Remote Sensing Data Distribution and Utilization in Japan

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1. Introduction

Since the launch of ERTS-1(Landsat-1) in 1972, the Science and Technology Agency(STA) has driven forward the use of data from earth observation satellites in Japan. Through the endeavor of the STA, the Earth Observation Center(EOC) had established as one of the projects of the National Space Development Agency of Japan(NASDA) for receiving and preprocessing of the data from Landsats 2 and 3 in 1979. At the same time, the data received and preprocessed at EOC has been distributed through the Remote Sensing Technology Center of Japan (RESTEC) as an authorized distributor. Since then the utilization of Landsat data has favorably grown in our country. For the 5 years from the direct reception of Landsat data, NASDA had delivered the limited number of data without charge to the government institutes and universities for encouragement of the research and development of satellite data utility. Since the fiscal year 1984, all the data has been sold with appropriate prices through RESTEC.

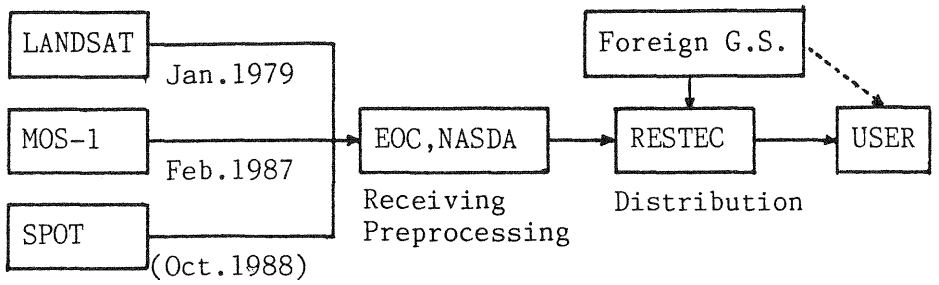
The 2nd generation satellites, Landsats 4 and 5 have been launched in 1982 and in 1984 respectively with the high resolution Thematic Mapper(TM), and their data became available to the user. The recent circumstances of utilized data has been turning to TM from MSS.

In the last year 1987, the first earth observation satellite of Japan called MOS-1(Marine Observation Satellite) was launched into its orbit and has been carried out its observing missions.

Followings are the overview on the satellite data distribution and their trend of utilization in our country.

2. Schematic flow of satellite data distribution

For the earth observation satellites except for meteorlogical purpose, EOC, NASDA has received and preprocessed the data from the American Landsats and the Japanese MOS-1 at present, and will receive and preprocess the data form the French SPOT in this year. These data produced at EOC has been distributed to users through RESTEC. And the data from the other stations in the world are also available through RESTEC as one of the contractual representative, such as SPOT data from SPOT IMAGE (France), Landsat data from EOSAT (USA) and from RSGS (China) and MOS-1 data from the Bangkok station as well.



3. Status and trend on distribution of Landsat data

Operational distribution of Landsat data has continued from the fiscal year 1979 and the change in the number of delivered data is shown in Fig. 1. It appears the rapid growth in the first 3 years from 1979 to 1981.

In the fiscal year 1982, EOC had interrupted its operation for upgrade the facility to receive and preprocess the data from new Landsat 4. In addition to this, the loss of observing capability had occurred on Landsats 2 and 3 at the same year, and the number of delivered data decreased in the year.

In the fiscal year 1983, the retirement of Landsats 2 and 3, and the followed mulfunction of transponder for TM on Landsat 4 caused the hold down of distribution. For the year, newly observing data was limited to the MSS on Landsat 4 only. However, a lot of orders from the foreigners especially from China were reached, and it reflected the rather increase in the number of photo products delivered for the year.

In the fiscal year 1984, along with the launch of Landsat 5 and the commencement of TM data's distribution in Japan, the number of delivered CCT, computer compatible tapes, increased dramatically. After that, TM CCT became the major utilized data and has been growing up of the numbers year to year, but the number of MSS data delivered tends oppositely to down. Similar trend is appeard in the number of digital data and photo products, that is to say, the more digital but the less phot products. For the black and white imagery, the demand by the foreign users directly reflects the number of distribution.

As above, the utilized data is being transfered to the digital, especially TM, along with the wide spread of computers and their utility, and 80% of digital data was occupied by TM CCT in 1987.

