GENERAL TREND OF REMOTE SENSING RESEARCH ACTIVITIES IN JAPAN

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ABSTRACT

The states of remote sensing studies in Japan have been largely encouraged in the recent ten years. That is closely related with various advisable policies on scientific technological advancement by the government, including the starting of Landsat data delivers by the National Aero Space Development Agency Japan (NASDA) in Japan.

The reported numbers of the remote sensing studies for Science and Technology Agency of Japan increased over 2.7 times in this period. Study activities by educational institutes have increased more than ten times.

Almost all of the data accessments employ the electronic techniques in studies.

Besides Landsat, the other satellite data or the future sensor data use studies have been steadily promoted in wider fields.

INTRODUCTION

Regular remote sensing studies in Japan started in 1972 on launching ERTS-1 and joining the EROS cooperation research project through Science and Technological Agency Japan (STA) officially.

Research activities have been encouraged and technical levels have been advanced by many advisable policies and financial supports for remote sensing studies based on a letter of admonition entitled "The Advancement System Construction for Realization of the Earth Resources Remote Sensing" by Standing Committee of Resources Survey of STA in 1973.

Such as

(1) The on trial Landsat data delivers for registered research institutes including educational organizations and public

data delivers by NASDA that started in 1979 have had a big effect for the development of study surroundings in Japan.

(2) The research work by the special regular/regulatory budget by STA, since 1973 to 1980 and operational research work of Landsat data by the special scientific technology promotion budget of STA since 1981 have composed the leading remote sensing research groups in wider fields.

(3) The establishment of the Remote Sensing Technology Center (RESTEC) has advanced the practical technical supports for research works very effectively since 1976.

(4) Annual remote sensing symposium by STA, NASDA, Federal Economic Organization of Japan, and RESTEC since 1976 and regular symposium and meetings by JSPRS and others or the temporal symposium by United States-Japan, also the starting of the training courses for ESCAP participants by Japan International Cooperation Agency and for domestic students have promoted information exchanges and publications inside and outside Japan.

(5) The advancement of MOS, ERS programs of Japan and other oversea satellites plans have clarified the future prospect of remote sensing data utilities. Then the practical application of the remote sensing study results for operational work have been expected earnestly in recent times.

Some of the significant events which encouraged remote sensing study activities in Japan from 1972 to 1982 are shown in Table 1.

Table 1

1972	Participation in ERTS data use research project
1973	Participation in SKY-LAB project
1974	Participation in UN Scientific Technology Subcommittee
1975	Establishment of RESTEC Participation in Landsat Follow-on project
1976	Start of the annual remote sensing symposium by STA and others
1977	Launching of GMS-1 Concept design of MOS-1
1978	Starting of remote sensing training course for ESCAP participants Establishment of Earth Observation Center of NASDA
1979	Starting of Landsat data services by NASDA
1980	GMS-2 launching
1982	ETS launching

CHANGE PATTERNS OF THE REMOTE SENSING STUDIES IN JAPAN

Only a few research institutions had carried out remote sensing studies in Japan before 1970, such as in Meteorological Agency using the US geometric satellite data, geological and oceanographical institute using airborne thermal data, forestry research institute using airborne multispectral data and so on.

Since 1972, the launching of the Landsat-1, the availabilities of the earth observation data, and the support for studies as before mentioned have promoted the remote sensing studies very much in many fields.

The Resources Survey Institute of STA has driven the annual investigation of remote sensing data use in research field since 1972 as a factor for grasping the real states of the scientific technological patterns in Japan.

The information of this investigation shows very clearly the changing patterns of the remote sensing studies in Japan during these ten years such as the numbers of related organizations, the kinds of data used, study cases, and data processing techniques. It shows the future trend also. The results of these investigations was published in two reports the first covering 1972 to 1976 and the second 1977 to 1981. These make it possible to compare the former and latter 5-year periods of the remote sensing study conditions during these ten years.

The numbers of all of the organizations which related with remote sensing studies was 285 in the former period and 378 in the latter, that is 33% up. Though these numbers are not sure to grasp correctly the whole of remote sensing organizations in Japan, they show the general views of them.

(1) Study Cases

The investigated study cases in 1972 were 38 only. The total numbers of them in 1981 was 721, that is about a 20-times increase.

The subtotal numbers of them in former period was 1441 and latter was 3524. That is about a 2.7-times increase.

(2) Data Platform

Among all of the study cases during these 10 years of 4965, the airborne data was 3583 and Landsat was 1243 cases. The rest of 139 cases used other satellite data such as GMS, NOAA, etc. but remarkable changes of their contents have happened.

1) Satellite data

The percentage of the Landsat data studies was lower than 7% before 1978 except 1972, that the year of first launching of Landsat-1.

