percentages of cloud cover and cloud top temperature in degrees Celsius for up to three cloud layers for each segment.
- CA data are distributed over the GTS in WMO SATOB code three times a day (based on image data for 00, 06 and 12 UT. 18 UT in planning).

d. Upper tropospheric humidity (UTH)

The method used to extract UTH is based on the interpretation of the 6μm water vapor channel radiances. The results represent mean value throughout a deep layer in the atmosphere between approximately 600 hPa and 300 hPa.

UTH is extracted twice daily at 00 and 12 UT and distributed over the GTS in WMO SATOB code.

e. Cloud top height maps (CTH)

CTH is distributed three times a day (03, 12 and 15 UT. 09 UT in planning) in the form of a pseudo image or map in the WEFAX format and is designed for general dissemination by the satellite.

2.1.3.2 **Data collection service**

METEOSAT has a total of 66 telecommunication channels dedicated to the collection of environmental data from automatic or semiautomatic Data Collection Platforms (DCPs). Half of these channels are presently assigned for regional purposes, and the remaining channels are assigned for part of the International Data Collection System (IDCS) and are reserved for mobile DCPs.

2.2 Polar orbiting satellites

2.2.1 NOAA

NOAA-10 and NOAA-11 are currently operational. These satellites provide operational coverage of the entire earth 4 times a day. Purposes of these satellites are to make measurements of temperature and humidity in the earth's atmosphere, surface temperature, cloud cover, water ice boundaries and others.

The sensor systems boarded on the satellite include AVHRR and TOVS. The AVHRR is a five channel scanning radiometer which provides imagery at 1 km resolution. The TOVS consists of three complementary sounding units, 20 channel High-resolution Infrared Radiation Sounder (HIRS), 3 channel Stratospheric Sounding Unit (SSU), and 4 channel Microwave Sounding Unit (MSU).

2.2.1.1 **Product service**

(1) Products on direct broadcast

Low resolution dissemination

Automatic Picture Transmission (APT) is provided in real time from the polar orbiting satellites at VHF frequencies.

High resolution dissemination

High Resolution Picture Transmission (HRPT) is one operational mode for data broadcast from the AVHRR and TOVS instruments on TIROS-N satellites. These data are constantly broadcast to all ground stations of the HRPT class at 1.1 km resolution in all five spectral channels, two visible and three infrared, of the AVHRR.

(2) Products on the GTS

Vertical temperature and humidity profile data are distributed in WMO SATEM code via the GTS.

2.2.1.2 **Data collection service**

They have ARGOS Data Collection and plat-

form location system (DCS).

2.2.2 **METEOR**

The image, corresponding to APT picture of NOAA satellite, is provided in real time from the polar orbiting satellites at VHF frequencies.

3. A summary of the recent status on the use of satellite data in RA-II

This chapter shows the results of the answer to our questionnaire on the use of the satellite data which is summarized in Appendix.

3.1 The status of ground receiving station

Satellite data become very popular to all Members and play a vital role in meteorological and hydrological services in each Member. Most Members receive both geostationary and polar orbiting satellite data and one Member receives solely polar orbiting satellite data. The distributions of geostationary and polar orbiting satellite utilization stations are shown in Figs. 1 & 2. The total number of the users for GMS, INSAT, METEOSAT, METEOR and NOAA is 15, 1, 13, 11 and 30 Members respectively (see Table 2). According to the answers, most of the ground receiving stations are in normal operation at the present time except for five receiving systems.

INSAT data are not opened to other Members now and the Members located at the edge of GMS and METEOSAT coverage can not receive the benefits of the geostationary satellite. Two Members intensively desire the use of INSAT data.

Fourteen Members answered their experience about the inactive events of the receiving system in the past. At the present time, five receiving systems are not in normal operation. For the continuous operation, two factors should be concerned. One is the operator's skill. Fortunately, most of