In response to the requests by personal computer users, RESTEC has sold the MSS data on floppy disk since 1983 for familiarization of digital data, and a favorable result has continued.

Through the 10 years experience, the most important factors in the distribution of satellite data are archiving the data for long term, continuity of observation, stability of the higher quality, providing the data on the required format and the reasonable prices, we think.

Fig.2 shows the number of delivered data in the world, and the circumstances are similar to that of Japan.

4. Status of utility based on Landsat data distribution

Total volume of standard Landsat data sold in the fiscal year 1987 was 626 frames of black and white images, 679 frames of color images, 573 scenes of CCTs, 260 sub-frames of floppy disks and 202 frames of quick look prints. Table 1 shows the number of products to the categorized users, and it appears a tendency of utility including objects, equipments and budget.

The government agencies including national institutes have applied the satellite data to the field of agriculture and forstry, land management, preservation of environment, prevention of disaster and map making, and they have driven a lot of projects about development of application technology, fundamental study as well as cooperative works with other countries. Such organization have rather big computer systems in their facility and they usually use the TM data at present.

Local government occasionally use the data for planning of regional development, preservation of green belts and monitoring of environment.

Many universities have now several courses of lecture on remote sensing as well as specific facilities and perform the fundamental study and the applications for many fields. Thus utilized data covers many types. They recently use unexpensive floppy disks as one of the basic materials for study.

Non-profit foundations use the data for the fundamental studies as well as the specific applications in accordance with their fields, such as energy and metal resources, agriculture, forestry and fisheries.

Private companies usually use the data in the wide field of bussiness involved the development of hardware and software for remote sensing data analysis. Types of priate company are, in order of utilized volume, surveyor, consultant, computer maker, publisher and advertizing.

The delivered data in the fiscal year 1987 is categorized to the application fields on table 2. The data was mostly used for the land application such as land use and preservation of environment. For the purpose of oceanic application, the record said the most utilized field was coastal study. For the category of "General", a lot of color images and floppy disks were used for the educational materials and publishing. On the other hand, many digital data were used for the development of software.

Trend of utilization for the last 9 years are shown in Fig. 3. The numbers on the figure show the sales volume but not include the volume of free distribution.

5. Status of distribution and utilization on MOS-1 data

MOS-1 is the first earth observation satellite of Japan. Since August 1987, its data has been delivered to the investigators who participate the cooperative MOS-1 verification program as well as

general users on test basis. Because operatinal distribution commences in this April, the record for the fiscal year 1987 was based on the free distribution for the verification program and the sales to the other users.

Delivered volume were 325 frames of black and white images, 453 frames of color images and 324 scenes of CCTs, and it was a favorable record as the beginning stage. Status of utilization is shown in tables 3 and 4.

The tendency of user was same as that of Landsat, and government and university occupied the most, but a particular situation has appeared in the record of individual. The reason is that MOS-1 is the first Japanese satellite and our promotion activities through the masmedia makes them to take a color image for memorial.

From application field point of view, MOS-1 data is fairly used for the oceanic and atmospheric purposres. Since the characteristics of each sensors are different form the other, but each images are taken at the same time, such data are expected to use for making the mutual understanding of observation performance.

In the current year, distribution of floppy disk data was added in April and favorable record is expected in the sales volume for FY.1988.

6. Distribution of SPOT data

As an authorized distributor, RESTEC has sold the SPOT data to users in Japan since May 1986. Sales volume in the fiscal year 1986 was 44 frames of photo products and 65 scenes of CCTs, but that of 1987 was fairly improved due to the increase of archived data and understanding of its capability. Followings are the number of delivered data in the fiscal year 1987.

Photo	B/W	PA:	18	CCT	PA:	68
		XS:	32		XS:	75
	Color	:	79			
Total			129			143

For the application field, 90% of both photo products and CCTs were used for land applications such as the extraction of precise information and height information for making a map as well as the combination with other data from Landsat and MOS-1.

In the current year, EOC will have a capability of direct reception and preprocessing the data from SPOT in October, and the more growth of sales will be expected.

7. Conclusion

Our land of Japan is located at the east of Asia and surrounded by the ocean. Its complicated geographical feature is consisted by main four islands laying from north to south.