Those studies had been carried out at some of the limited institutes in that period. But they increased suddenly in 1979 and became to occupy almost half the studies in remote sensing. Then the percentages of the airborne data use was reduced about one half. The Landsat studies were encouraged very much by the on trial delivers of the received data for registered research organizations which was started by NASDA in 1978. The states of Landsat data services by NASDA are shown in Table 2.

Table 2 Landsat Data Service by National Aero-Space Development Agency (NASDA)

	On Trial Delivers		Compensation	
	Photo Scene	CCT Scene	Photo Scene	CCT Scene
1979	3,217	373	1,204	108
1980	2,841	394	2,862	252
1981	3,094	559	2,930	428
1982	2,360	469	2,362	283
1983	3,044	549	1,170 (April-August)	128 (April-August)
Total	14,558	2,340	10,528	1,199

The other satellite data such as from NOAA, NIMBUS, or GMS are constantly used without irregular changes.

2) Airborne data

The percentages of the airborne data used studies was reduced to half of before 1978 due to the increase of Landsat data used studies before mentioned. But the actual use of airborne data have not decreased as that, because they were not reported as the study cases when they are used as the supplimental data for the Landsat studies.

MSS data studies have occupied a half of all almostly in airborne data since 1974. The rest 1 to 10% are monochrome photos, 21 to 47% are color photos and 5 to 10% are color-infrared studies which are regularly done for vegetation or environmental studies.

On the other hand the studies of multispectral photographs which had a high ratio before 1975 was decreased suddenly after 1977 and very few in 1981. They are replaced by MSS in digital use and color photos or color-infrared photos in graphical use.

3) Study field

The study cases of agriculture and forestry have covered about 20% of all cases constantly through these periods. The land use study cases have increased since 1977. The reported study cases for the regional environmental survey by remote sensing was only 5 in 1972. But they jumped up to 114 in 1979, then have sustained about 10% of all in recent years.

Landsat studies for other fields such as fishery, geography, oceanography, meteorology, etc. have also increased largely since 1979 together with the airborne studies.

4) Organization

Remote sensing studies were done at some of the governmental institutes and industrial laboratories before 1972, 3.

Educational institutes or juridical organizations have joined after 1974. The study cases by educational institutes increased several times in 1979. The governmental, educational, and juridical institutes have occupied each of 30% of whole of the study cases. The remaining 10% were done by industrial institutes in present.

The study cases by operational organizations such as prefecture government have less than 1% share of all. That means a few of practical use techniques are exploited in present.

The increment of airborne data use in 1974 and '77 depended on the MSS data services by the special project of Japan Shipbuilding Promotion Foundation.

The general views of remote sensing data use conditions are shown in Figs. 1, 2, 3, and table 3.