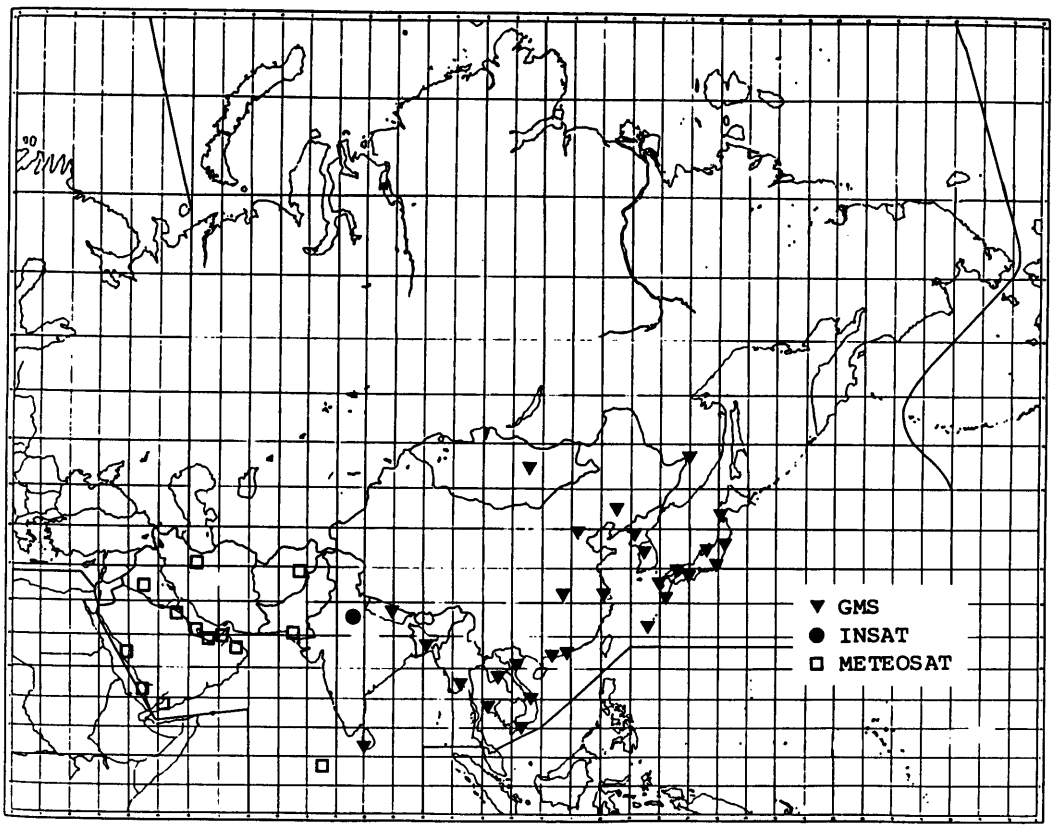

Fig. 1 Distribution of the geostationary satellite utilization stations

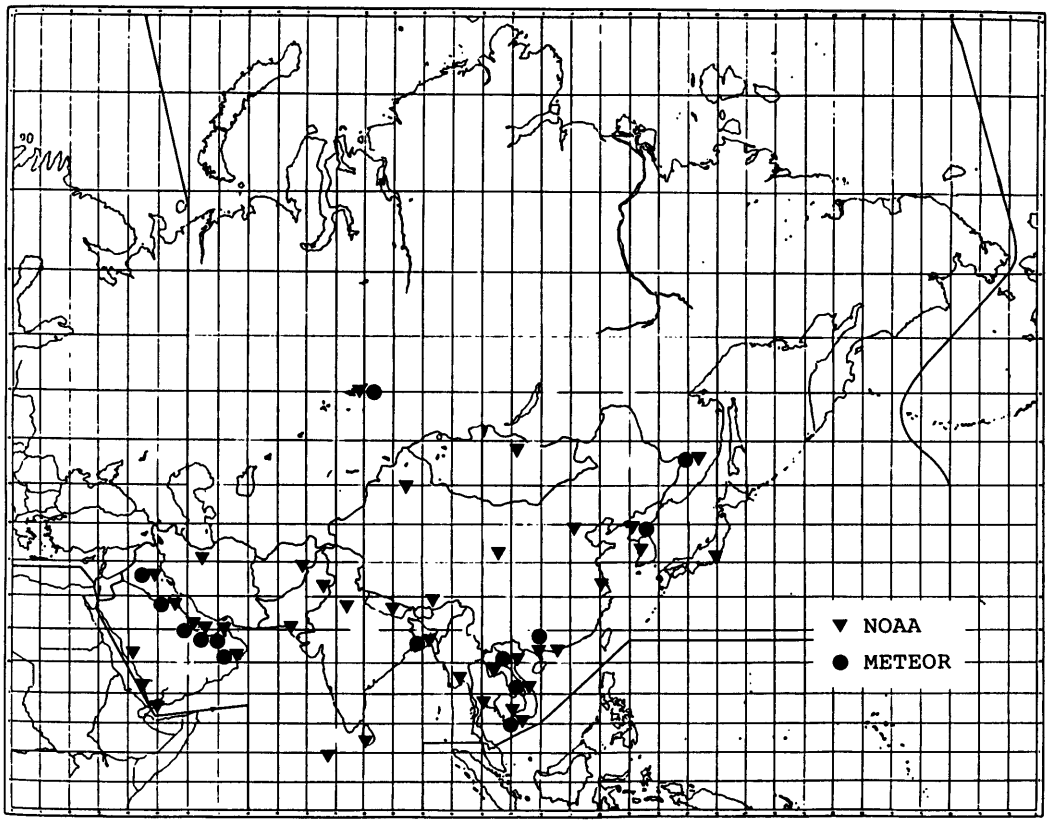

Fig. 2 Distribution of the polar orbiting satellite utilization stations

the field operators have generally sufficient skill to operate their systems. Other factor is an availability of the back-up system for the failure of the receiving and processing system. More than half Members express their insufficient opportunities of the manufacturer's maintenance and about half Members express insufficiency of the stock of spare parts.

The capacity of the receiving and processing system is an important factors for the use of satellite data. Eight Members have plans to upgrade their systems and 4 Members tell the need of the upgrade of their systems. Concerning the receiving of GMS S-VISSR data, 7 Members either already began to or are going to receive S-VISSR data.

3.2 The use of direct broadcast

The information derived from the satellite images is used for various kind of services. Most of the Members use it for weather forecast, for the general and specified purposes. Some Members use it for agrometeorological forecast and in climatological and hydrological fields.

Most of the Members use the cloud imagery primarily for monitoring phenomena such as tropical cyclone, heavy rain, thunderstorm, squall line, southwest monsoon, ITCZ, fog, and so on. Some Members use it for monitoring :

(a) hydrological phenomena such as snow and ice coverage, soil moisture and flood, and

(b) oceanographical phenomena such as ocean front, sea mud distribution and sea ice coverage.

The usage in other fields is to monitor :

(c) forest fire, volcano activity, vegetation

Table 2. Satellite data utilization in RA-II

Member	Geostationary Satellite			Polar Orbiting Satellite			Product Processing			Reception of S-VISSR data	Information Souce
	Sat. ID	H R	L R	Sat. ID	HRPT	APT	SST	TOVS	DVORAK		