In this geographical circumstances, we have many changes caused by natural disasters such as raining, snowing, eruption and earthquake. In addition to them, we also have many changes caused by the economical activities. In order to grasp the situation, we have now a lot of thematic maps and statistical informations on our land and human activities. However the circumstances around us are rapidly changed in recent year, so utility of satellite data is expected for updating such informations in the various fields, and in the particular field, operational use of satellite data is being planned.

From the characteristic point of view, the high resolution data will mainly used for the land and coastal applications and the data having wide field of view for the oceanic applications. On the other hand, the data over foreign countries are fairly used for the purpose of international cooperative activities.

In order to effectively use the satellite data, we think the combination with the other data taken by ground survey and the other satellite data is important. We, RESTEC, will continually distribute the data from various satellites in orbit at present or in the future, so could you please use more and more data from the satellites.

Table 1 Landsat standard products to categorized users in FY. 1987

Category of users	Number of users	Number of delivered data / Share (%)								Sales value share (%)
		MSS				TM			Quick Look	
		B/W	Color	CCT	Floppy	B/W	Color	CCT		
1 Government agency	28	57/15.0	20/6.4	36/31.3	0/0	48/19.6	22/6.0	250/54.6	232/75.6	51.3
2 Local Government	39	10/2.6	19/6.0	10/8.7	21/8.1	3/1.2	28/7.7	10/2.2	2/0.7	3.0
3 Educational institute	63	174/45.7	51/16.2	31/27.0	117/45.0	91/37.1	48/13.2	52/11.4	11/3.6	10.2
4 Non-profit foundation	24	21/5.5	5/1.6	15/13.0	11/4.2	10/4.1	65/17.8	37/8.1	19/6.2	7.6
5 Private company	168	95/30.0	183/58.3	20/17.4	103/39.6	46/18.8	188/51.5	58/12.7	11/3.6	17.8
6 Individual	12	11/2.9	30/9.6	0/0	8/3.1	0/0	2/0.5	1/0.2	26/8.5	0.7
7 Foreign country	20	13/3.4	6/1.9	3/2.6	0/0	47/19.0	12/3.3	50/11.0	6/2.0	9.4
Total	354	381/100	314/100	115/100	260/100	245/100	365/100	458/100	307/100	100.0

Table 2 Landsat standard products to application fields in FY. 1987

Application fields		MSS B/W	MSS Color	MSS CCT	MSS Floppy	TM B/W	TM Color	TM CCT	Quick look
Land	L-1	172	34	27	42	81	104	123	29
	L-2	18	30	10	5	27	29	27	21
	L-3	3	2	1	12	7	20	21	0
	L-4	9	5	10	1	25	28	32	0
	L-5	19	0	0	0	0	0	1	0
	L-6	21	87	25	34	10	39	154	120
	L-7	1	0	0	11	0	1	1	0
	sub-total	243	158	73	105	150	221	359	170
Ocean	M-1	6	2	4	0	0	0	11	0
	M-2	52	1	4	6	26	3	20	7
	M-3	0	1	1	0	0	1	4	8
	M-4	4	2	0	1	0	3	0	0
	M-5	5	1	1	9	1	1	0	0
	sub-total	67	7	10	16	28	8	35	15
Atmospher	A-1	0	0	0	0	0	0	0	0
	A-2	3	1	20	2	11	0	2	103
	A-3	0	0	0	0	0	0	0	0
	sub-total	3	1	20	2	11	0	2	103
General	G-1	0	4	4	2	0	3	2	0
	G-2	1	9	0	2	10	11	0	1
	G-3	24	18	2	49	11	14	5	0
	G-4	1	12	0	23	1	38	1	0
	G-5	0	50	2	19	0	51	7	0
	G-6	13	6	3	2	15	3	26	6
	sub-total	39	99	11	97	37	120	41	7
Other	O-1	9	5	0	20	2	1	10	0
	O-2	0	0	0	1	0	0	0	0
	O-3	10	44	1	19	17	15	11	12
	sub-total	29	49	1	40	19	16	21	12
Grand total		381	314	115	260	245	365	458	307

L-1: Land use
L-2: Agriculture & forestry
L-3: Geography
L-4: Geology
L-5: Water resouces
L-6: Environment
L-7: Others

