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INVESTIGATION OF THE ENVIRONMENTAL CHANGE PATTERN OF JAPAN

Type III Report for Period

July 1972 - August 1973

Tokyo University

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October 1973

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15. Abstract

I. A STUDY ON EROSION OF THE NIIGATA BEACH FROM ERTS-1 IMAGERIES

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Faculty of Engineering
University of Tokyo

ABSTRACT

One of the causes of coastal erosion is the cultural construction works such as flood control dams, short cut channel or greakwater, which reduce transportation of river effluents such as silt and sand.

ERTS-1 imagery make clear the relations between the status of erosion, effluents pattern affected by the coastal current and the cultural construction works.

1. Objectives of the Study

Niigata alluvial plain, faced with the Japan Sea, is produced by two big rivers, one is the Shinano River and another is the Agano River, the former is the biggest river in Japan, 12,000 km^2 in catchment area and 370 km in distance.

While the water in the Agano River is almost chear through all seasons, the Shinano River is rich in sand and silt, especially in the flood season and in the melting season of snow.

In the ancient time before about 80 years ago when the cultural structures such as river improvement works or flood control dams had been carried out along Shinano River, the Niigata shore line had grown in the offshore direction with average rate of 30 meters to 120 meters in a year. Fig. 1 shows schematic change patterns of the Niigata shore line in the past.

About 70 years ago, the breakwater for the construction of Niigata Port was constructed at the outlet of the Shinano River.

Since Ohkozu short cut channel was excavated 50 years ago to prevent Niigata City from flood, outflow of sand and silt through the outlet of Shinano River remarkably decreased.

Since then, interactions between the breakwater, the short cut channel, wind, wave and current began to attribute erosions at the both sides of the west beach and the east beach in different ways.

The shore line at the west beach has been eroded with the magnitude of 360 meters at maximum for 60 years since the completion of the breakwater, while the shoreline at the east beach, 300 meters at maximum for 40 years since the construction of the Ohkozu short cut channel.

Although a number of countermeasures such as submerged breakwater, sea walls and revetments have been constructed, erosion is still progressing. In 1972, another short cut channel was completed against the erosion of the west beach. This new channel, however, would not be effective for improving the erosion of t the east beach.

As it can be considered from the above mensioned background, the objectives of the study are as follows.

a. To investigate the distribution pattern of the sand deposit transported by the Shinano River, and its behavior.

b. To study the effect of the cultural structures upon the sand sedimentation.

c. To establish the method of the preservation of coastal environment against erosion.

The use of ERTS imagery will be effective in feasibility studies of a and b, and c finally.

2. GROUND TRUTH SURVEYS

Following ground truth data are available ~~from the existing surveys~~.

a. Change patterns of Niigata shore line.

b. Contour map of depth of Niigata beach. (Fig. 2)

c. Surveys of settlement of the beach

d. Predominant wind and its velocity.

e. Wave height.

f. Classification of the sand deposits.

3. ERTS-A IMAGERY OF NIIGATA BEACH

Following ERTS-A imagery are available for the interpretation of the erosion of Niigata beach.

Date and time;	29 August, 1972
Identified number;	032, 064, 096, 128
Format;	MSS 70mm positive
Center point;	37°20'N, 139° 12'E

Cloud coverage;	about 10 percent in the mountaeneous sites
Major features included;	Niigata City, Sado Island, Shinano River, Agano River, Japan Alps, Inawashiro Lake

Fig. 4. shows the enlarged print of the band MSS 4 in the scale of 1:1,000,000,which shows the effluent pattern clearly.

Significant results are obtained from ERTS-1 as follows.

a. Effluents from Ohkozu short cut channel are refracted by the curved coast and Tsushima current, which flows in the direction of the north east. They disperse in the offshore far away from Niigata west beach and sand sedimentation is not active.

b. The new short cut channel is identified to contribute the sand deposition along the west beach as it was estimated by coastal engineers.

c. Effluents from the breakwater of Niigata port are distributed in the direction of the north east together with those from Agano River. They are also affected strongly by the coastal current.

d. The east beach has no tendency to have sand deposit from effluents. There will be increase of erosion at the east beach.

Further studies as follows will be feasible by the use of ERTS imagery.

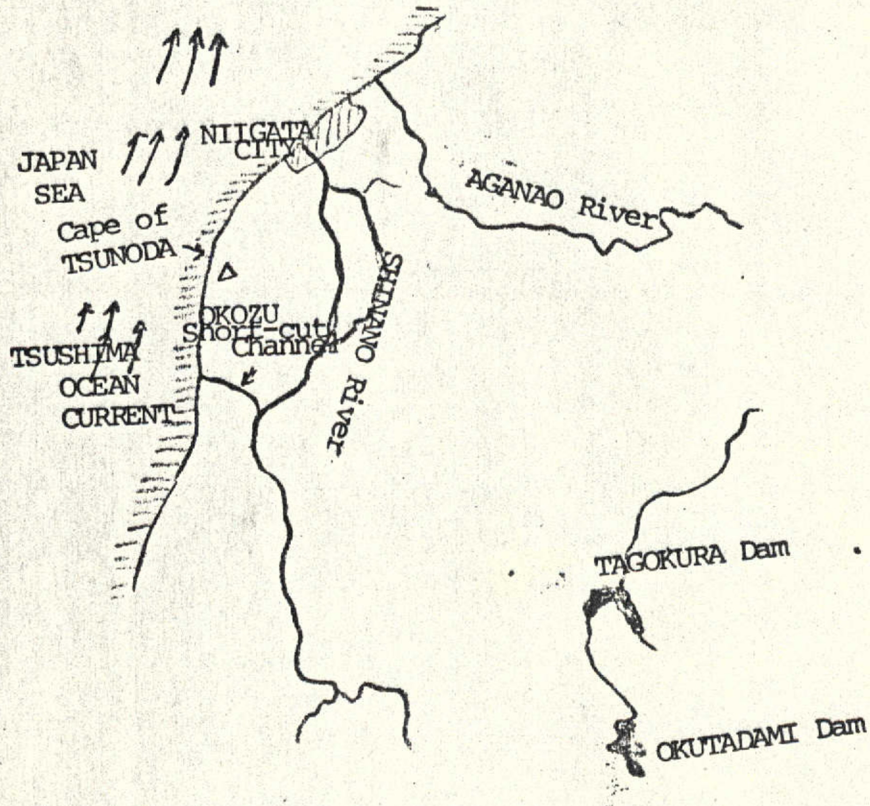
a. Estimate the volume of sand deposits discharged from the Shinano River, and its ditribution, in the flood season and at the snow resolution time.

b. Surveys of the effect of the predominant winter wind on the erosion.

c. Determination of the sites of dredging and disposing sand deposit.

d. Study on the effect of the cultural works upon the coastal environment.

e. Surveys of the correlation between pomping natural gas and the settlement of the ground in Niigata coastal area.



SCHEMATIC MAP OF NEAR NIIGATA

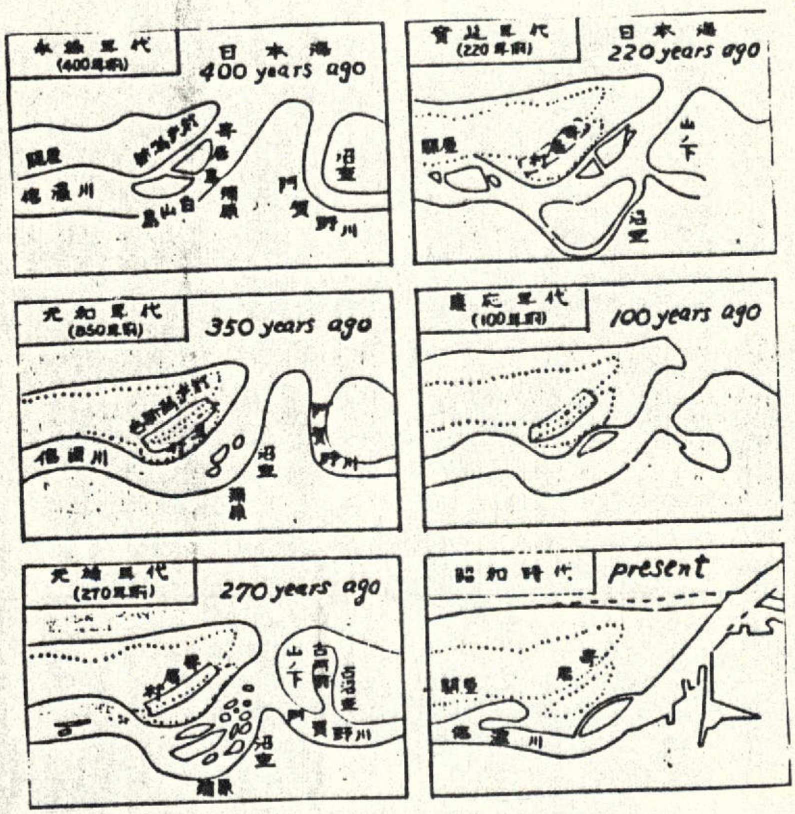
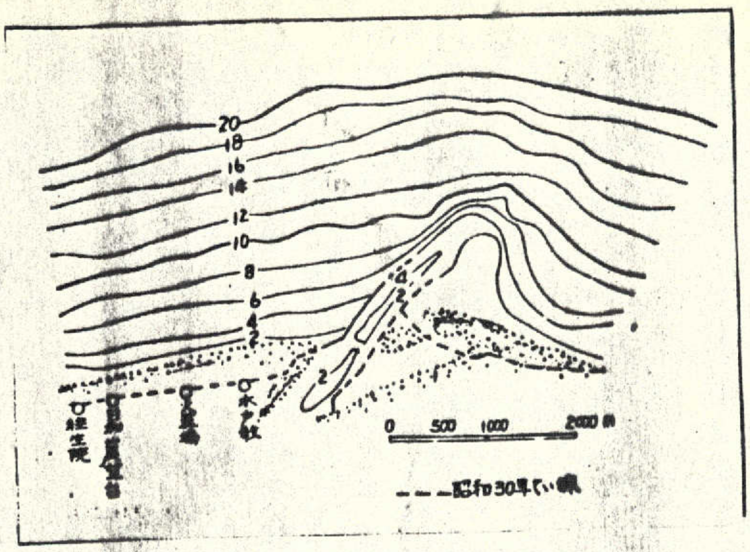
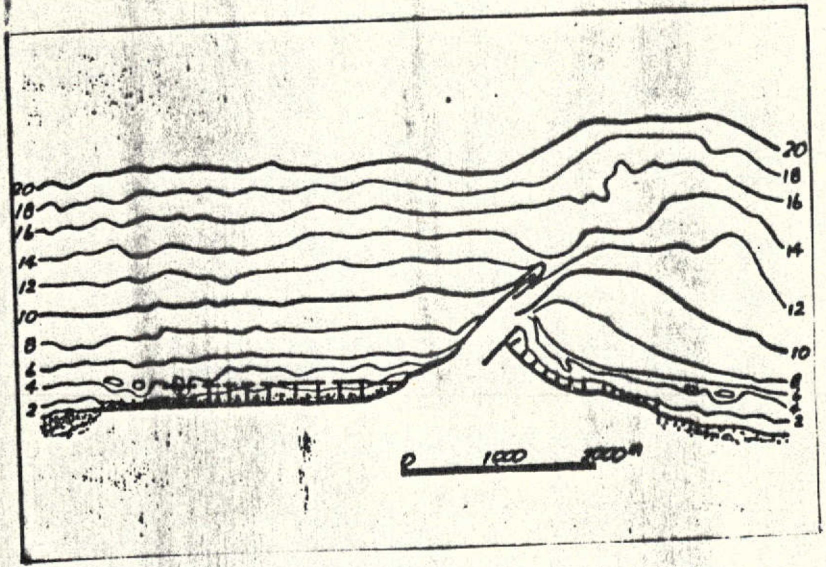


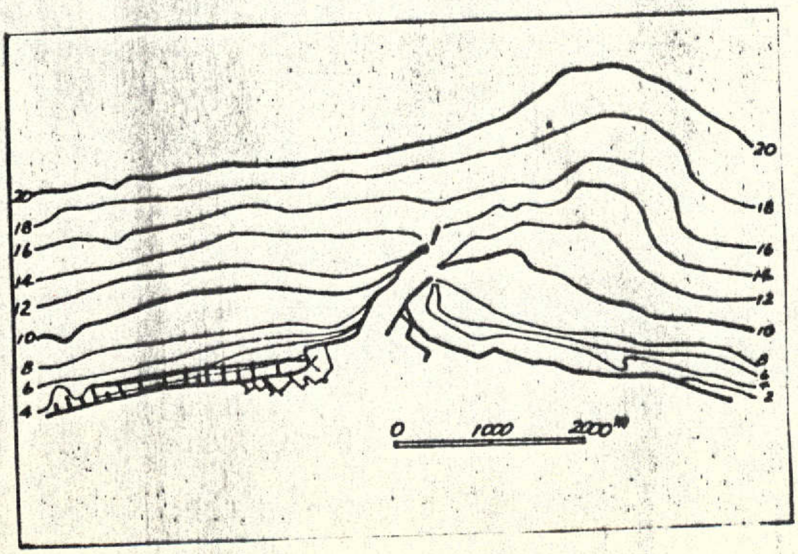
Fig. 1 Historical change pattern of Niigata Beach