Afghanistan	M		1	N		1		*	*	P	NE, S, S2
Bahrain	M		1	N, M		1					NE, S
Bangladesh	G	1		N, M	1(N)	1				*	NE, C, S2
Burma	G		1	N		1					NE, S
China	G	4	1	N	5	11	*	*	*	E	4, 5, NE, S, W, S2
Democratic Kampuchea				N		1					NE
Democratic People's Republic of Korea	G	1	1	N, M		1				*	4, S2
Democratic Yemen	M		1	N		1					NE, S, S2, S2
Hong Kong	G	1	1	N		1			*	P (1988.7)	4, NE, Na, S, S2
India	I	1	20	N	1	8	*	*	*		3, 5, NE, S, C, S2
Iran, Islamic Republic of	M			N	1	1					NE, S, S2
Iraq	M			N, M		1					NE, S2
Japan	G	4	221	N	1	1	*	*	*		3, 4, 5, NE, Na, S, S2
Kuwait	M			N, M		1					NE, S2
Lao People's Democratic Republic	G		1	N		1			*		S2
Maldives	M		1	N		1					S, S2
Mongolia	G		1	N	1						NE, S, S2
Nepal	G		1	N		1					NE, Na, S2
Oman	M		1	N, M		1					NE, S, S2
Pakistan	M		1	N		3	*				5, NE, Na, S, S2
Portugal (Macau)	G		1	N, M		1					S, S2
Qatar	M		2	N, M		3					S, S2
Republic of Korea	G	1	1	N	1		*			P (1989.3)	4, 5, NE, Na, S, S2
Saudi Arabia	M	1		N	1						NE, S, S2
Sri Lanka	G		1	N		1			*		5, NE, Na, S, S2
Thailand	G	1	1	N	1	1				P	4, 5, NE, Na, S, S2
United Arab Emirates	M		1	N, M		2					NE, S2
Union of Soviet Socialist Republics	G		1	N, M		(200)	*				NE S2
Viet Nam	G		3	N, M		3			*		W, S2
Yemen	M			N		1					NE, S2

G : GMS
M : METEOSAT
I : INSAT
N : NOAA
M : METEOR

E : In experiment
P : Planning

SST : Sea Surface Temperature
TOVS : TOVS vertical profile
Dvorak: Typhoon analysis by Dvorak's method

3 :SAT-3(WMO/TD NO.61)
4 :SAT-4(WMO/TD NO.82)
5 :SAT-5(WMO/TD NO.183)
NE:NESDIS PROGRAMS(March 1985)
Na:National Report of WMO training course in Beijing 1987
S :Summary of the questionnaire on satellite use in RA-II and RA-V 1986 by Kubota
W : WMO Roving Mission to Members of the Typhoon Committee on new upgraded GMS transmission scheme
C :Country Report for the Group Training Course in Meteorology by JICA 1986 and 1987
S2:Summary of the second questionnaire on satellite use in RA-II 1988 by Noumi

and oil spill.