M-1: Fisheries etc.
M-2: Coastal study
M-3: Ocean phenomena
M-4: Navigation
M-5: Others

A-1: Pollution, etc.
A-2: Meteorology
A-3: Others

G-1: Prevention of disaster
G-2: Cartography
G-3: Education
G-4: Publication
G-5: Advertizement
G-6: Others

O-1: Software
O-2: Hardware
O-3: Others

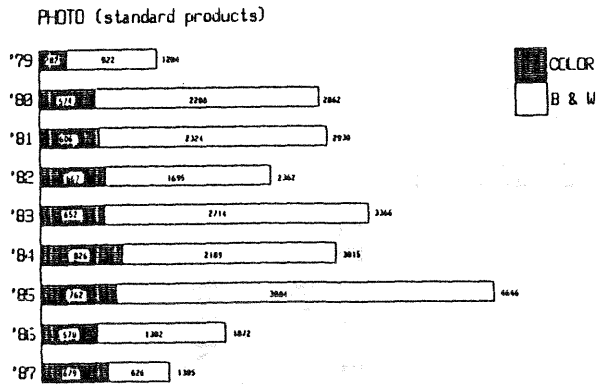
Table 3 MOS-1 standard products to categorized users in FY. 1987

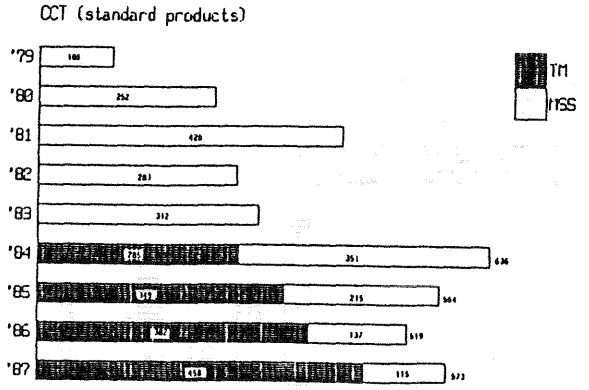
Category of users	MESSR			VTIR		MSR		Quick Look
	B/W	Color	CCT	B/W	CCT	B/W	CCT	
1 Government agency	30	28	43	3	71	20	38	33
2 Local Government	5	29	3	0	0	0	0	0
3 Educational institute	107	68	66	12	12	50	19	0
4 Non-profit foundation	4	20	12	5	4	17	13	0
5 Private company	9	73	12	3	12	6	3	3
6 Individual	49	231	0	0	2	0	0	0
7 Foreign country	3	4	14	0	1	0	1	0
Total	207	453	150	23	100	95	74	36

Table 4 MOS-1 standard products to application fields in FY. 1987

Category of applications	B/W	Color	CCT	Q.L.*
Land	87	85	67	3
Ocean	57	0	89	0
Atmospher	33	3	98	11
General	33	71	6	0
Others	137	276	64	0
Total	325	453	324	36

* Quick look





Transition of LANDSAT Data Distribution

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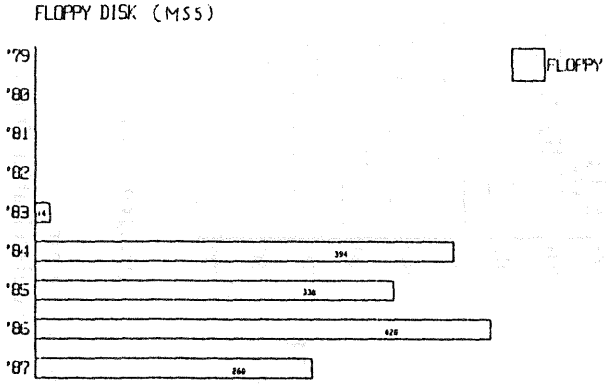
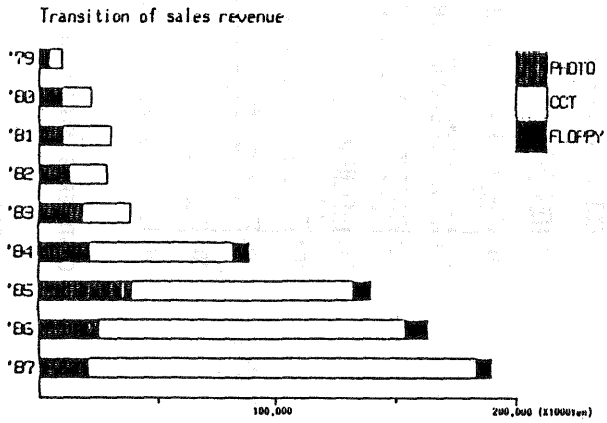