(a) Contour map of Niigata Beach in 1905



(b) Contour map of Niigata Beach in 1960



(c) Contour map of Niigata Beach in 1970

Fig. 2 Contour map of depth of Niigata Beach

Fig. 4 Enlarged print of the MSS 4

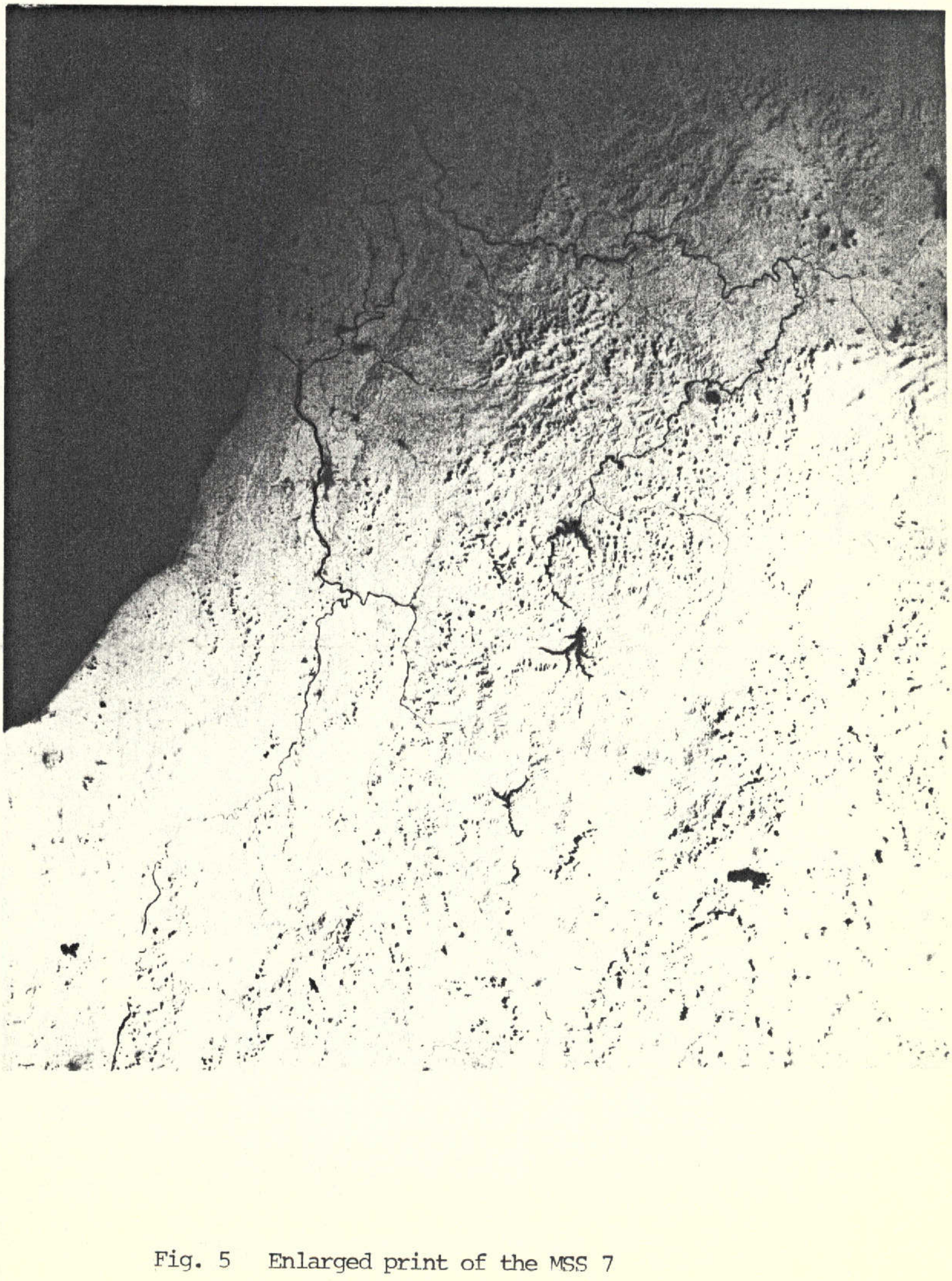


Fig. 5 Enlarged print of the MSS 7

II. ENVIRONMENTAL CHANGES IN THE TOKYO DISTRICT

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Youichi KATO Researcher

The Institute of Industrial Science
The University of Tokyo

INTRODUCTION

ERTS imageries of four different days are utilized to identify the environmental changes in Tokyo District.

Environmental change patterns identified by ERTS imageries are:

(1) Large scale land formation such as for residensial new town and for golf course, which are generally constructed in mountaneous area by a great quantity of earth works.

(2) Air pollution of smogs from lots of industries located in the reclamated industrial area along Tokyo Bay.

(3) Seasonal changes in vigors of trees in those parks which are located in the downtown.

Utilized imageries are of 26 Nov. '72, 14 Dec. '72, 1 Jan. '73 and 19 Jan. '73.

IDENTIFICATION OF LAND FORMATION

Many of the newtowns in the suburban area of Tokyo have been or being constructed in hilly area. The scale of the construction is about 100 h.a to 300 h.a in area and is about 10 meters cut on filling.

These construction works result in not only the destruction of forestry resources but also the disaster such as slope failure or flood.

More than 260 golf courses are located in Tokyo District and not less than 800 golf courses are now proposed to be newly constructed in hilly or mountaneous area.

These golf courses are also constructed by smoothing the mountain covered with dense trees.

New towns can be well identified in MSS 5 and golf courses are indentified in MSS 5 and MSS 7 as shown in Fig. 1.

New towns and golf courses, which are identified by ERTS imageries, are shown in Fig. 2.

2. MONITORING AIR POLLUTION

Air pollution in Tokyo District was well detected in MSS 5 of ERTS imageries of four different days in different patterns respectivly. (See Fig. 3)
High density of air pollution can be seen in the three images of ERTS, while very little can be identified in the image of Jan. 1, '73. It is because most of industries have a custom of stopping their operations on Happy New Year Day.
Distribution of air pollution is mainly affected by the location of industries, the chemical characteristics of air pollutants and the wind. Air pollutants from Kawasaki industrial area and the world biggest steel factory in Kimitsu can be seen covering the Tokyo Bay deflected by the north or northwest wind in the images of Nov. 26, '72, Dec. 14, '72 and Jan. 19, '73. The latter images

shows the drastic air pollution mass, which can be estimated to be formed by jointing the various air pollutants.

The image of Dec. 14, '72 shows a somewhat different pattern of air pollution. This is because a newly reclamated island for solid waste treatment was burnt for more than two weeks around the above date. Fig. 4 is the enlarged ERTS image in Kawasaki industrial zone and the corresponding aerial photograph.

3. CHANGE IN VIGOR OF TREES

Changes in vigors of trees between before and after the fall of leaves are well delineated in ERTS imageries. Broad leaved trees in Japan change its color in yellow or red in October or November and fall these leaves in Dec. and Jan. ERTS images of MSS 7 of Nov. 26, '72 and 19, Jan. '73 show the difference of vigors of trees in the parks in down town. (See Fig. 5)

4. CONCLUSION

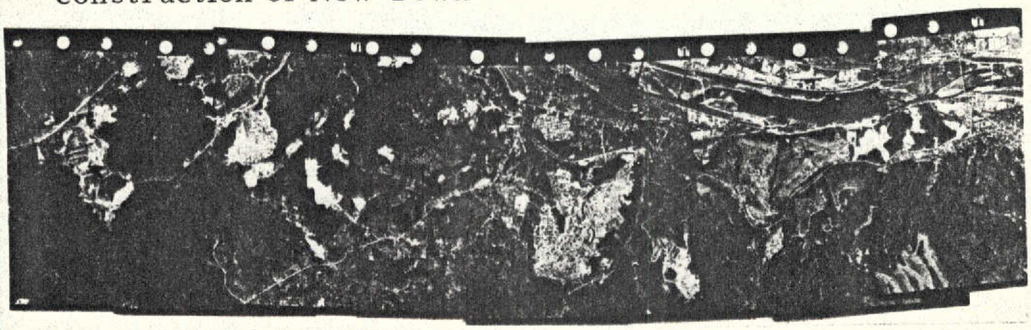
Obtained results are as follows:

(1) Sprawls of urbanization which strip the green cover, are identified in size and scale in ERTS imageries. These urvanization results from the concentration of population, land cost and transportation. The urban studies by ERTS imageries are so much efficient for management and development of the city.

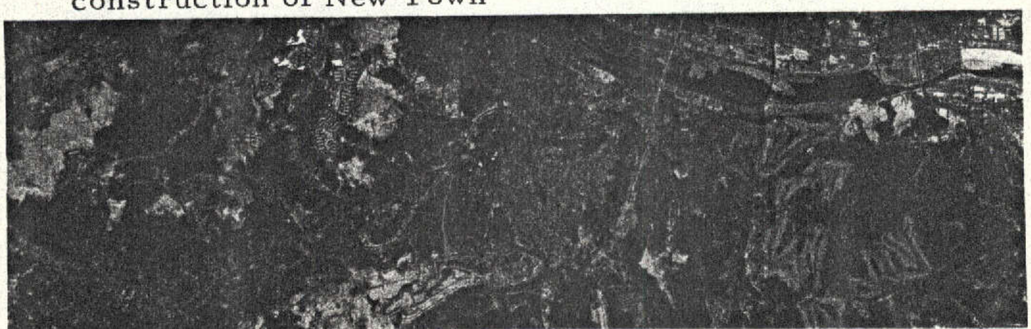
(2) Dynamics and distribution of air pollution and the sourse of smogs are well monitored. ERTS imageries give the information for control of operation for the respective large industries. Correlation between the air pollution and the wind could be made clear.

(3) Vigors of trees in the parks in winter season are possibly compared between those before and after fall of leaves.

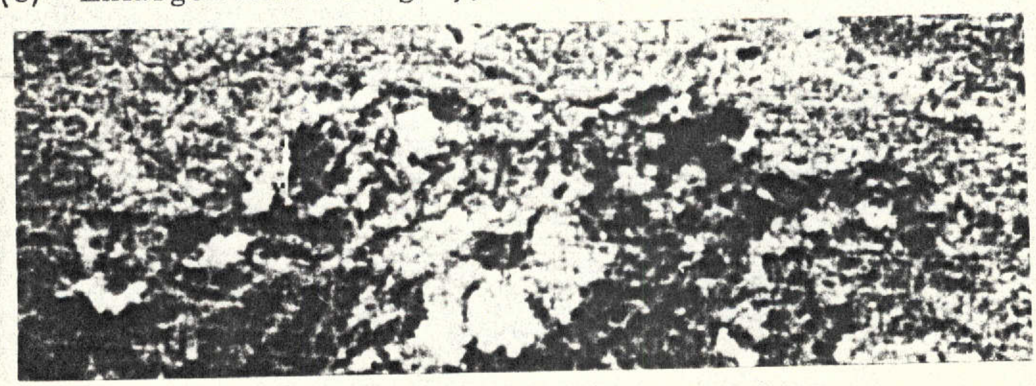
(a) Aerial photographs, which were taken in July 1965 before construction of New Town



(b) Aerial Photographs, which were taken in Apr. 1971 after construction of New Town