The most popular method using the satellite data is to analyze the images on a display in enhancement, enlargement, animation and overlay procedure with other data. Various kinds of information are derived by using such procedure. Furthermore, 8 Members use Dvorak method to analyze typhoon or tropical cyclone by small computer system.

Precise structures of cloud and state of earth surface are detectable using multi-band data of polar orbiting satellite. For example, vegetation index is derived from the combination of visible and near infrared band data and sea surface temperature from the combination of the data of two or three infrared bands. Some Members adopt the multi-band data processing.

TOVS data are processed by 4 Members to derive vertical temperature and humidity profiles, and sea surface temperature.

The usage in hydrological and agrometeorological fields is not so popular in many Members due to some limitations of hardware and experience. It is expected that the present status be improved to extend the use to other fields in the near future.

3.3. The use of data via GTS

(1) Geostationary satellite data

The data transmitted through GTS network are also useful ones for a few Members. For example the cloud motion winds (CMWs) are used as initial data for numerical weather prediction (NWP). The impact of CMWs on NWP is observed especially in the data-sparse area such as tropics, southern hemisphere and oceanic area.

The CMW data are produced by Japan and India as described in section 2. Japanese CMW covers almost all GMS coverage every 6 hours, but Indian CMW only the vicinity of India once a day (06 UT). It is desirable to extend the processed area to the whole INSAT coverage and increase the reliability of the CMWs. Japan and Hong Kong use the CMW data as initial data for NWP in routine operation.

(2) Polar orbiting satellite data

The global vertical sounding data produced by NESDIS twice a day are used as initial input for NWP by two Members. It is acknowledged that those data have great impact on the global data analysis and forecasting. The use of vertical sounding data facilitates better analysis of 3-dimensional atmospheric structure in RA-II.

3.4. The use of Data Collection System

(1) Geostationary satellite

The DCP of GMS

Data collection system of GMS is used by China's 12 stations. In Japan, 26 DCPs (13 land stations, 6 ships, 6 buoys and 1 mountain station) are in operation. Furthermore, collection of weather radar data on meteorological observation ships of JMA is operated. Three ships with international DCPs and ASDAR system of GMS are operated.

(2) Polar orbiting satellite

The DCP of NOAA

ARGOS data collection system on NOAA satellite is used by Saudi Arabia (13 stations), India and Japan.

Acknowledgment

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Appendix. Questionnaire and Answers

The questionnaire on the use of satellite data (Table A. 1) were sent to all Members in RA-II on May 20, 1988 and the answers were returned from 27 Members as of January 1989. The answers to the questionnaire are summarized in Table A. 2.

Table A.1. The questionnaire on the use of satellite data

May 1988

This is on the use of satellite data and consists of three parts. PART I is on a status of satellite data utilization and it is sufficient to complete one for each Member. PART II is on a status of the ground receiving station and if plural receiving stations are established, please complete it for each station. PART III is on the receiving and processing system. Please complete it for each system. If the same systems are established at plural stations, it is sufficient to complete one.

Concerning PART I. If satellite data are used, please complete all of items. If satellite data are not used, please complete the items 1, 2, 3 and 9.

Please return completed questionnaire to the following address to be received not later than 10 July 1988.

Address:

Takenori Noumi
Rapporteur on the use of satellite data in RA II
Head, Data Processing Department
Meteorological Satellite Center
3-235 Nakakiyoto, Kiyose, Tokyo 204, Japan

PART I　PLEASE COMPLETE THE FOLLOWINGS FOR EACH MEMBER.

1. Member Name: _____

2. Organization: _____

3. Contact person of this questionnaire.

   Name: _____

   Affiliation: _____

   Address: _____

4. Satellite data utilization.
   Please put a mark and make an entry.

   (a) Satellite data are used for;

   ☐ general forecast for the public　☐ short-range
   ☐ medium-range
   ☐ long-range
   ☐ warnings of hazardous weather, typhoon, floods
   ☐ aviation forecast
   ☐ agromet forecast, short, medium and long-range
   ☐ marine and transport
   ☐ climatology
   ☐ hydrology and water resources
   ☐ others (please make an entry)

   _____　_____

(b) What kind of information do you get from satellite data ?