Fig. I STUDY FIELDS

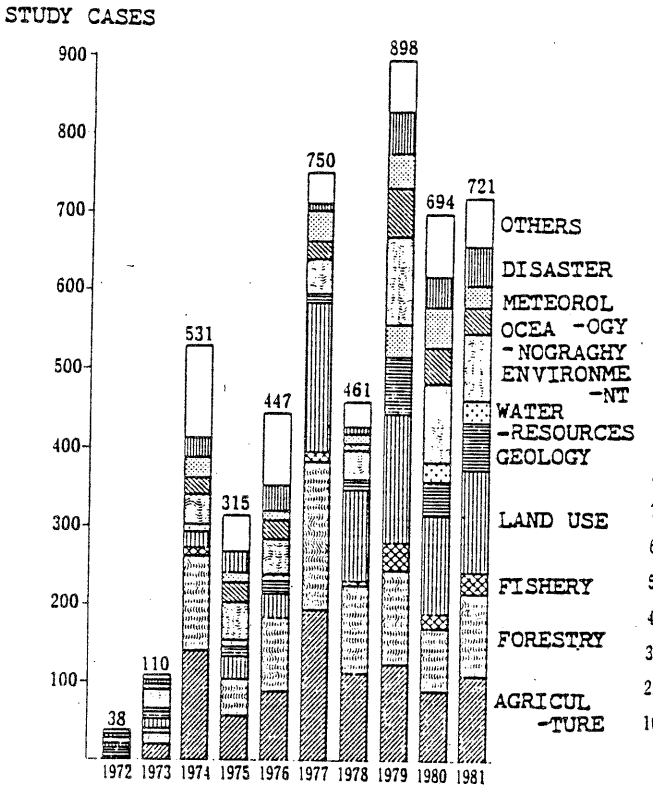

Fig. 2 STUDY CASES AND PLATFORM

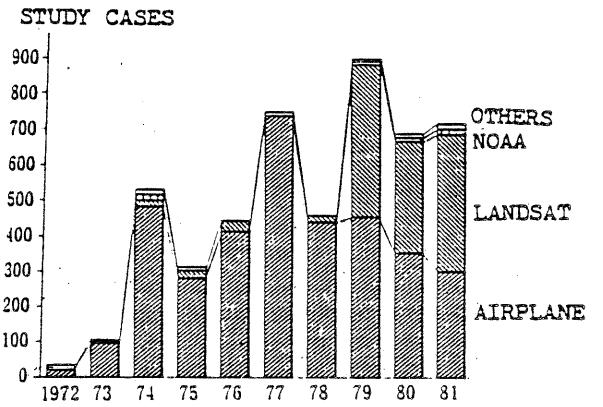

Fig. 3 STUDY CASES AND ORGANIZATIONS

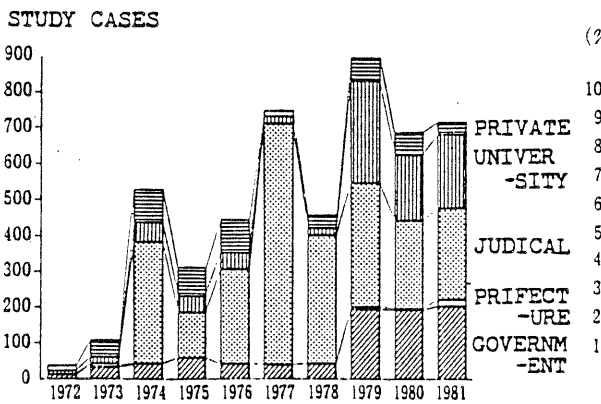

Fig. 4 PERSENTAGES OF AIRBORNE DATA SENSORS

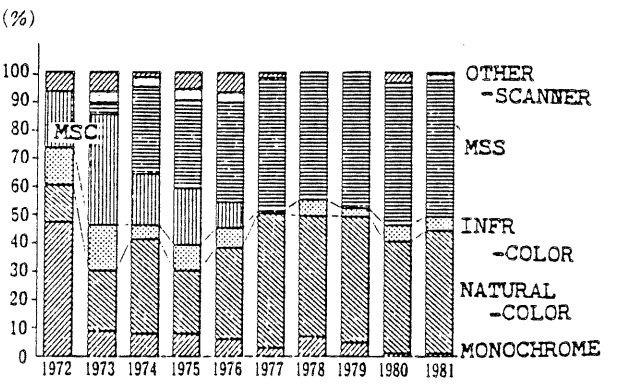

Table 3 ORGANIZATIONS AND DATA PLATFORMS

		Airplane	LANDSAT	NOAA	Other satellite	Total
GOVERNMENT	72~76	168 (92)	15 (8)	0 (0)	0 (0)	183 (100)
	77~81	213 (31)	418 (62)	23 (3)	28 (4)	682 (100)
PRIFECTURE	72~76	10 (100)	0 (0)	0 (0)	0 (0)	10 (100)
	77~81	5 (18)	23 (82)	0 (0)	0 (0)	28 (100)
JURIDIAL	72~76	712 (96)	28 (4)	0 (0)	0 (0)	740 (100)
	77~81	1830 (97)	54 (3)	2 (0)	0 (0)	1886 (100)
UNIVERSITY	72~76	109 (62)	7 (4)	33 (19)	26 (15)	175 (100)
	77~81	109 (15)	589 (82)	4 (1)	13 (2)	715 (100)
PRIVATE	72~76	297 (89)	35 (11)	0 (0)	1 (0)	333 (100)
	77~81	130 (61)	74 (35)	3 (1)	6 (3)	213 (100)
TOTAL	72~76	1296 (90)	85 (6)	33 (2)	27 (2)	1441 (100)
	77~81	2287 (65)	1158 (33)	32 (1)	47 (1)	3524 (100)
	72~81	3583	1243	65	74	4965 CASES

( ) : %

DATA PROCESSING

Most of the data processing in research studies have employed digital facilities. It means that according to the popularization of the computer system appertures, the remote sensing studies generally have a trend of sophisticated data processing ways in Japan. The content of the data handlings are very diverse depending on each exploitation trial in varied utilization purposes.

The active use of the multi temporal data overlay and coordination techniques studies of satellite data with ground survey data have carried out for practical use studies of research results especially in vegetation and land use survey fields.

The microwave data applications as the future technique studies, have steadily done not only in water area use but in land area also.

(1) Vegetation

The paddy field extraction, the states of the crop survey and more accurate yield estimation by using remote sensing techniques are expected in agricultural studies. But the study states are still in narrow area case study trials mostly then the airborne data are used seriously.

Forest type and vegetation type recognition, change pattern extraction by natural disasters or human activities have attached importantly in forestry studies. The pine nematode damage survey works by Landsat data have already adopted as the operational survey method of Forest Agency. The checking business of the cutting and planted area in the forest are becoming to practice by Hokkaido Prefecture Government.