(c) Enlarged ERTS imagery, MSS 5, Nov. 26 '72



(d) Enlarged ERTS imagery, MSS 7, Nov. 26 '72

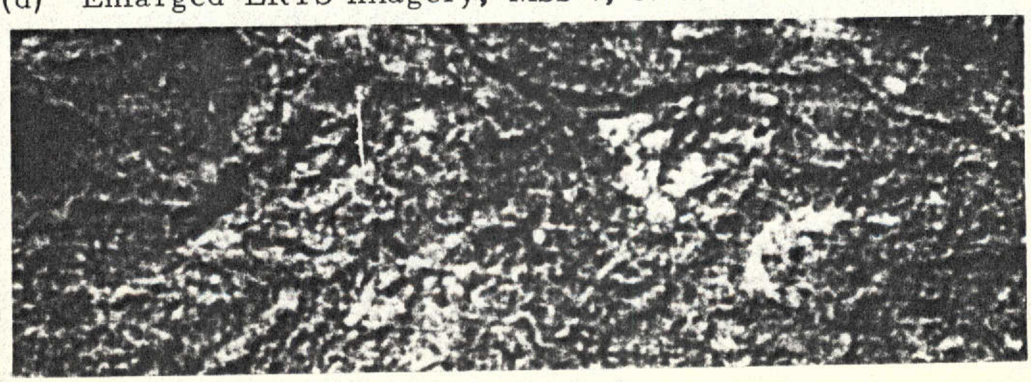


Fig. 1 Identification of Land Formation

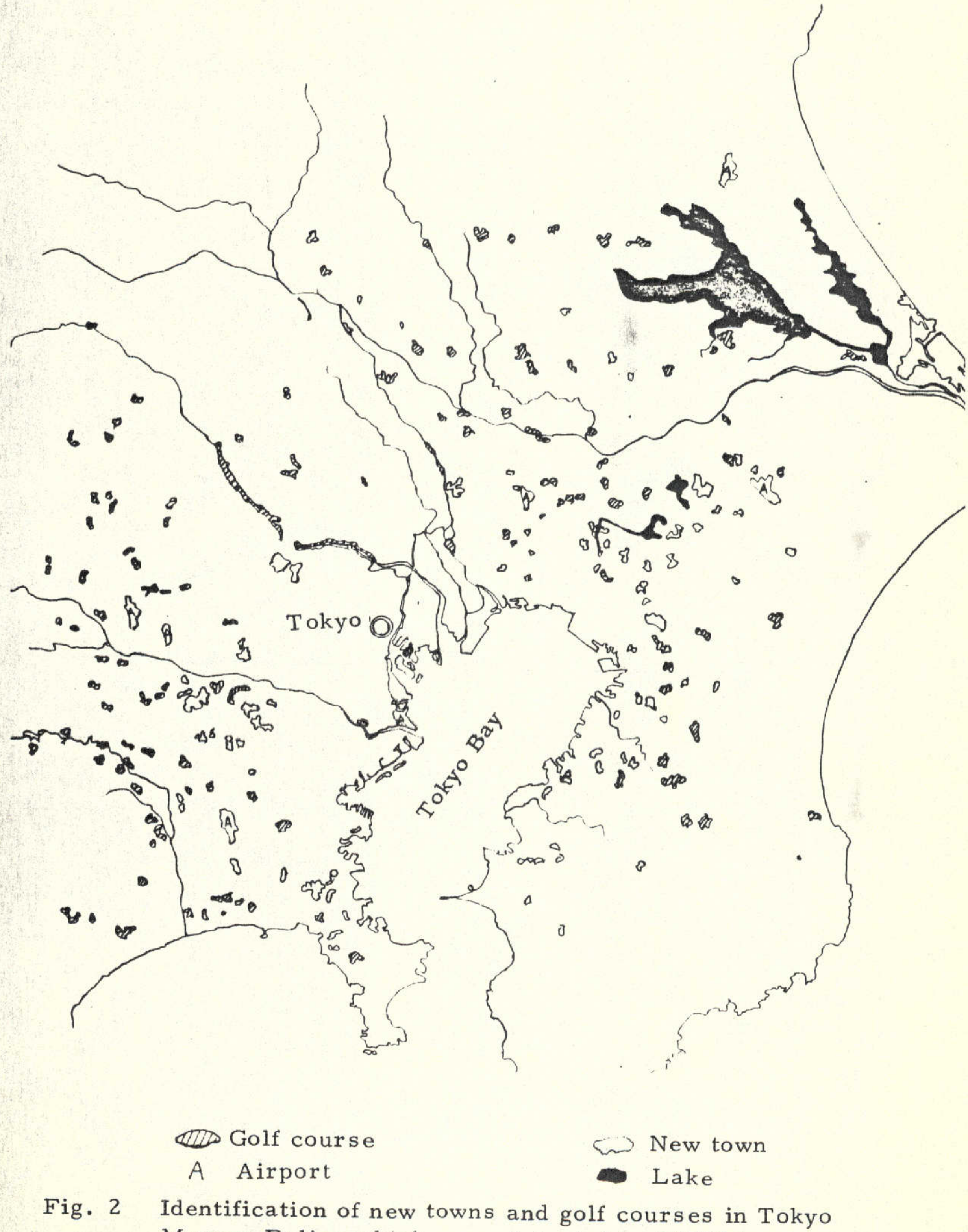


Fig. 2 Identification of new towns and golf courses in Tokyo Megaro Police which were detected by ERTS imageries. Nov. 26, '72