Transition of LANDSAT Data Distribution

Fig. 1 Transition of Landsat data distribution in Japan
- number of delivered data from FY. 1979 to FY. 1987 -

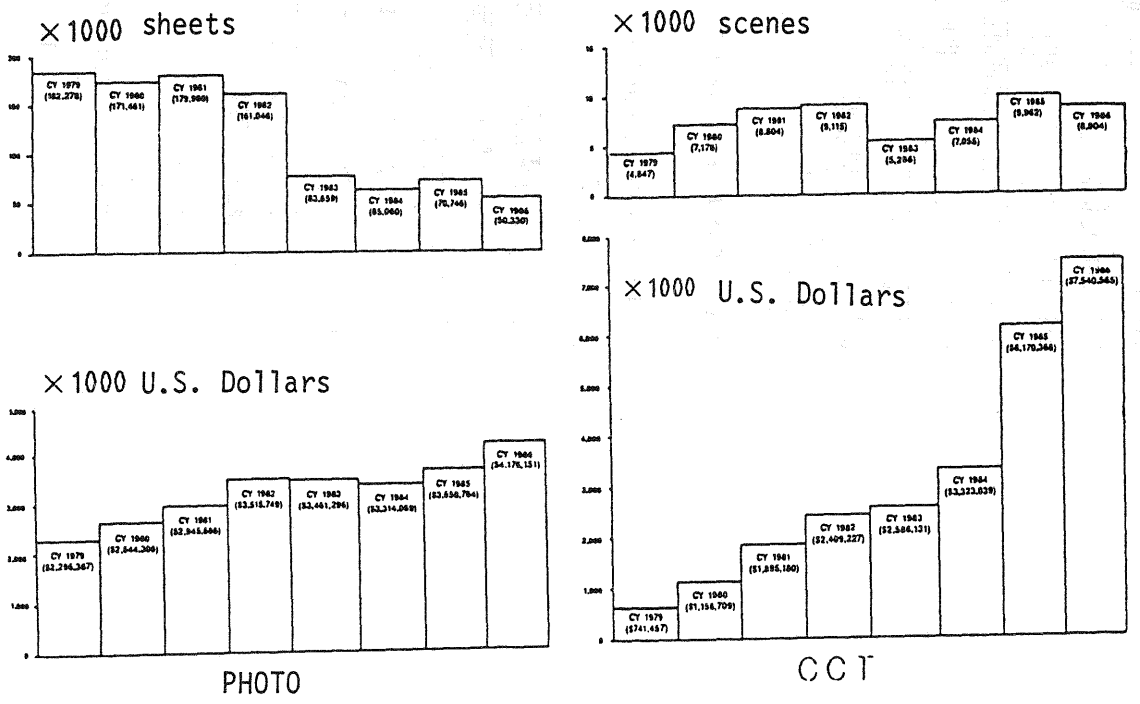
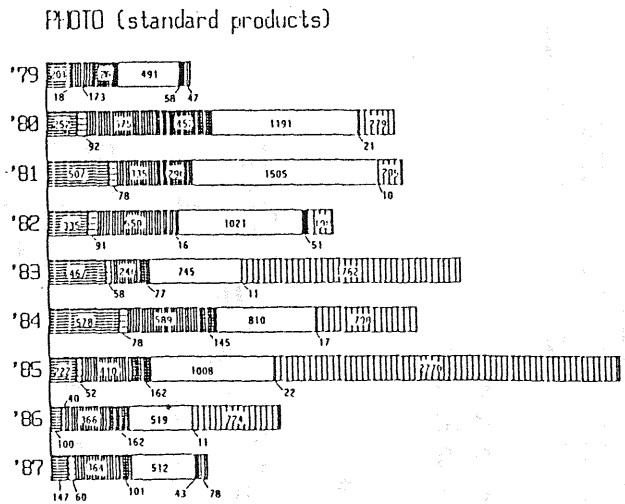
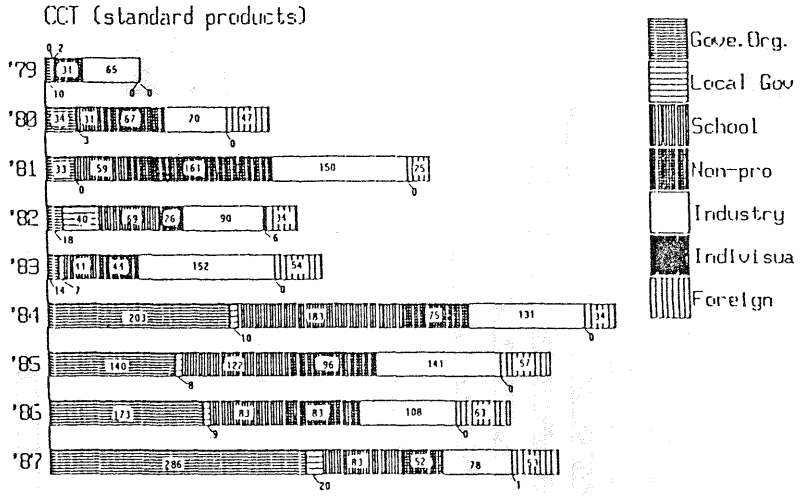