☐ tropical cyclone
☐ developed low
☐ heavy rain
☐ thunderstorm
☐ squall line
☐ fog
☐ monsoon
☐ ITCZ

☐ sea surface temperature
☐ oceanic front
☐ oceanic current
☐ sea ice

☐ soil moisture
☐ solar radiation
☐ snow and ice coverage
☐ vegetation
☐ crop assessment
☐ flood
☐ forest fire

☐ others (please make an entry)

_____ _____

_____ _____

5. Data processing of received satellite data on direct broadcast.
Please put a mark and make an entry.

Dvorak method
☐ adopted ☐ not adopted

Nephanalysis
☐ adopted ☐ not adopted

Derived physical parameters
☐ none
☐ cloud motion wind
☐ sea surface temperature
☐ cloud amount
☐ cloud top height
☐ cloud thickness
☐ outgoing longwave radiation
☐ precipitation index
☐ vegetation index
☐ vertical profile (TOVS)
☐ others (please make an entry)

_____ _____

6. Use of products available on GTS.
If the following products are used, please put a mark or make an entry.

☐ cloud motion wind
☐ sea surface temperature
☐ SAREP
☐ cloud analysis
☐ upper tropospheric humidity
☐ SATEM (TOVS data)
☐ others (please make an entry)

_____ _____

7. Use of Data Collection System(DCS).
If DCS is used, please put a mark and make an entry.

(a) Data collected by DCS

☐ surface observation data
☐ upper air observation data
☐ hydrological observation data
☐ others (please make an entry)

_____ _____

(b) Number of operational Data Collection Platforms(DCPs) of geostationary satellite and the location of them.

(location) (number)

☐ mountain _____
☐ river _____
☐ island _____
☐ ship _____
☐ buoy _____
☐ aircraft _____
☐ others (please make an entry)

_____ _____ _____ _____

_____ _____ _____ _____

(c) Number of DCP of polar orbiting satellite and the location of them.

(location) (number)

☐ buoy _____
☐ others (please make an entry)

_____ _____ _____ _____

8. If you have any comment on study and training of satellite data receiving, processing and utilization, please describe them.

9. If you have other opinion or comment on satellite data utilization, please describe it.

PART II PLEASE COMPLETE THE FOLLOWINGS FOR EACH RECEIVING STATION.

10. Ground receiving station.
Please put a mark and make an entry.

Name of organization: _____

Address: _____

Latitude and longitude: _____

Date of establishment: _____

Model name: _____

Status at present
☐ active ☐ inactive
(the date on outage: _____)

Manufacturer's maintenance since establishment
☐ sufficient ☐ insufficient ☐ none

Stock of spare parts
☐ sufficient ☐ insufficient ☐ serious

Stock of expendable supplies
☐ sufficient ☐ insufficient ☐ serious

Operators skill
☐ sufficient ☐ insufficient

Any inactive event in the past
☐ exists ☐ none

(received data)
Geostationary satellite
☐ GMS ☐ HR dissemination ☐ VIS
☐ INSAT ☐ LR dissemination ☐ IR
☐ METEOSAT ☐ WV
☐ Met.Chart
☐ Test Pattern
☐ MANAM
☐ DCP data

Polar orbiting satellite.
☐ NOAA ☐ HRPT
☐ APT

☐ METEOR ☐ APT

Other satellite (please make an entry) _____

If the received images are delivered to domestic users, please describe it.

_____

_____

_____

11. If you have any renewal plan of present system or other comments on the ground receiving station, please describe it.

12. These items are only for users of GMS HR-dissemination.
Please put a mark and answer the following items.

Present status of stretched VISSR reception.
- ☐ already received and used in operation.
- ☐ already received but not yet used in operation.
- ☐ in planning
- ☐ no plan in present

-- If already received, please describe present status about the reception and the utilization of S-VISSR. --

-- If in planning, please describe it. --

PART III PLEASE COMPLETE THE FOLLOWINGS FOR EACH RECEIVING SYSTEM.

13. Function of receiving and data processing system.
Please put a mark and make an entry.
(a) Name of the station where the following system is installed.