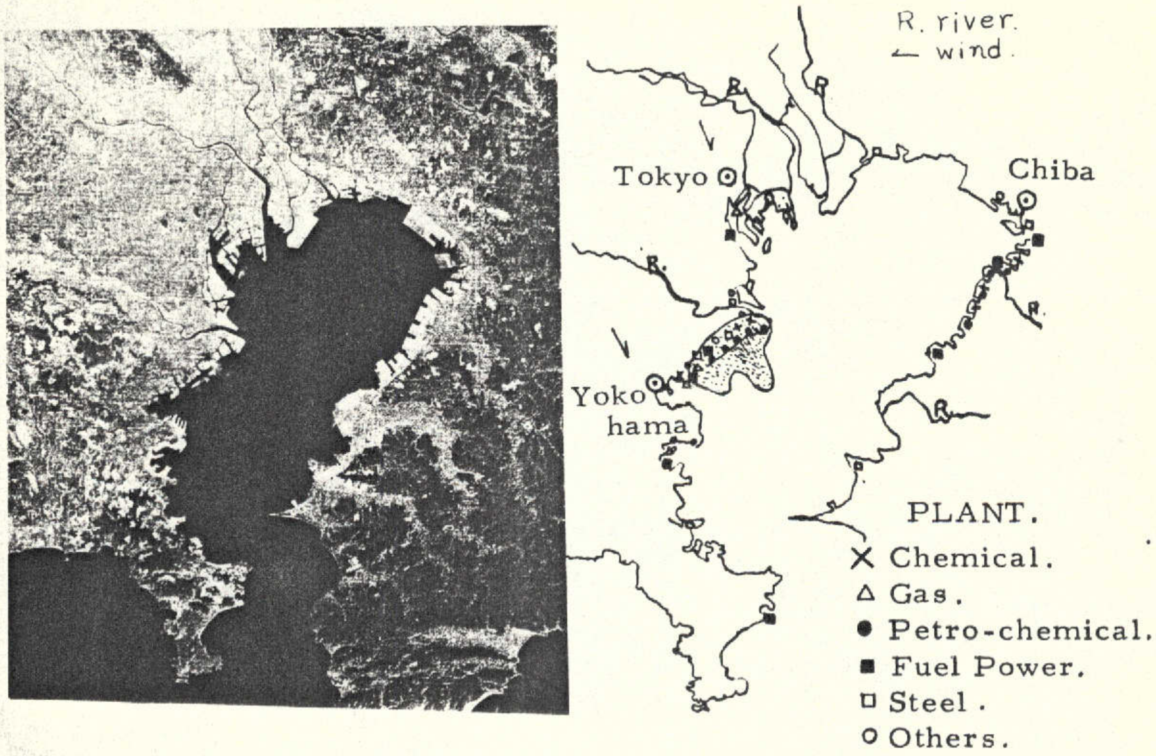


Fig. 3 (a) Smog conditions on Nov. 26 '72

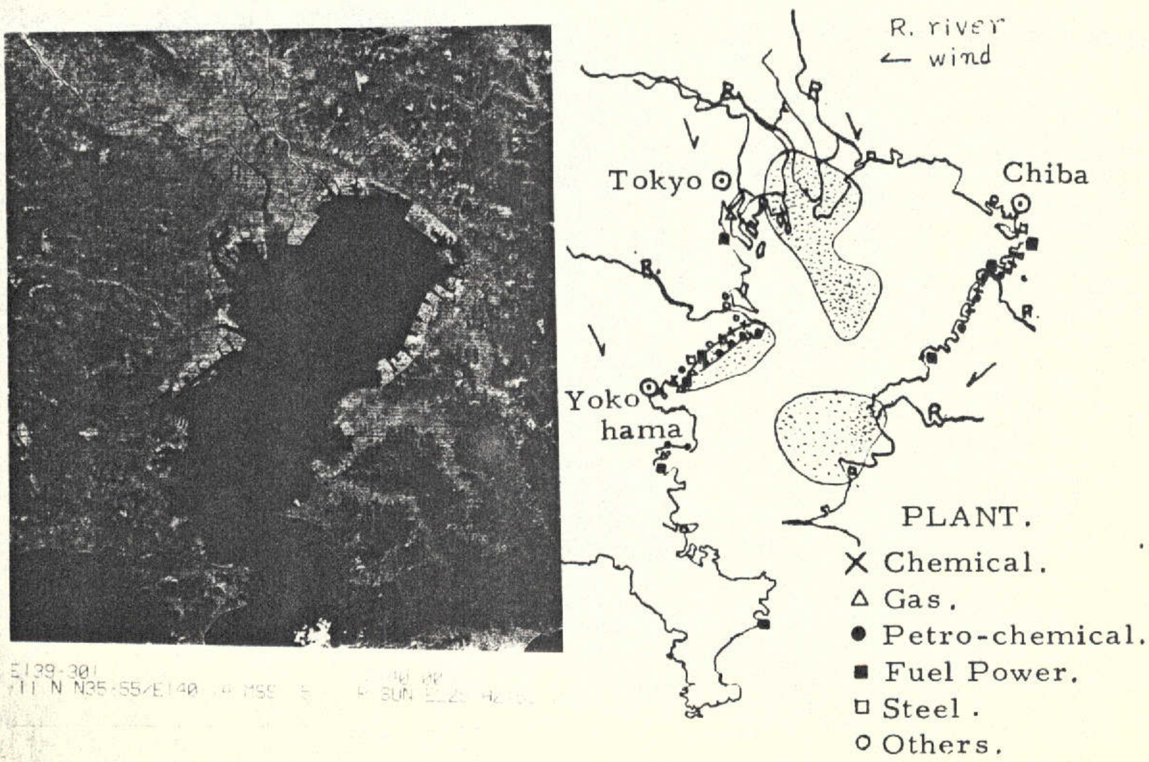


Fig. 3 (b) Smog conditions on Dec. 14 '72

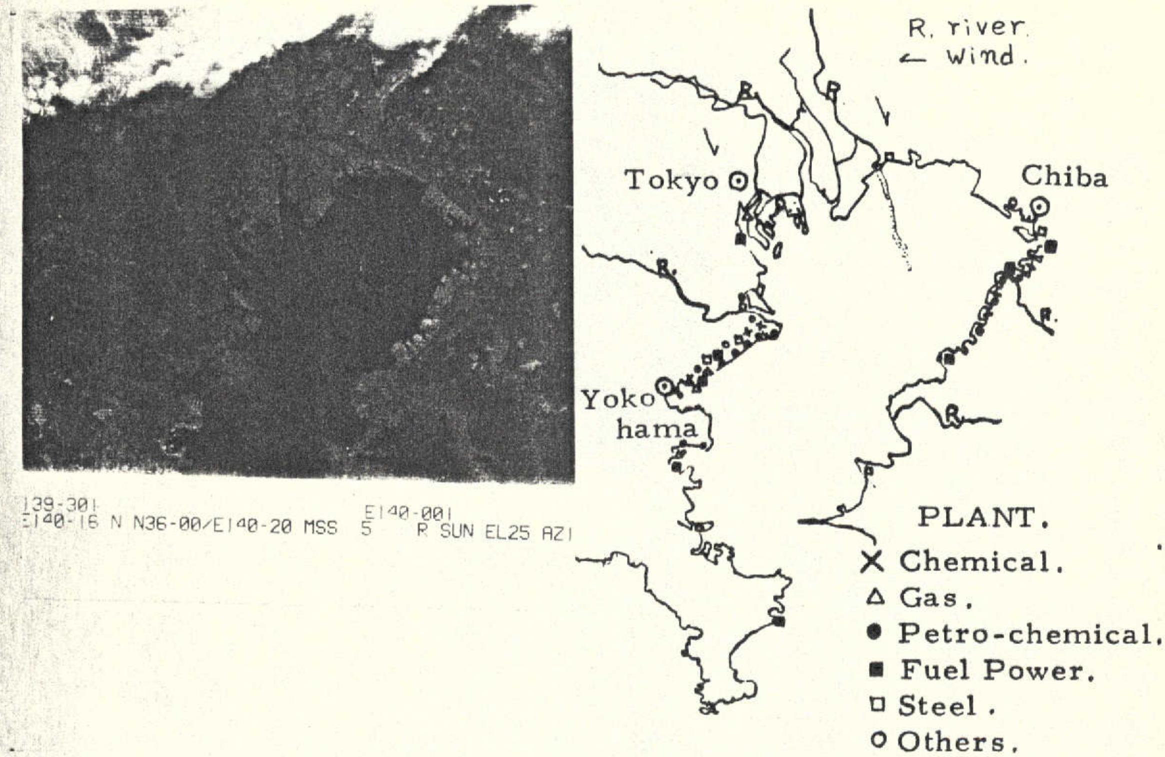


Fig. 3 (c) Smog conditions on Jan. 1 '73

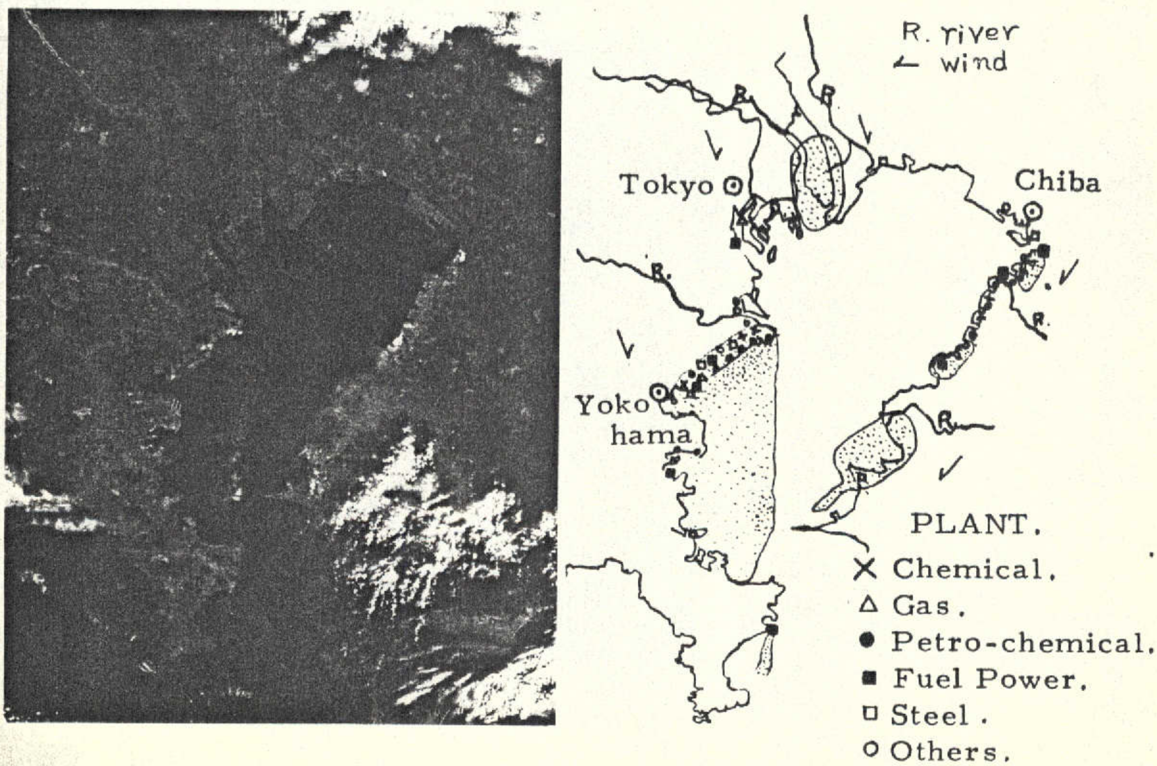


Fig. 3 (d) Smog conditions on Jan. 19 '73

(a) MSS 5 1/200,000

(b) Aerial Photograph

(c) Location of industries

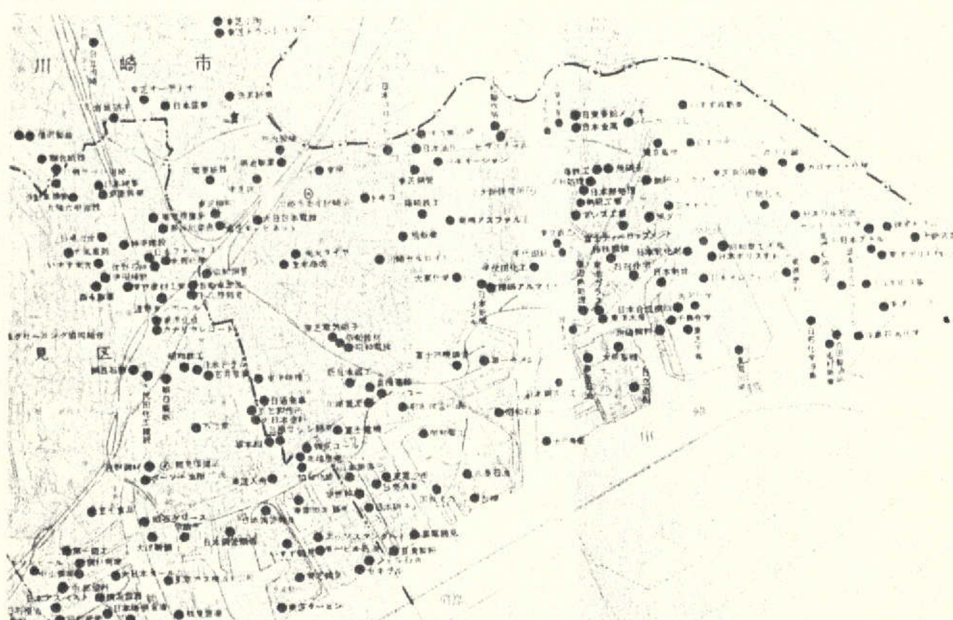
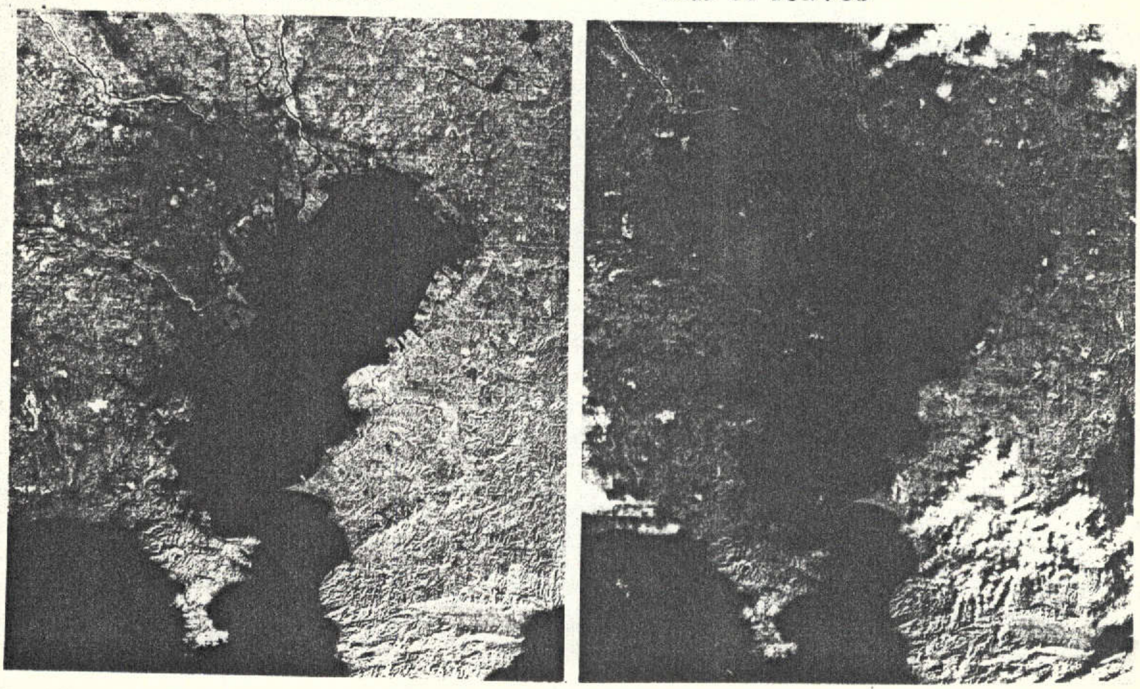


Fig. 4 Enlarged ERTS image of MSS 5 and the corresponding aerial photograph in Kawasaki industrial zones.

(a) MSS 7 Nov. 26 '72 before the fall of leaves

(b) MSS 7 Jan. 19 '73 after the fall of leaves



(c) Identification of changes in vigors of trees in the park between before and after the fall of leaves.

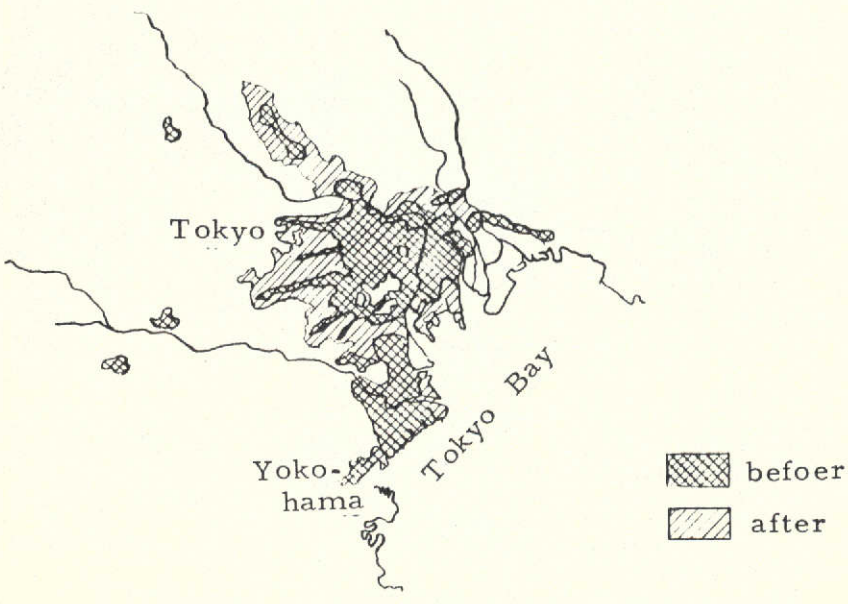


Fig. 5 Changes in vigors of trees in winter

III. POLLUTED AND TURBID WATER MASSES IN THE OSAKA BAY AND ITS VICINITY REVEALED WITH ERTS-1 IMAGERIES

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TOKAI UNIVERSITY

ABSTRACT

The heavy water pollution is one of the most serious problems in the Osaka bay and its vicinity. However, the status of water pollution there has hever monitored in the scale of the whole Osaka Bay because the conventional point-to-point observations make it impossible to detect the periodical movement of water masses by the fairly strong tidal current.

ERTS-1 took very valuable MSS imageries of the Osaka bay and its vicinity on October 24, 1972. In the MSS-4 and MSS-5 imageries, a complex grey pattern of water masses can be seen. Though some of grey colored patterns seen in black and white prints of the MSS-4 and MSS-5 imageries and easily identified form their shapes as cloud covers or polluted water masses characterized by their color tone in longer wavelengths in the visible region, and correct distribution pattern of polluted or turbid water masses can be hardly detected separately from thin cloud covers in a quick look analysis.

In the present investigation, a simple photographic technique was applied using the fact that reflected sun light from cloud including smog and inclined water surfaces of wave have a certain component in near infrared region, that is, MSS 7, where as the light scattered from fine materials suspended in the sea water has nearly no component in the channel of MSS 7 but has only the green and yellow component sensible in MSS 4 and MSS 5 channels. That is, combined prints were make from a possitive imagery of MSS 4 or MSS 5 together with a negative imagery of MSS 7 using a photographic enlarger. In the combined prints areas of clouds and smogs are shown as white or lighter grey, whereas polluted or turbid water masses are clearly represented with black or darker grey tone.

SIGNIFICANT RESULTS

Significant results are obtained as follows:

1) The simple method mentioned above is useful technique for detecting water masses distribution seperately from cloud covers and also noise caused by the reflected sun light from wave surfaces.

2) The polluted water does not diffuse continuously into the oceanic water but forms masses of the oceanic water flown from the outer sea, that is the Kuroshio area.

3) The polluted or turbid water mass in the just north of the Tomogashima Channel, the south outlet of the Osaka Bay, shows that the northward tidal current runs in a clockwise eddy at the tidal period when the imagery was taken. Such an eddy-like pattern of tidal current has never been revealed

by the conventional oceanographic data.

4) A front between an oceanic water mass and a polluted water mass runs in the direction of NW-SE in the center part of the Osaka Bay.

5) The patterns of turbid water discharged from the Kii River and the Yoshino River show the northward tidal current in the North Kii Straits at the time of imageries taken.

6) The pattern of lighter turbid or polluted water located in the north west region of the North Kii Straits suggests the existance of a clockwise eddy in the straits.

ILLUSTRATIONS

FIG. 1

Two examples of ERTS-1 MSS imageries taken on October 24, 1972. Cloud covers, heavy smog areas and turbid water masses are represented equally by grey color in imageries of MSS-4 and 5, because they have sensible components of light in these channels. On the other hand, there is no grey-colored image of turbid or polluted water mass but are the ones of cloud cover and smog area in MSS 7 (infrared) imagery since the infrared component of light is strongly absorbed by the sea water.

FIG. 2

Using the difference of grey-colored images over sea regions in MSS 5 (or 4) and MSS 7 imageries explained in Fig. 1, turbid or polluted water masses can be represented by darker images separately from cloud covers and smog areas which are represented by lighter grey images in a combined print made with a negative imagery of MSS 5 or MSS 4 together with a negative imagery of MSS 7 by a photographic enlarger.

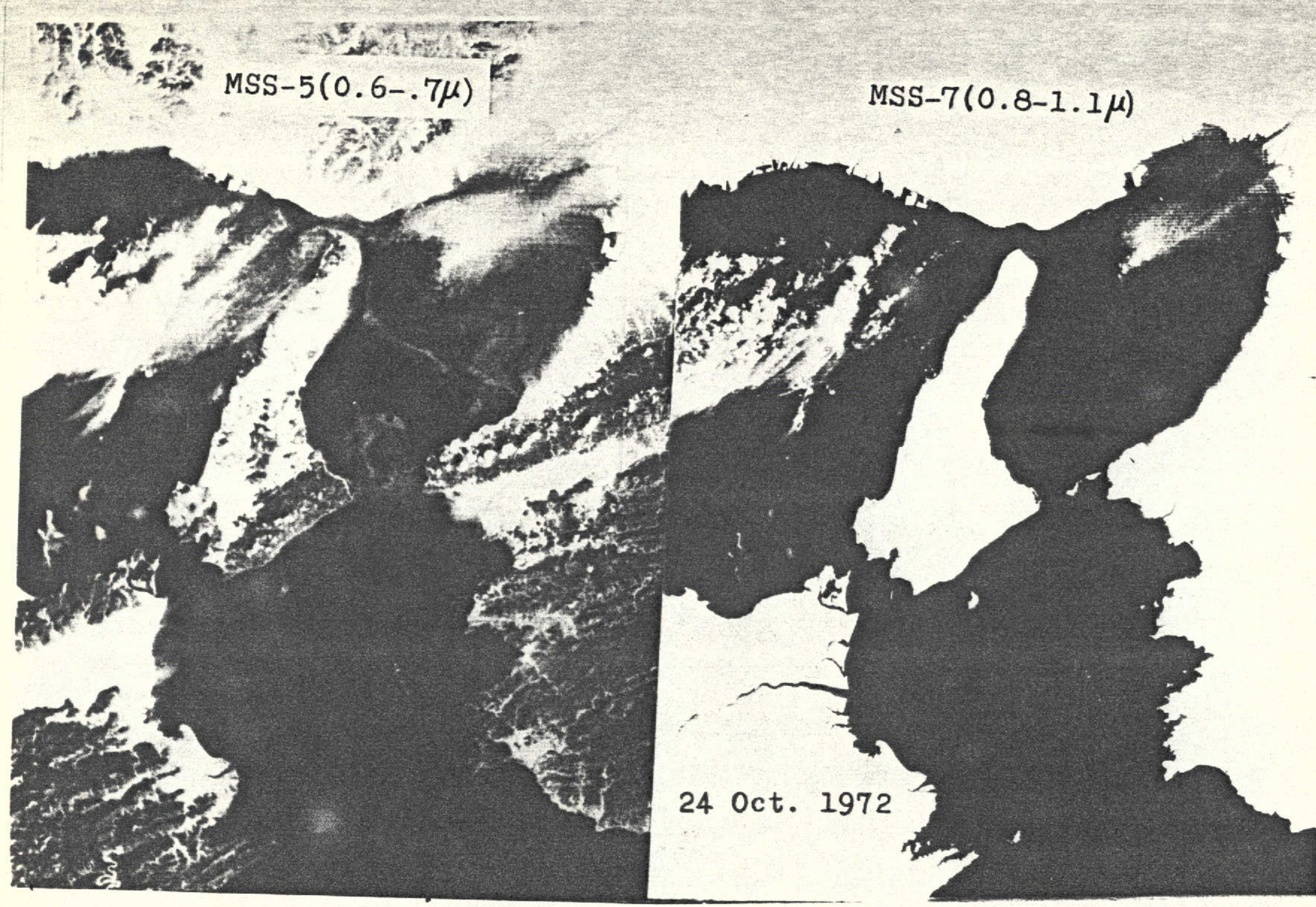
FIG. 3

Turbid or polluted water masses distribution manually copied from the combined print (in Fig. 2). The darker is any area the heavier is the degree of turbidity or pollution is this chart. The pattern is this chart suggests that turbid or polluted waters diffuse into oceanic water masses flown from the outer sea without any continuous density variation in some short time, but form patches of turbid or polluted water masses. The major mass of polluted water is thought to locate under a cloud cover and smog areas off Osaka and Kobe ports. The putch of turbid or polluted water mass having an eddy-like pattern near the Tomogashima Channel (marked by T) is assumed to have disparted from the major mass of polluted water off Osaka and Kove ports in a former tidal time. Effuents from the Kii and Yoshino Rivers are chearly seen.