--- Some of the main referred organizations ---

Agricultural Environmental Technical Institute,
Forestry and Forest Product Research Institute,
Japan Forest Technical Association, etc.

(2) Environment

1) Water quality

The water quality survey in the lake and inland sea have done using Landsat data and airborne data in many cases.

The procedure of these data processing are mostly as that; Pro-processing - noise elimination - geographical correction - path radiance correction - regulation modeling of the water quality parameters with the graphical data density - water quality classification mapping by cluster analysis -.

As the factors for water quality indexes, chlorophil, ss contents, and clearness are used.

--- Some of the main referred organizations ---

Information Technical Center of Tokai University,
National Environmental Disaster Research Institute,
etc.

2) Urban environment

Landsat and airborne data are used for the studies of the heat island phenomenon in urban areas. The ground surface temperature elevation due to the local development of the land use, sunny ratio of the ground surface in constructed area or the vegetation cover ratio have studied by Landsat and airborne data for living ammenity classification surveys in the dense urban area.

--- Some of the main referred organizations ---

Osaka Prefecture Government,
Japan IBM Co.

3) Land use

The exploitation of Landsat and high-altitude airborne data use in land use mapping have almostly accomplished. Time change pattern monitoring or refreshment of the national digital informations have been promoted in present.

--- Some of the main referred organizations ---

Geographical Institute Japan,
Industrial Research Institute of Tokyo University.

4) Geology

The geological construction survey of the terrestrial heat area using the airborne data, geological liniment and active faults extraction studies by Landsat data or the oil productivities estimation studies by Landsat data have been conducted earnestly.

--- Some of the main referred organizations ---

Geological Survey Institute,
Oil Resources Exploitation Agency.

5) Water resources

The studies for the modelization of the snow flood by Landsat snow survey information and snow thaw models have effectively carried out. Also the microwave data application studies for snow quality and quantities started in recent year. The soil moisture or the underground water pattern finding studies have investigated.

The exploitations for the evaporation model design of the lake surface have been done using the surface temperature data and meteorogical data combinations.

--- Some of the main referred organization ---

Resources Survey Institute of STA.

6) Oceanography

The monitoring techniques of the ocean current, water mass upwelling, current boundary changing and other ocean dynamics studies have been developed by using NOAA-AVHRR data largely. The sea ice, coastal current or water polution watching studies have been done using Landsat and airborne data.

--- Some of the main referred organizations ---

Maritime Safety Agency,
Tokyo Scientific University.

7) Meteorology

The three-dimensional estimation study of the rain fall pattern by using X and K band in microwave data analysis or the velocity and the direction survey studies of the sea surface wind and wave have done by the airborne data and floating buoy data combination. Also the effective use of the scatrometer or altimeter data those will be on board MOS-1 are expected by these basic studies results.

Besides the operational data use of GMS, the studies for the more accurate surface temperature and velocity measurement method or air condition survey using NOAA-AVHRR have done remarkably.

--- Some of the main referred organizations ---

Meteorogical Research Institute,
Electro-wave Research Institute.

8) Natural disaster

The application of Landsat and airborne data for the volcanic ash spouting damages, crater survey by in activity, soil erosion and land slide accident by typhoon survey or urban calamity prevent planning have done in many cases.

--- Some of the main referred organizations ---

National Disaster Prevention Center,
Remote Sensing Technology Center.

9) The others

The basic research studies such as the software and hardware system exploitations, microwave data processings, especially SAR data handling or the future sensor exploitation studies have emphasised very much at the research organizations of industrial enterprises and educational institutes recently.

--- Some of the main referred organizations ---

Nippon Electric Co.
Toshiba Electric Co.
Fujitu Electric Co.
Hitachi Electric Co.

CONCLUSION

The remote sensing studies in Japan have developed and have been encouraged very much by the political and financial support of STA such as satellite data delivers for research institutes, research project findings or the proposals for other ministries and so on together with the general recognition for remote sensing technology for social management business in future.

The effects of the application or the higher technological development on the remote sensing studies have been published and interchanged through the organized technological symposiums and meetings since 1972.

The foundation of an authorized synthetic remote sensing organization is expected in future under the cooperation of all official and industrial research field including training and educational divisions.

One of the temporal goal of the remote sensing technology exploitation in Japan is the comformation of the satellite data utility in operational business before 1991 that the time of the first launching of MOS-1 and other oversea satellites besides by NASA.

For the advancement and promotion of the remote sensing studies JSPRS has been and be making the big progress in Japan, through the information exchanges by the publications of journals and books, annual convention of the seminar or training courses and so on.

The activities of JSPRS have been recognized in research and educational fields very well and will be sure in future also.

BIBLIOGRAPHY

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