Fig. 2 Transition of Landsat data distribution in the world



CUSTOMER'S PROFILE of the TYPE of ORGANIZATION



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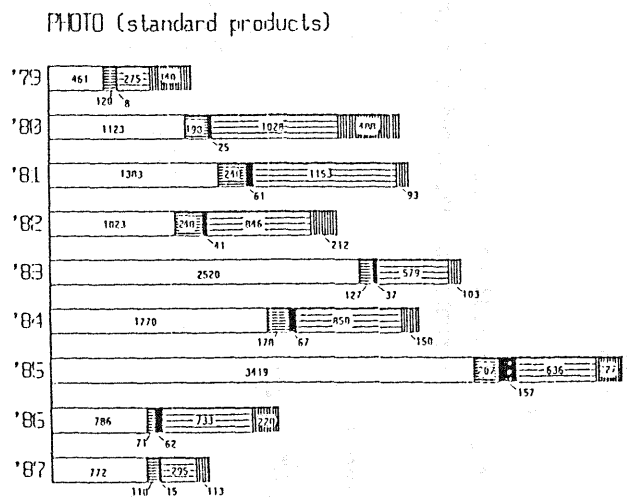
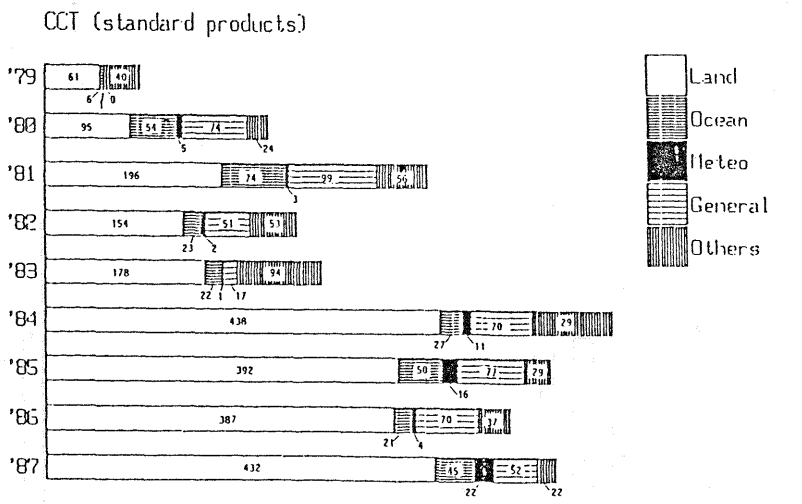


CUSTOMER'S PROFILE by APPLICATION FIELD



CUSTOMER'S PROFILE by APPLICATION FIELD

Fig. 3 Trend of utilization in Japan
- based on Landsat data distribution from FY. 1979 to FY. 1987 -