FIG. 4

Flow pattern of tidal current inferred from the combined print of Fig. 2.

As it was at the time of tidal current shown by the inserted curve at the upper left corner, most of flowing water directed nearly north except of the ones near the Akashi and the Naruto Channels. A clockwise eddy is strikingly revealed closely north of the Tomogashima Channel. A front of two different water masses runs NW-SE nearly in the center of the Osaka Bay. These phenomena have never been observed in any point-to-point observation by ship. North of the front a clockwise eddy can be inferred in this analysis which have already been observed by ship's surveys. There are seen two small eddies, one of which is counter clockwise and another clockwise, in the mouth of the Naruto Channel which is famous by the formation of numerous eddies at the time of maximum tidal current.

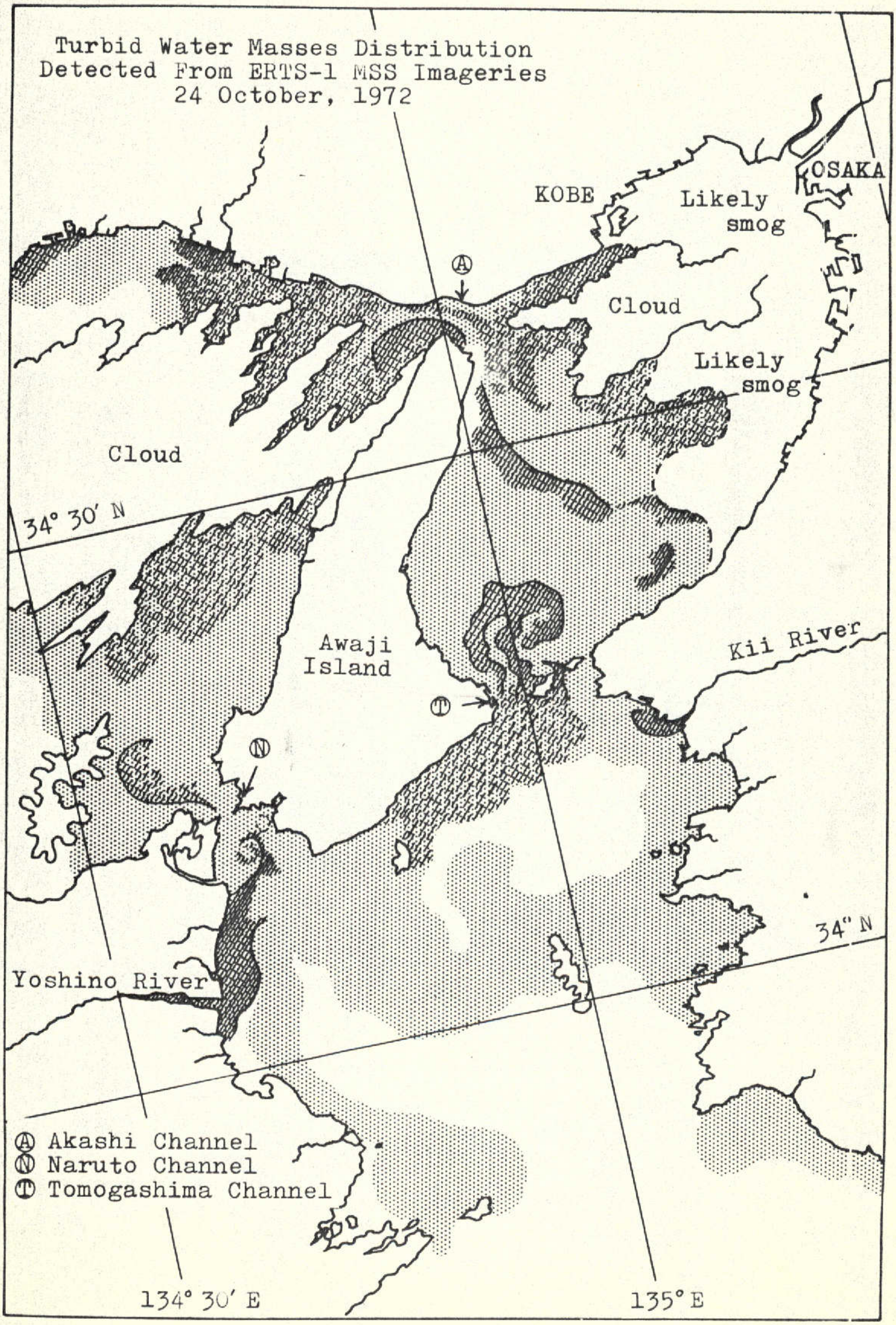


Polluted and Turbid Water Masses in the Osaka Bay and its Vicinity Revealed with ERTS-1 Imageries (By Kantaro Watanabe)

MSS-5(P) + MSS-7(N)

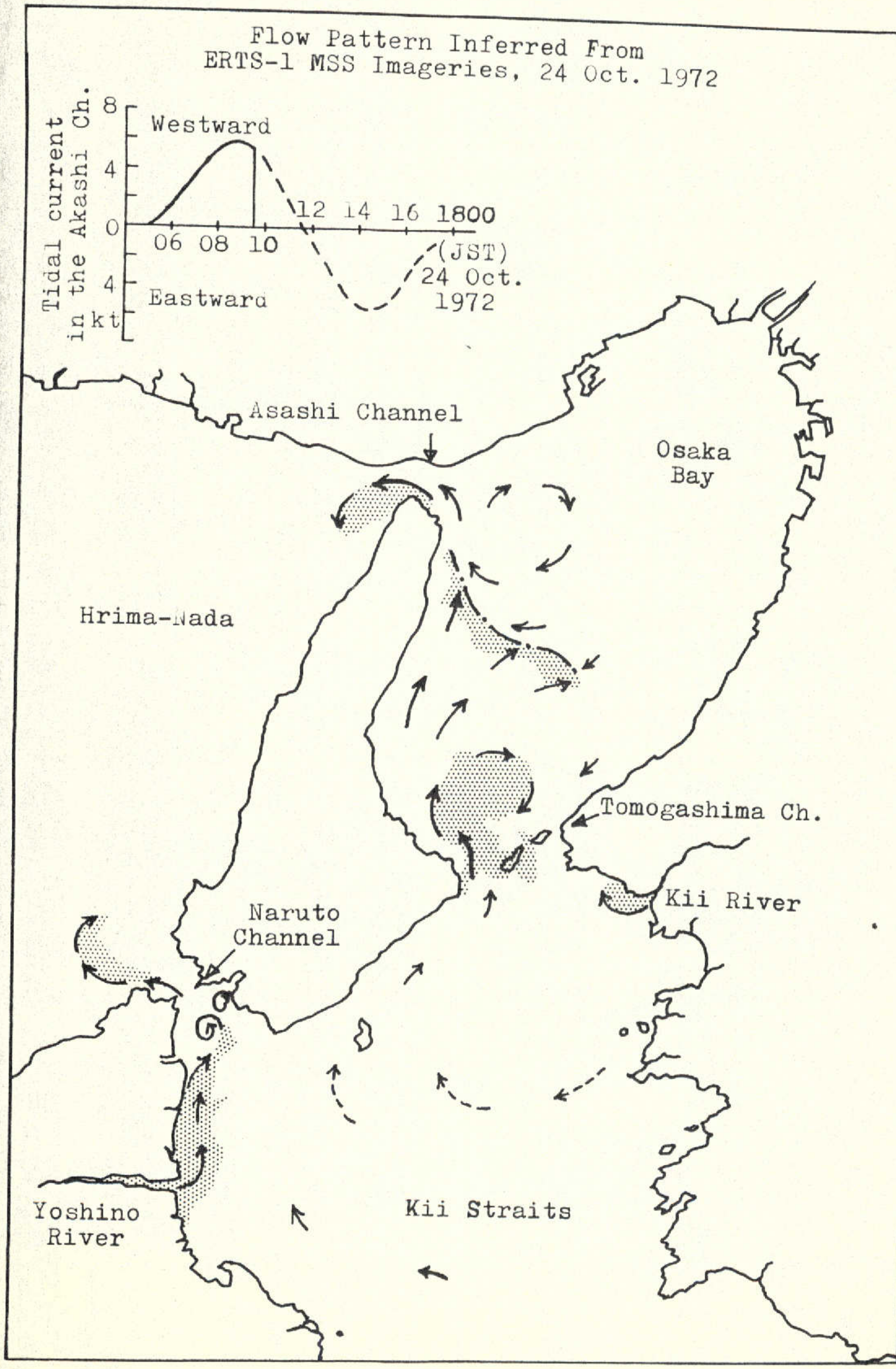
24 Oct. 1972

Combined Print with a Negatibe of MSS-5 and a Positive of MSS-7, 24 October, 1972



Turbid Water Masses Distribution
Detected From ERTS-1 MSS Imageries
24 October, 1972
KOBE
OSAKA
Likely
smog
Cloud
Likely
smog
Cloud
34° 30′ N
Awaji
Island
Kii River
Yoshino River
34° N
Ⓐ Akashi Channel
Ⓝ Naruto Channel
Ⓣ Tomogashima Channel
134° 30′ E
135° E

Fig. 4


Flow Pattern Inferred From
ERTS-1 MSS Imageries, 24 Oct. 1972
Tidal current in the Akashi Ch.
8
4
0
4
kt
Westward
Eastward
06 08 10
12 14 16 1800
(JST)
24 Oct.
1972
Asashi Channel
Osaka
Bay
Hrima-Nada
Tomogashima Ch.
Kii River
Naruto
Channel
Yoshino
River
Kii Straits

IV. MULTISPECTRAL OBSERVATION OF MARINE ENVIRONMENT IN CENTRAL JAPAN

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Toba Merchant Marine College

Tova-shi, Mie-ken, Japan

ABSTRACT

With the launching of ERTS-1, it has become possible to detect not only sea surface structure but also under water circumstance. In this report three applications of multispectral observation for marine environment in central Japan are shown.

1. RED TIDE IN THE ISE BAY

From March through November, dense red tide makes its appearance in the Ise Bay and cames fish, shell and sea weed serious damages against. Recently, the red tide appeared in the coldest month Feburary too. In early October of 1972 the dense red tide spread over northern part of the Ise Bay for about one month. The estimated boundary of the red tide according to ship's report is showed in Fig. 1. The area spread to eastward along the western coast of the Ise Bay. But the ship's report is sometimes not so correct because a fishing boat is usually not equipted with efficient instrument for ship's position.

The green band with 0.5-0.6 m wavelength is expected to detect the under water circumstance where the transparency is good condition. But if the tranceparency is not enough case, I can not get under water data from green band imagery. Detected data means sea surface circumstance instead of under water circumstance.

The transparency distribution of Ise Bay showed in Fig. 2 means no good condition along the western coast near Yokkaichi. In the green band imagery produced by positive film showed in Fig. 3, I can find out two black pattern near Yokkaichi (pointed out with arrows). These two black pattern is the boundary of red tide I suppose. On January 3rd 1973 I can also find out the small pattern of red tide near Yokkaichi in green band imagery too.

2. RIVER EFFLUENT MONITORING

In the area of effluent monitoring, Fig. 4 is an example in three band of river plume from Kumano River which flows into Kumano Nada, the Pacific ocean. In this case, I can not find out the pattern of river plume in the 0.7 - 0.8 um band. Although I can get the pattern in the 0.6 - 0.7μ m band imagery, there is no contrast of river plume. The best results can be get in the green band. In another example showed in Fig. 5, I can get the best results in the green band imagery reproduced from positive film too.

But in case of the river effluent from Saburi River which flows into Wakasa Bay, Japan Sea, I can find out river plume in three band imageries showed in Fig. 6. Although the boundary of river plume is not so different between green band imagery and orange band imagery as pattern, the contrast is expected better in orange band imagery. By mean of river effluent, each river has its own characteristic reflectance curve.

3. SHORE CURRENT IN JAPAN SEA

In the another area of application, Fig. 7, I can see the boundary of shore currents towards northeasterly direction in green band imagery. There many river effluent can be seen in Toyama Bay and another places. Here, shore currents are preventing these river effluent from mixing with sea water and inthis case, shore currents force the river plumes inward along the coast line. In winter, strong northwesterly monsoon prevails over the central Japan. So shore currents towards northeasterly should be set up I belive. The dimension of these shore currents are about 15 kilometers in breadth in winter. When the northwesterly monsoon is not prevails in another season, shore currents towards southwesterly direction except Toyama Bay and in this case shore currents in warm season should be set up as counter current of Tsushima Current. The boundary of shore currents is detected 10 kilometers in breadth in warm season.

The reason why anti-clockwise shore current can be seen in Toyama Bay year around is considered that small circulation of drift current by strong wind occures inside of bay in winter and small circulation as counter current of big circulation of shore current in warm season.