_____ _____ _____ _____

_____ _____ _____ _____

(b) Antenna and receiving subsystem

Model name (ANT): _____

Manufacturer (ANT): _____

Diameter (ANT): _____

Gain (ANT): _____

Mount type (ANT): _____

Orientation adjustment range (ANT): _____

Model name (RCV): _____

Manufacturer (RCV): _____

Configuration
☐ for only geostationary satellite
☐ for only polar orbiting satellite
☐ for both satellites

Receiving procedure
☐ manually ☐ automatically

(b') If another antenna and receiving subsystem installed,

Model name (ANT): _____

Manufacturer (ANT): _____

Diameter (ANT): _____

Gain (ANT): _____

Mount type (ANT): _____

Orientation adjustment range (ANT): _____

Model name (RCV): _____

Manufacturer (RCV): _____

Configuration
☐ for only geostationary satellite
☐ for only polar orbiting satellite
☐ for both satellites

Receiving procedure
☐ manually ☐ automatically

(c) Data processing or recording subsystem

-- If digital processing subsystem installed, --

Model name: _____

Manufacturer: _____

Configuration
- ☐ personal computer
- ☐ mini computer
- ☐ middle or large computer

Digitized count on data processing
- ☐ 3 bits ☐ 4 bits ☐ 5 bits ☐ 6 bits
- ☐ 7 bits ☐ 8 bits ☐ 10 bits ☐ other ___ bits

Display equipment
- ☐ active ☐ inactive ☐ none

Hard copy equipment
- ☐ active ☐ inactive ☐ none

MT(9-tracks) equipment
- ☐ active ☐ inactive ☐ none

Audio tape recorder
- ☐ active ☐ inactive ☐ none

Other equipment (please make an entry)

_____ _____

Function of overlay of other data
- ☐ exists ☐ none

-- If exists, --
- ☐ weather map
- ☐ digital radar data
- ☐ surface observation data
- ☐ upper air observation data
- ☐ others (please make an entry)

_____ _____

Function of enhancement
- ☐ exists ☐ none

Function of enlargement
- ☐ exists ☐ none

Function of animation
- ☐ exists ☐ none

Software of mapping
- ☐ exists ☐ none

Software of adding coast line
- ☐ exists ☐ none

-- If only image printer installed, --

Model name: _____

Manufacturer: _____

Gray scale of image printer
☐ sufficient ☐ insufficient ____ shades

(d) If you have other opinion or comment on the function of receiving and processing system, please describe it.

Table A.2. The answers to the questionnaire on the use of satellite data

Member	Type of Receiving Station M: MDUS P: PDUS H: HRPT S: SDUS *: ?? A: APT					Contents of Receiving Data MC: Met.Chart DC: DCP TP: Test Pattern MA: MANAM							Number of Inactive Systems	Inactive Events in the Past	Maintenance by Manufacturer	Stock of Spare Parts	Stock of Expendable Supplies	Operator's Skill	Receiving of GMS S-VISSR Data
	GMS	INSAT	METEOSAT	METEOR	NOAA	IR	VS	WV	MC	DC	TP	MA		○ : exist — : none	○: sufficient △: insufficient ×: serious Plural symbols: from more than two stations				
Afghanistan			*		A	✓	✓	✓	✓					○	△	△	△	△	Planning
Bahrain																			
Bangladesh	M			A	H,A		✓							—	×	△	△	○	In Operation
Burma																			
China	M,S				H,A	✓	✓				✓	✓		—	○,△	○,×	○,△	○	Received and Not In Operation
Democratic Kampuchea																			
Democratic People's Republic of Korea	M			A	A									—	×	×	△	○	In Operation & Planning
Democratic Yemen			S		A	✓	✓	✓					1:METEOSAT (1987.5〜)	○	×	×	×	△	
Hong Kong	M,S				A	✓	✓					✓		—	×	○	○	○	Planning
India		*			H,A	✓	✓			✓				○	○	○	○	○	
Iran, Islamic Republic of			*		H	✓	✓	✓											
Iraq			S	A	A	✓	✓	✓	✓		✓			○	○	○	○	○	
Japan	M,S				H	✓	✓			✓	✓	✓		—	○	○	○	○	
Kuwait			*	A	A	✓	✓	✓						—		○	○	○	
Lao People's Democratic Republic	S				A	✓	✓				✓	✓	1:GMS (1985〜)		×	×	×	×	
Maldives			S		A	✓	✓							○	○	○	○		
Mongolia	S				H	✓	✓					✓		○	△	△	△	○	
Nepal	S				A								1:GMS (1985/86)	○	×	×	×	○	
Oman			S	A	A	✓	✓	✓	✓		✓			○	×	△	○	○	
Pakistan			S		A	✓	✓						1:METEOSAT	○	△,×	○,△	○,△	○	
Portugal (Macau)	S			A	A	✓	✓				✓	✓		—	○	○	○	○	
Qatar			*	A	A	✓	✓	✓	✓		✓			○	×	△,×	○	○	
Republic of Korea	M,S				H	✓	✓				✓	✓		—	○	○	○	○	Planning
Saudi Arabia			P		H	✓	✓	✓		✓			1	—	△	○	○	○	
Sri Lanka	S				A	✓	✓							—	×	○	○	○	
Thailand	M,S				H,A	✓	✓				✓	✓		○	△	△	○	○	Planning
United Arab Emirates			S	A	A	✓	✓	✓	✓		✓			○	○,×	○,△	○	○	
Union of Soviet Socialist Republics	S			A	A	✓	✓							○	○	○	○	○	
Viet Nam	S			A	A	✓	✓				✓	✓		—	○	○	○	○	
Yemen			S		A	✓	✓	✓						○	△	△	△	○	

