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Produced by the NASA Center for Aerospace Information (CASI)
Title of Investigation: 28990

Investigation of Environmental Change Pattern in JAPAN

Principal Investigator: Takakazu MARUYASU
Science University of Tokyo
Noda City, Chiba ken, 278, JAPAN

October 29, 1976

Quarterly Progress Report for period

July-Sept. 1976

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Title of Investigation: 28990

Investigation of Environmental Change Pattern in Japan

Principal Investigator: Takakazu Maruyasu

October 18, 1976
SUMMARY

SUBJECT: Investigation of Environmental Change Pattern in Japan

OBJECTIVES: The applications and feasibilities of space sensing of the environment and its change in Japan will be investigated with particular focus on the following subjects:

1. Establishment of ecological indicators of environmental disruption through observation of regional vegetation covers and growing conditions.
2. Application of space-acquired data for understanding environmental changes in the coastal and offshore zone.

Summary of the results

The study is still going on and the results as intended at the beginning has not been obtained due to partly lack of data and partly due to delay of data. The results so far obtained are summarized below.

Land use

A detailed land use classification for a large urban area of Tokyo was made using MSS digital data. It was found that residential, commercial, industrial, wooded area and grass land can be successfully classified.

Based on the basic researches on land use and vegetation cover classification, an experiment of operational application of Landsat data in an environmental survey was made for a large area of Kanto and Central Japan area. In this experiment air-borne data of training area were also added. The result indicates that a regional planning map can be made very effectively. The systems for this operational application is also developed.

Coastal zone and offshore zone

A mesoscale vortex associated with Large Ocean Current Kuroshio which is a rare phenomenon was firstly recognized visually through the analysis of MSS data. It was found this vortex affects enormously the effluent patterns of river. A majority of investigators agree that this is a mesoscale oceanographical vortex, however there are few investigators taking this vortex as an atmospheric phenomenon.

Based on the Watanabe's theory and technique the same author made every possible efforts to distinguish between oceanographical and atmospheric phenomena.

The areal influence and pattern of "Red Tide" popularly called due to its color in Ise Bay located in Central Japan is found. Through the analysis of four bands data of MSS it is found Band-4 can show partly red tide, however there remains a problem to distinguish it from other water pollution and smog.

An experiment was made to enhance and distinguish sea surface status through photographic processes.

Geophysics and related field

In an attempt to find the applicability of MSS data in the field of volcanology and geology, MSS data covering Active Volcano Sakurajima were analyzed. It was found that lava flowed out at the time of 3 major eruptions which took place in 1779, 1914 and 1946 can be clearly classified.
The observed values of MSS include the effects of atmospheric scattering and absorption. An attempt is made to numerically evaluate its effects through numerical integration of radiative transfer equation. It is found that the radiance due to atmospheric effect popularly called as path radiance for Bands 4, 5, 6 and 7 of MSS amounts as large as 47, 34, 24 and 20% of the measured value (total radiance) respectively.
LAND USE

Fig. 1. Theme Extraction Imagery of Kanto Area
Blue: Forest
Yellow: Firm field
White: Bare soil
Red: Urban area, Polluted water

Fig. 2. Color Composite Imagery of Westside Tokyo by LANDSAT-1 CCT, used for the determination of the classification and the training area.

Fig. 3. Digital Pattern Recognition Output of Fig. 2 area.
Classification to 10 items.

Fig. 4. Color Composite Imagery of Middle Part of Japan, at the end of September the rice field harvested already.

Fig. 5. Land Use Map of Fig. 4 area.
Green: Rice field
Yellow: Other crops
Black: Urban
Red: Under construction

Fig. 6. Pattern Classification in Mountainous Forest.
Green: Ever green grass land
Brown: Artificial conifer
Yellow: Pine and other conifer
Fig. 7. Land Use Pattern Recognition of North Suburb Tokyo.
Green: Forest
Yellow: Firm field
Red: Urban
Blue: Water

Fig. 17. Forest Type Quadrate Map of North Kanto.
5 classes by the tree cover densities. (2x2 km unit)
Total area: 7,460 km².