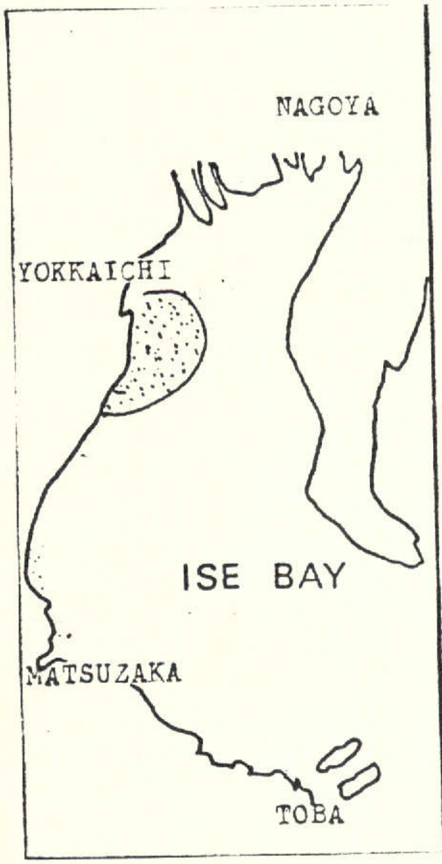

Fig. 1 Red-tide area by ship's report

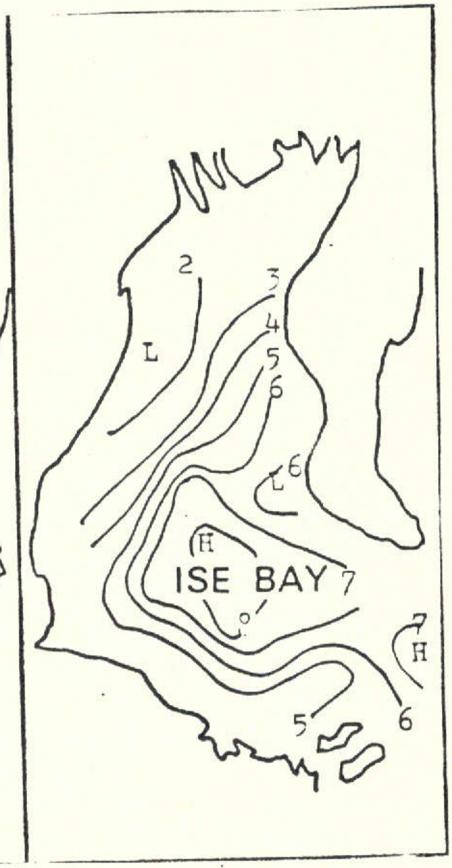

Fig. 2 Tranceparency distribution (m)

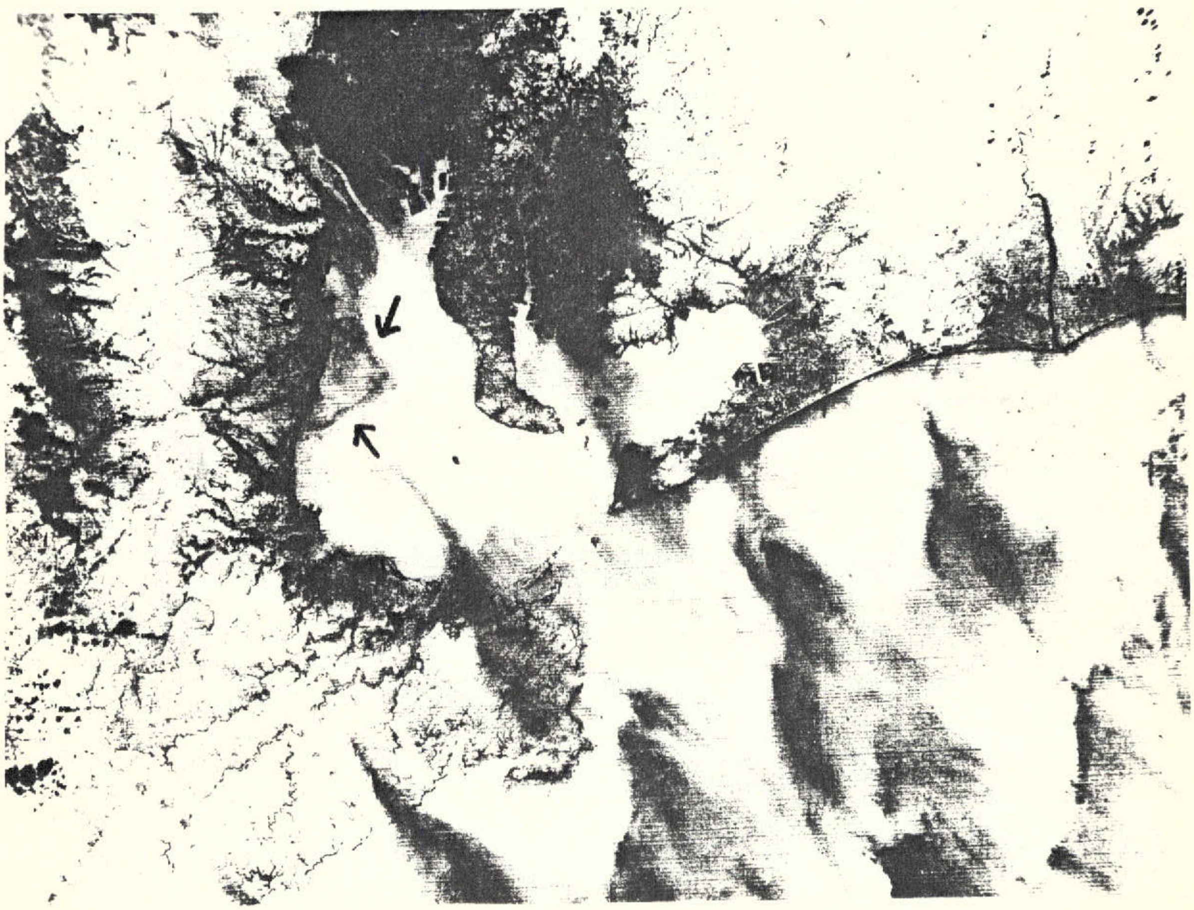

Fig. 3   Green band positive imager.

Oct. 5, 1972

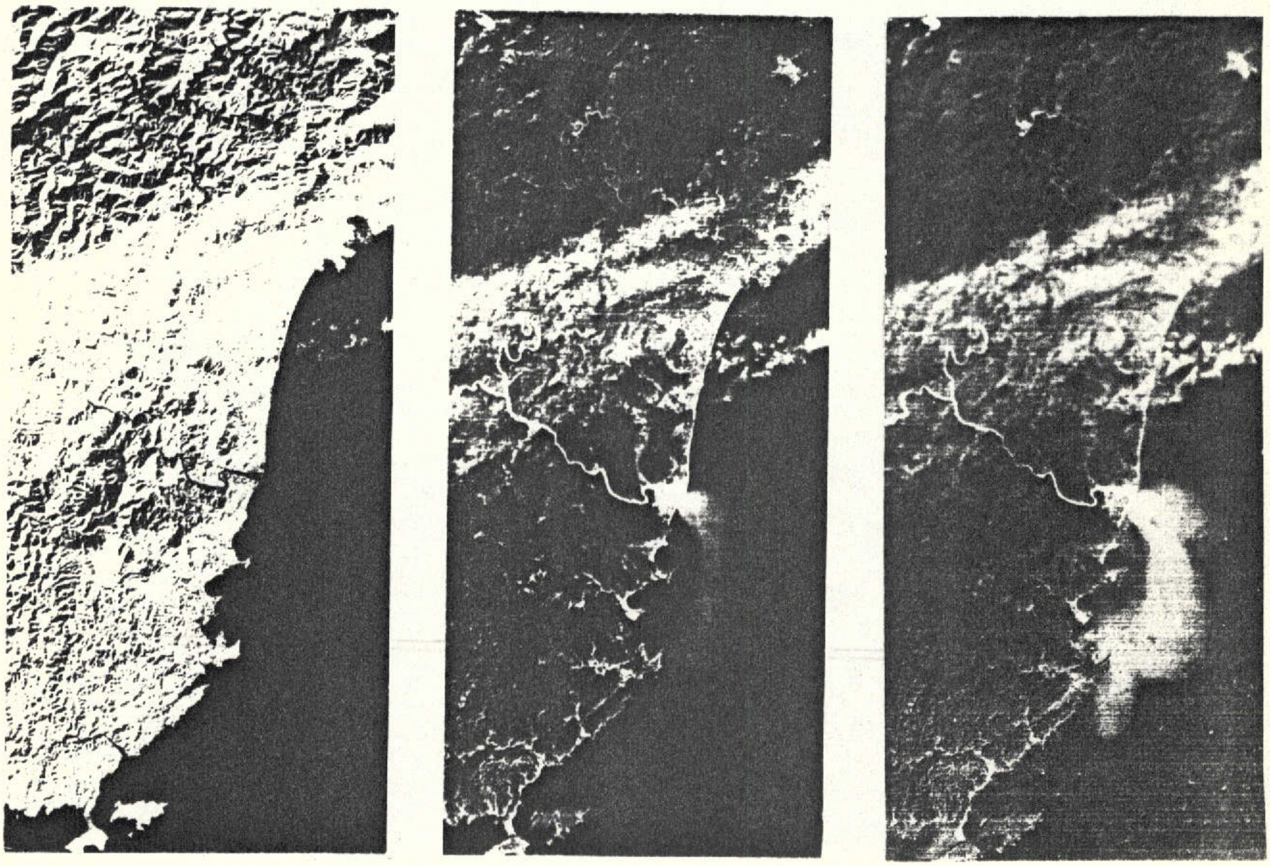

Fig. 4 Three band imageries of river plume.