Table A.2. (continued)

Member	Prepared Services by Using Satellite Data									
	General Forecast			Warning	Aviation Forecast	Agromet Forecast	Marine & Transport	Climatology	Hydology & Water Resource	Others
	Short	Middle	Long							
Afghanistan		√	√	√	√	√		√	√	
Bahrain										
Bangladesh	√	√		√	√	√	√		√	
Burma										
China	√			√	√	√		√	√	
Democratic Kampuchea										
Democratic People's Republic of Korea	√			√			√			
Democratic Yemen	√			√	√					
Hong Kong	√			√	√		√			
India	√	√	√	√	√		√	√	√	
Iran, Islamic Republic of	√			√	√	√	√			
Iraq				√	√			√		
Japan	√	√	√	√	√	√	√	√		
Kuwait	√				√					
Lao People's Democratic Republic	√			√	√	√				
Maldives	√			√	√		√			
Mongolia	√	√			√				√	
Nepal	√				√					
Oman	√			√	√		√			
Pakistan	√	√		√	√				√	
Portugal (Macau)	√			√						
Qatar	√			√	√		√			
Republic of Korea	√			√						
Saudi Arabia	√	√		√	√		√			Oil Spill Monitor (Saudi Arabia)
Sri Lanka	√			√	√		√			
Thailand	√	√		√	√	√	√			
United Arab Emirates	√	√		√			√	√		
Union of Soviet Socialist Republics	√	√		√	√	√	√	√	√	
Viet Nam	√									
Yemen		√			√					

Table A.2. (continued)

Member	Phenomena Monitored by Satellite Data																		
	tropical cyclone	develop low	heavy rain	thunder storm	squall line	fog	monsoon	ITCZ	SST	ocean front	ocean current	sea ice	soil moisture	solar radiation	snow ice coverage	vegetation	crop assessment	flood	forest fire	others
Afghanistan	✓	✓	✓	✓	✓	✓	✓						✓	✓	✓	✓	✓	✓		
Bahrain																				
Bangladesh	✓	✓	✓	✓	✓		✓	✓												
Burma																				
China	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	sea mud distribution
Democratic Kampuchea																				(China)
Democratic People's Republic of Korea	✓	✓	✓	✓	✓	✓														
Democratic Yemen	✓	✓		✓	✓	✓	✓	✓												
Hong Kong	✓	✓	✓	✓	✓	✓	✓	✓	✓											
India	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓					
Iran, Islamic Republic of	✓	✓	✓	✓	✓	✓	✓	✓												
Iraq		✓		✓		✓														
Japan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓					volcano (Japan)
Kuwait	✓	✓	✓	✓	✓	✓	✓	✓												
Lao People's Democratic Republic	✓	✓	✓	✓			✓	✓												
Maldives			✓	✓			✓													
Mongolia			✓												✓	✓		✓	✓	
Nepal	✓	✓		✓	✓	✓	✓	✓							✓					
Oman	✓	✓	✓	✓	✓	✓	✓	✓												
Pakistan	✓	✓	✓	✓	✓	✓	✓	✓												
Portugal (Macau)	✓	✓	✓	✓	✓	✓	✓	✓												
Qatar		✓	✓	✓	✓			✓												
Republic of Korea	✓	✓	✓						✓											
Saudi Arabia		✓		✓	✓	✓		✓												
Sri Lanka	✓	✓	✓	✓	✓		✓	✓												
Thailand	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓			✓		✓	✓	✓	✓	
United Arab Emirates	✓	✓	✓	✓	✓	✓	✓	✓	✓											dust haze & total absence of cloud for aerial photography (United Arab Emirates)
Union of Soviet Socialist Republics	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓			✓	✓	
Viet Nam	✓	✓					✓	✓												
Yemen	✓	✓	✓	✓		✓		✓												