Right green band

Center orange band

Left 0.7-0.8μ m band

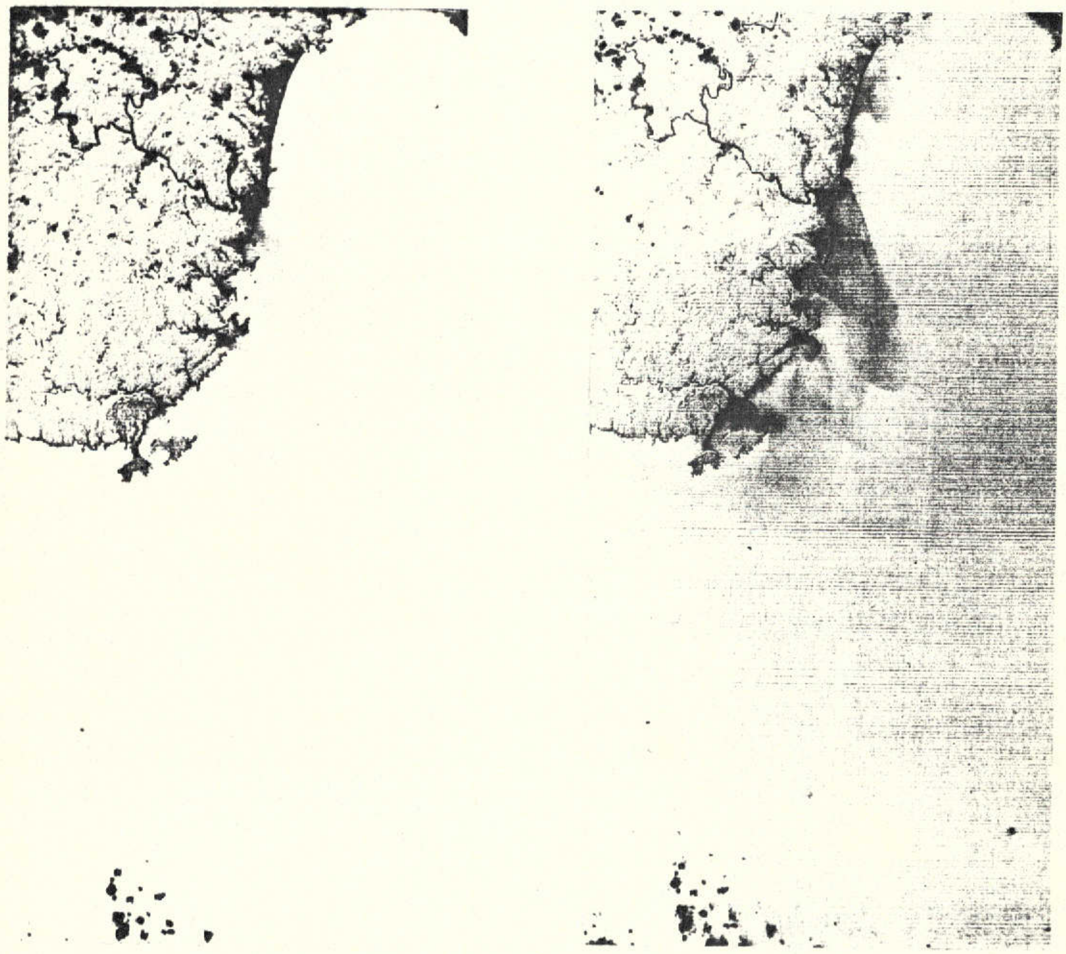

Fig. 5 Imageries of river plume

Right green band

Left orange band

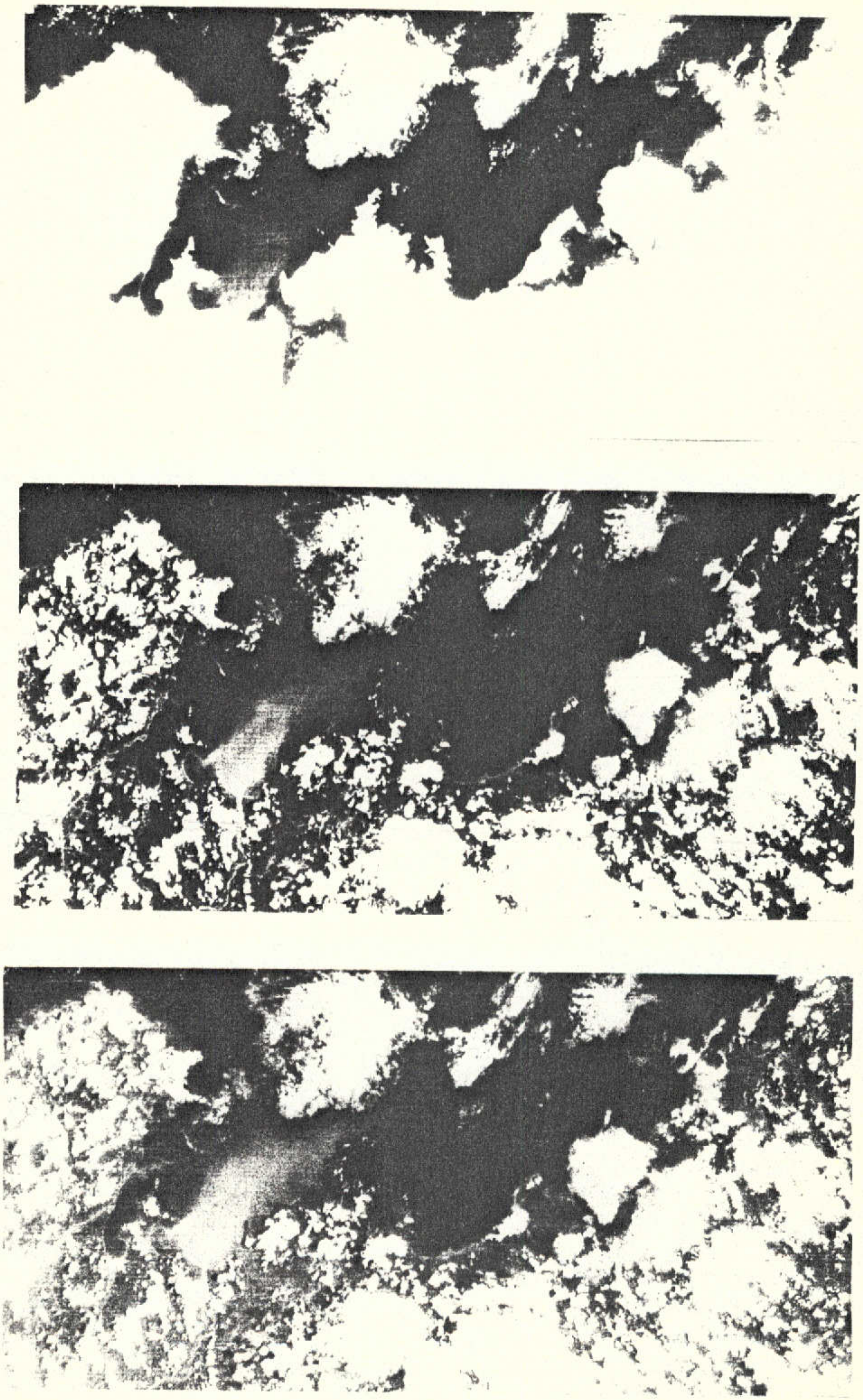

Fig. 6 Three band imageries of river plume

Top 0.7-0.8 μm band

Middle orange band

Bottom green band

Fig. 7 Green band imagery of shore currents.

Dec. 16, 1972

V. EVALUATION OF ENVIRONMENTAL QUALITY FROM ERTS-1 IMAGERIES

Dr. Iwao NASAZIMA, Co-Investigator

ABSTRACT

It is stated that the ratio of response of IR Band and Green Band of ERTS-1 Imageries is a useful measure to evaluate the natural environmental quality. The Tokyo metropolitan District is classified into six by this method as shown in Table 1. Other data demonstrate that this is a reasonable and applicable result.

I. METHOD OF EVALUATION

As a measure of estimation of bio-environmental quality, the ratio of density of coverage with vegitation and artificial structure is now useful term. And the density of coverage is estimated through the tone density of 7 Band and 5 Band, respectably. By this method, it is observed that the lighter the tone in 7 Band becomes, the more dense the area is covered by vegitation. Further, the lighter the tone in 5 Band film becomes the more highly the area is urbanized. Fig. 1 shows an example of the results of measurement of the tone density on both band ERTS-imageries of the Tokyo District. This figure obviously shows that the response of IR decreases and that of 5 band increase when approaching to the city zone, and two lines of response cross at the suburbs. It can be estimated that the coverage with vegetation and artificial structure is almost equal, at the crossing point. Thus the percentage of reflectance of IR and 5 band can be used as a criterion of judgement of degree of destruct of natural environmental condition.

2、RESULTS

By making use of the data of Fig. 1, the 1000 km area about the center of Tokyo can be devided into 6 classes. Table 1 shows the results of analysis, and through these data following results are concluded:

I Area keeping natural environmental condition. In this area vegitation is very vigor and producing fresh air fully.

about 5000 km ----- 27% of the whole examined area

II Urbanized area. In this area vegitation loses the vigor and can only producing fresh air slightly

about 4140 km ---21%of the whole area.

(This is consentrated in the center part of Tokyo) and 6.8% of this area is covered by concrete structures)

III The area developed recently. In this area new-towns, golf courses,and etc. have been constructed.

about 300 km ---(80% of it is in the belt zone of 30 - 50 km from center of Tokyo)

The results of the above were checked by the the analogue processing of imageries. Fig.2 shows how urbanized each area is by the color scale which change from dark red (most densely urbanized area) to dark blue (area keeping natural condition perfectly) Fig. 3 is the imagery of 4+5-7 band response. Th shows the good correspond with the results of Fig.1.

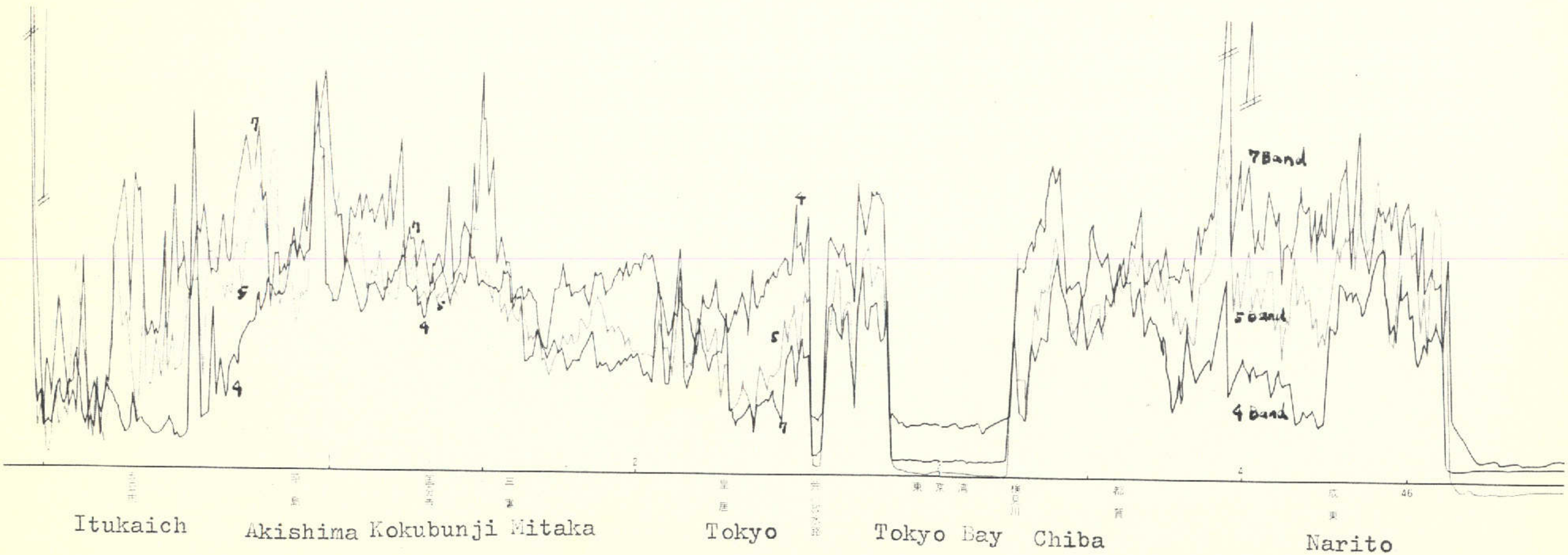

Fig.1 Densit measurment diagramme of Kanto area.

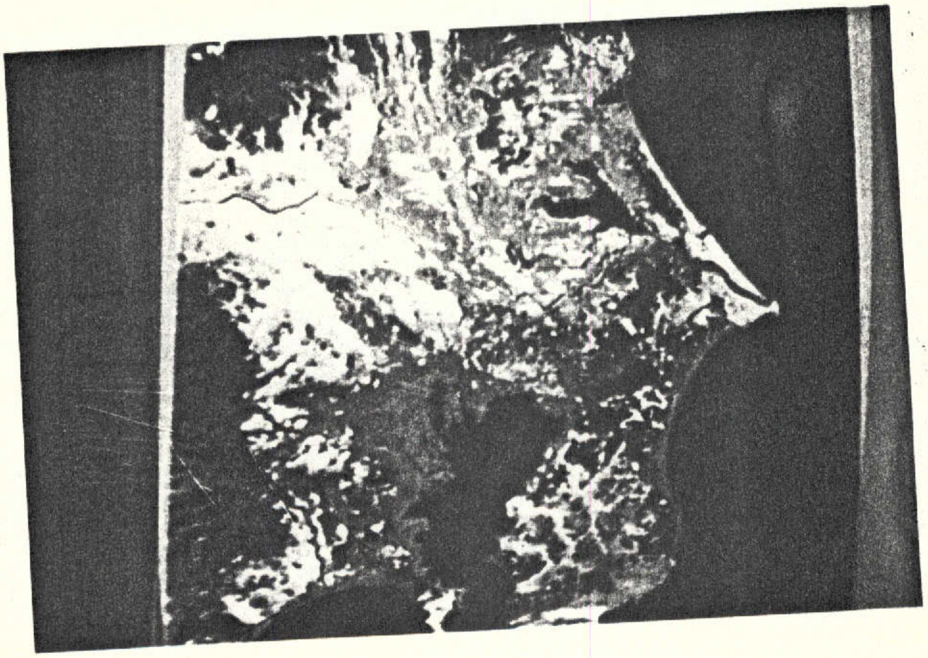

Fig. 2 Environmental classification imaginary by Multi-data-color system

Fig. 3 Emphansed imaginary of 4+5-7 bands response

Fig. 6 Distribution map of new developing area under construction or grassland

TABLE. ENVIRONMENTAL CLASSIFICATION BY AMOUNT OF FRESH AIR PRODUCED

Vegion	1) Fully	2) Resonable	3) Slightly Supply	4) Urban area	5) Dense urban area	6) Lake	Total	New developing area
100km	4987.4km^2 (26.6%)	9374.5km^2 (49.9%)	2610.9km^2 (13.9%)	987.4km^2 (5.3%)	541.4km^2 (2.9%)	276.5km^2 (1.5%)	18778.9km^2	482km^2
50km	1360.5km^2 (19.2%)	3051.9km^2 (43.0%)	1389.0km^2 (19.6%)	812.3km^2 (11.4%)	486.9km^2 (6.9%)		7100.5km^2	414km^2
30km	0	503.0km^2 (23.6%)	610.0km^2 (28.6%)	578.7km^2 (27.2%)	438.1km^2 (20.6%)		2129.9km^2	63km^2

VI. RECOGNITION OF POSSIBLE STRUCTURE IN THE KANTO DISTRICT ON THE ERTS-1 IMAGERIES

Remote Sensing Committee
Science and Technology Agency

Photographic (or Photogeologic) lineaments of EW direction across South Kanto district was recognized on the ERTS-1 imageries taken at 10:00 am, November 26, '72. This finding was obtained through the study of ERTS image data by the several members of the Remote Sensing ~~Soecial~~ Committee.

Through this study the committee concluded that this findings deserved further detailed studies and requested to the academic associations concerned with problems of this sort. Southmost lineament amongst ones which acrosses the central portion of Tokyo city area must be studied in relation to earthquake disasters prevention.

FINDINGS Obtained through the study by the committee

1) Lineaments are recognized on the band of green (4) and 2 bands of near IR (6) and (7). These are enhanced on the composit colour image of above 3 bands images.

2) The lineament which across the Tokyo city area is composed of tonal lineament and topographic ones. Tonal lineament is considered to be

related to vegitation feature, i.e. thick wood groves stretch along the lineament in Chiba Prefecture. As to topographic features, such rivers as the Tone, the Edo, the Ko(old)-Edo and the Ara make sharp crooks from the north-south to east-west direction in the sections where they go across the lineament. It is found also that many ponds in marshy lands exist along the lineament. It is also considered that curves and crooks of old roads can be related to the lineament.

3) The Musashino table land on which the city area of Tokyo situated is a upheaved river fan of quaternary age. The surface of the fan north of the lineament downheaved north-east. Maximum amount of downheave is estimated 40 - 50 meters relative to the southern portion of the lineament.

4) Gravity contour (Bougner anomaly) shows different pattern between both sides of the lineament (Geological Map of Tokyo, scale 1:500,000, Geol. Surv. Japa, 1969). As a whole, north of the lineament is relatively high compared with the southern portion. Direction of arrangement of high anomalies is of N-S direction. In the souther portion,arrangements of anomalies are of EW direction.

5) Airborne magnetic survey which was conducted offshore area East of the Kanto district inclued the coastal land areas shows same tendency with gravity contour in arrangement of high and low magnetic anomalies.

Member of this Report

Kiyoo WADACHI Chairman, Special Committee of Remoto Sensing

Iwao NAKAJIMA	Chief of Photogrammetry Laboratory Government Forest Experiment Station Ministry of Agriculture and Forestry
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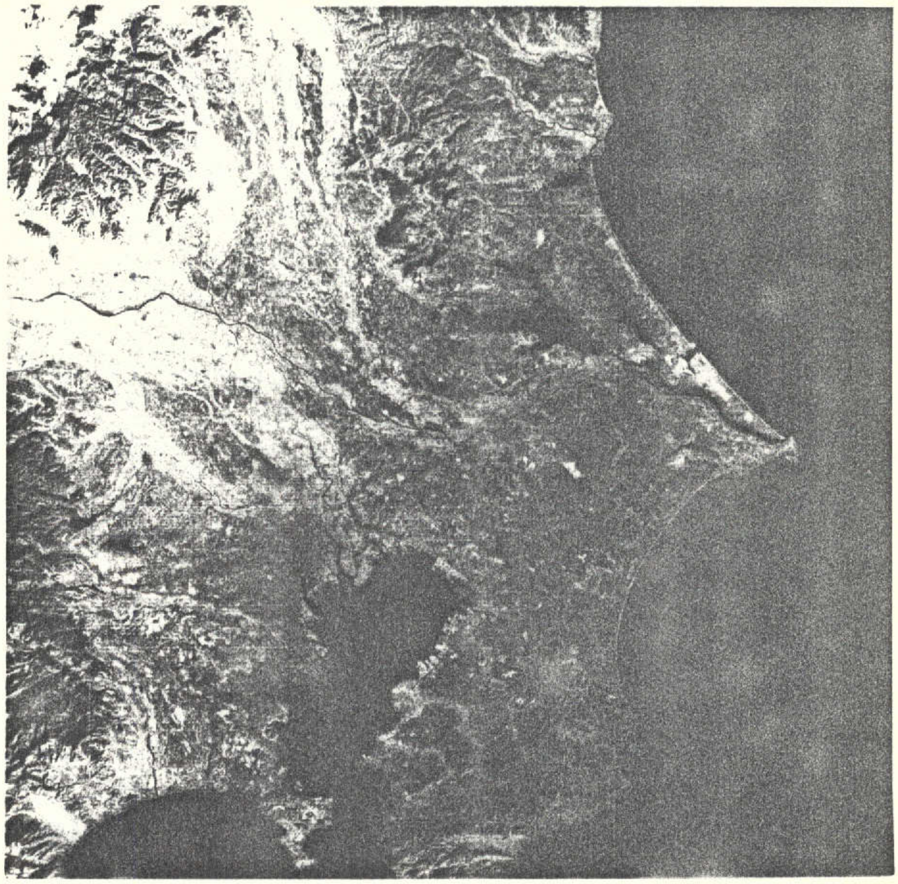
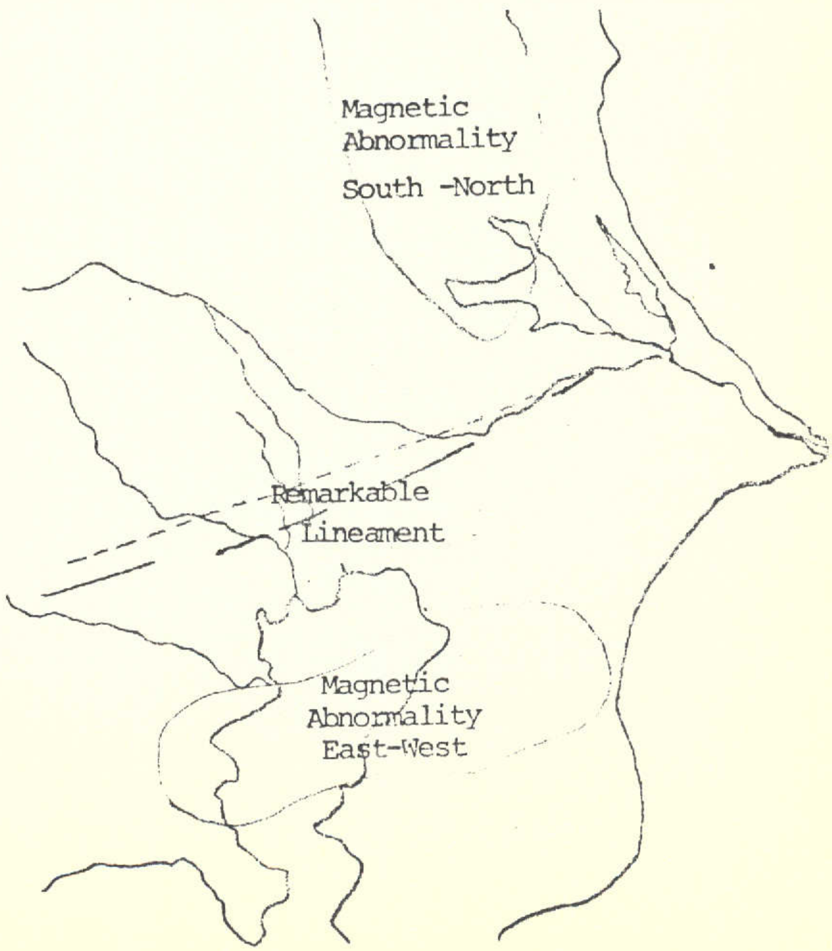
Keiji NISHIMURA	Chief of Planning Office, Geographycal Survey Institute Department, Ministry of Construction
Hiromasa SUZUKA	Secretary General of Special Committee of Remote Sensing Science Research Officer, National Institute of Resources, Science and Technology Agency




Magnetic
Abnormality
South -North
Remarkable
Lineament
Magnetic
Abnormality
East-West

VII.. SYSTEMATIZATION OF INFORMATIONS ON LAND ENVIRONMENTAL CHARACTERISTICS BASED ON ERTS-1 IMAGERIES - AS THE BASIS ON STUDIES OF CHANGING ENVIRONMENTAL PATTERNS IN JAPAN -

Takamasa NAKANO, Co-Investigator

1.1. INTRODUCTION

This is a part of the report to NASA on "Investigation of Environmental changing pattern in Japan" by principal investigator T. Maruyasu.

Considering the long term basic studies on the possibilities of the application of ERTS data to environmental protection, the author examines the basic problems of ERTS-1 imageries basing on resolving power and pattern of surface characteristics, reffering previous materials which have been compiled by both national and local governments.

1.2. SUMMARY ABSTRACT

To attempt the systematization of informations on land environments and their changes basing on ERTS-1 imageries is thought as basic research which provides the standards for the study on changing environments, though very primary, in Japan, where the case studies are not so accumulated.

The Seto Inland Sea area is selected as the test area. This area has been developed and still the industrialization is progressing in densely populated areas, involving and expanding various kind of environmental problems such as air pollution, water polution, and collapses, land reclatation, land development

on mountain slopes. Such situation brings this area into suitable test area on this subject on studies. Tokyo and Nagoya areas are added as comparative studies areas.

The investigation is carried out by eye-observation of contact prints, 4 times enlargements, negative transparencies on light table, digital color viewer, densitometer, and comparative studies of ERTS-1 data and previous data such as various kind of topical maps and aerial photographs. As the result, it is believed that ERTS-1 data can be used as one of source data for environmental prevention planning in smaller scale. This means the changing patterns of environment will also be made clear basing on ERTS-1 data.

1.3. BACKGROUND

Establishment of geographical information systems for environmental problems basing on ERTS-1 imageries is thought as one of the future tasks. However, various kind and various scales of topical maps on land, land use, water resources, vegetation cover the whole territory of Japan or its partial regions, and those are used as basic materials for administration and scientific studies. Those data have no relation with time sequential changes of data contained in the maps. Present day significances of those maps should be supplemented by data which indicate the time sequential data, particularly for environmental prevention or studies.

Unfortunately, however, it is rather difficult to seek the seasonal changes of air pollution and water pollution. Very limitted cases such as land slides, land collapses, volcanic eruptions, land deformations due to earthquake will be studied basing on ERTS-1 imageries. In this paper, the author intends to examine the possibilities of the establishment of the methods to clarify the long term changes of land environment basing on ERTS-1. Long term in this case means 5-10 years, considering the changing speed and size of area of land environment in Japan. Attention should also be given to the comparison of aerial photographs and ERTS-1 imageries.

2.1. STATEMENT OF WORK

Interpretation of imageries basing on either spaceborne data or airborne data is achieved based on (I) comon sence, (2) scientific knowledges and (3) proper technology. Anyone can read something from both space-borne imageries and air-borne photographs, because of the exsistence of the common sence. Scientific knowledges can provide proper interpretation of imageries, and at present Japan, proper technology can be treated by very limitted number of specialists. In this studies, (2) and (3) are stressed for interpretation of ERTS-1 imageries. However, (1) is always in act, even among the specialists.

2.2. OBJECTIVES

a) Landforms, geology and soils

As various kind and scales of topical maps concerned have been piled, one of the aims of this study is to examine the possibilities to provide new data for those maps from ERTS-1 imageries, and on the other hand, the possibilities to compile topical maps based on previous concepts and with proper contents and accuracy from ERTS-1 imageries will be examined. This respect will provide an answer the possibilities to compile topical maps for unmapped regions basing on ERTS-1 imageries.

b) Water Body

Morphological characteristics of embayments and lakes will be examined comparing previous data and ERTS-1 imageries.

c) Land use and vegetation

It is aimed to testify the limitation and accurracy of setting up of land use types and vegetation types based on certain supporting ground data in urban areas, suburban areas and rural areas independently or totally.

d) Change of Pattern

It is also intended to examine the possibility to delineate the changes of the pattern concerning the items a), b) and c) mentioned above. For a) the changes of 5-10 years intervals, and for b) and c) seasonal changes should be examined. The future changes of pattern for 5-10 years should also be considered. The annual changes of shifting of sanddune, drift sands along coast, land slides, snow covered areas etc. should be investigated.
Technically, resolving power by each items, each wave length band, spectral characteristics of objects, densitometric characteristics and digital color patterns should be taken into consideration. Air-borne multispectral photographic data should also be compared with that of space-borne data.

2.3. APPROACH

a) The examination of resolving powers of 70 mm bulk processed black and white negative films for each band is achieved on light table using 8 times magnifying glass, the contact prints and enlarged prints of 4 times by 8 times magnifying flass. In this study color prints and color compound printed pictures are not so interested, and not so important. Color examination is only done in digital color analysis.

b) Comparative studies of data obtained in a) mentioned above and the previous data will provide the data on the quality and the accurracy of space-borne imageries.

c) Comparative studies of the data examined in a), aerial photographs and air-borne multispectral data will bring the results of the advantages and disadvantages of space-borne data.

d) The possibility of transferring and combining space-borne data to the previous science and technological concepts will be examined.

e) Through a) - d), 2.1 a) ÷ d) will be examined. In the test areas mentioned before.

3. RESULTS

a) The results obtained are shown in Table 1.

b) Where ground data available, furtuer informations will be able to obtain. This means, as many ground data available in test areas, space-borne data can add not so many new data to previous data. However, if scale of space-borne imageries is taken into consideration, the ability of space-imageries should be evaluated as high and possible to be applied for unmapped areas.

c) Scientific meanings of space-borne data, particularly for sciences dealing with earth surface, should also be highly evaluated, because of uniform data display, possibility of statistic and photographic treatment, and synthetic display of data.

4. FURTURE PROBLEMS ON THIS SUBJECTS

a) Standardization of interpretation of space-borne imageries, compiling the characteristics, patterned characteristics in digital color viewer etc.

b) Improvement of interpretation accurracy, comparing with ground data.

c) Construction of instrumental systems for time sequential changes of environment and data bank necessary for that.

d) Adjustment and rearrangement of previous knowledges and newly obtained space-borne data.

e) Quantitative evaluation systems for land resources and the transformation to previous knowledges.

Tab. 1 Items analysed form ERTS-1 imageries of test areas

(E: Easy , I: Impossible , F : Fairy , ? : Doubtful)

I. Land	4	5	6	7	4.5.7	4.5.6	remarks
Mountains							Large size only
Collapses	F	F	F	F			Large size only
Landslides	F	F	F	F			Large size only
Lineaments	F	F	E	E	E		Large size only
Faults	F	F	E	E	E		Large size only
Volcanoes	F	F	E	E			Craters included
Structures	F	F	E	E	E		
Calseras	F	F	E	E	E		
Flat lands							
Uplands	F	F	F	F	E		
Lowlands	F	F	E	E	E		
Sand bars etc.			F	F	E		
Sand dunes	F	F	F	F	F		
Old rivers	F	F	E	E			
Artificial lands			F	F	F		
Geology, soils							
Tectonics			E	E			
Drainage	E	E	E	E	E		
Rocks difference			F	F	F		
Soil moisture			F	E			
Lakes	F	F	E	E			

	4	5	6	7	4.5.7	4.5.6.	Remarks
Coastal drift	E	F	F	F			
Coastline	E	E	E	E	E	E	
2. Land use							
Land use type	E	E			E		Major type only
Orchards	E	E					
Tea garden	I	I	I	I	I		
Paddy fields	F	F	?	?			
Dry fields	F	F					
Traffic systems				?			Large one only
Urban areas			F	E	E	E	
Ports	E	E	E	E	E	E	
Reclaimed lands	E	E	E	E	E	E	Large one only
Golf Course	F	F					
Aerodrome		F	F	F	F		
Irrigation ponds		F	E	E	E		
Dammed lakes	E	E	E	E	E		
Vegetation cover	F	F	I	I	E		
Industrial area			F	F	F		Coastal one only
Water pollution	E	E	I	I	E	E	Area only
Air polution	E	F	I	I	E	E	
Vegetation damage	F	F	I	I			
Tidal current	E	E	I	I	E		
Flood disaster							
Snow cover	E	E					
Resources							
Mineral							
Forest							
Submarine							