Table A.2. (continued)

Member	Data Processing			Physical Parameteres Derived from Satellite Data									Use of GTS Data					
	DVORAK	neph-analysis	TOVS processing	cloud motion wind	cloud amount	cloud top height	cloud thickness	SST	OLR	precipitation index	vegetation indx	others	cloud motion wind	SST	SAREP	cloud analysis	upper humidity	SATEM
Afghanistan	✓		✓	✓	✓	✓	✓		✓	✓	✓							
Bahrain																		
Bangladesh					✓											✓		
Burma																		
China	✓	✓	✓			✓		✓	✓		✓		✓	✓				✓
Democratic Kampuchea																		
Democratic People's Republic of Korea										✓								
Democratic Yemen																		
Hong Kong	✓												✓		✓	✓		
India	✓	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓		✓
Iran, Islamic Republic of		✓		✓	✓	✓	✓											
Iraq																		
Japan	✓	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓			✓
Kuwait																		
Lao People's Democratic Republic	✓																	
Maldives				✓	✓	✓												
Mongolia		✓			✓	✓					✓							
Nepal																		
Oman																		
Pakistan					✓			✓								✓		
Portugal (Macau)		✓			✓		✓											
Qatar				✓	✓	✓	✓					total atmospheric moisture content (Qatar)				✓		
Republic of Korea								✓										
Saudi Arabia															✓	✓		
Sri Lanka	✓	✓																
Thailand		✓											✓	✓	✓	✓	✓	✓
United Arab Emirates																		
Union of Soviet Socialist Republics	✓	✓		✓	✓	✓		✓				Meteor vertical profile (USSR)						
Viet Nam																		
Yemen		✓		✓	✓								✓			✓	✓	

Table A.2. (continued)

Member	Data Collected by DCS				Location and Number of DCP *: The number is unknown.										
					Geostationary Satellite								Polar Orbiting Satellite		
	surface obser.	upper air obser.	hydro-logical obser.	oceano-graphycal obser.	Land	Mountain	River	Island	Ship	Buoy	Aircraft	Others	Land	Buoy	Others
Afghanistan															
Bahrain															
Bangladesh															
Burma															
China	✓		✓			1	6					Plateau (2) Desert (3)			
Democratic Kampuchea															
Democratic People's Republic of Korea															
Democratic Yemen															
Hong Kong															
India	✓		✓		100									*	
Iran, Islamic Republic of															
Iraq															
Japan	✓	✓		✓	13	1			9	6		Ship radar (1)			
Kuwait															
Lao People's Democratic Republic	✓		✓			*	*								
Maldives	✓														
Mongolia															
Nepal															
Oman															
Pakistan															
Portugal (Macau)															
Qatar	✓	✓			2								1		
Republic of Korea															
Saudi Arabia				✓										*	
Sri Lanka															
Thailand															
United Arab Emirates															
Union of Soviet Socialist Republics															
Viet Nam															
Yemen															

WMOのRA-II（Asia）*における衛星データの利用

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気象衛星センターシステム管理課

WMOのRA-II（Asia）における衛星データの利用状況について、地区内の国・領域へアンケート調査した結果をまとめた。

(a) 大部分の国・領域が静止気象衛星と極軌道気象衛星の両方からデータを取得している。

(b) 受信局の安定運用の維持のためには2つの基本的要因：運用担当者の技術的熟練と施設障害時のバックアップ体制が考えられる。

(c) WEFAXやストレッチドVISSR等、衛星経由で放送されている雲画像は、大部分の国・領域が気象予報やその他の目的で利用している。

(d) GTS経由で配信される抽出データ（SATOBコードの風計算結果など）は、いくつかの国・領域が数値予報の初期値として利用している。

(e) 数十の各種DCPが地区内に設置されており、観測データは静止および極軌道気象衛星により集信されている。

なお、本報告は著者(能美)がRA-II内の衛星データの利用状況に関するラポータとして1988年4月と8月にRA-IIの総裁あて報告した2つのレポートをまとめ、その後の情報を入れて一部改訂したものである。この2つのレポートは1988年9月5日から16日に中国の北京で開催された第9回RA-IIの総会で資料として各国・領域の代表に配布された。

* RA-II（Asia）：WMOの第2地区協会（アジア地区）、6つある地区協会のうちのひとつで、日本、中国等アジア地区の30の国・領域が参加している。