Fig. 18. Timber Productivity Classification.
Produced by LANDSAT data and census data.

Fig. 19. Recreation Area Zoning in 3 classes.
Calculated from the population data and green capacity of each quadrate unit, also relative distance.

Fig. 20. Forest Conservation Planning Map.
Each quadrate unit was evaluated by the potential power for watershade, erosion control, flood control and timber productivity.
Land Use around Central Tokyo

These 4 photos show the results of land use analysis of Central Tokyo by using the LANDSAT CCT on 14-DEC-72.

A: Central Tokyo
- Red: Densely built up area
- Pink: Residential area
- Green: Park and woody field and forest
- Light blue: Fresh water
- Dark blue: Salty water
- Black: Uncategorized area

B: Urban of Tokyo
- Red: Built up area
- Pink: Residential area

C: Urban of Tokyo
- Green: Woody forest as imperial palace
- Yellowish green: Grass field as golf links

D: Tokyo bay
- Water area divided into sea area and fresh water
### Table 1. Land use ratio in the Central Tokyo

<table>
<thead>
<tr>
<th>GRP NO</th>
<th>CATEGORY</th>
<th>NOB</th>
<th>PERCENT OF TOTAL</th>
<th>ACRES</th>
<th>SQ. KM.</th>
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<tbody>
<tr>
<td>1</td>
<td>UNCATEGORYIZED</td>
<td>1570</td>
<td>8.25</td>
<td>1755.10</td>
<td>7.10</td>
</tr>
<tr>
<td>2</td>
<td>KOKYO GREEN</td>
<td>1366</td>
<td>7.17</td>
<td>1527.04</td>
<td>6.18</td>
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<tr>
<td>3</td>
<td>SHIBANISHI</td>
<td>7795</td>
<td>40.96</td>
<td>8718.46</td>
<td>35.26</td>
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<td>4</td>
<td>Todoroki Pink</td>
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<td>34.85</td>
<td>7418.35</td>
<td>30.02</td>
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<tr>
<td>5</td>
<td>ARAKAWA LB</td>
<td>805</td>
<td>4.23</td>
<td>899.91</td>
<td>3.64</td>
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<tr>
<td>6</td>
<td>TOKYO BAY</td>
<td>864</td>
<td>4.54</td>
<td>965.86</td>
<td>3.91</td>
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**TOTALS**
19046   100.00  21284.74   86.14

### Table 2. Training area selected for MCP analysis

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</tr>
<tr>
<td>16</td>
<td>5</td>
</tr>
</tbody>
</table>

### Table 3. Categorization table (showing the precision of analysis)

<table>
<thead>
<tr>
<th>TNG SET</th>
<th>PERCENT CATEGORIZED AS GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>2</td>
<td>1 3 4 5</td>
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<tr>
<td>3</td>
<td>1 2 4 5</td>
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<td>1 2 3 5</td>
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<tr>
<td>5</td>
<td>1 2 3 4</td>
</tr>
</tbody>
</table>

**ORIGINAL PAGE IS OF POOR QUALITY**
Land Use

LANDSAT MSS CCT

Land cover recognition

Air Photos
Topographic map

Cluster Analysis

Image processing
Vegetation map

Land use classification

Census data
Topographic data

Land Use Zoneing
Forestry, Agriculture, Urban.

Block plan data
Natural quality of vegetation

Evaluation of Forestry zone in each quadrat.
Forest Products, Watershed, Erosion and flood control recreation purpose.

Forest conservation plan.

Table 1. LANDSAT data application diagram for Forest conservation plan.
Coastal zone and offshore zone

A Vortex off Shionomisaki (1)

Photograph

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Figure's captions are found in page 10.
Figure's captions of "A vortex off Shionomisaki", coastal zone and offshore zone.

Photograph : Elliptical Vortex off Shiono Misaki, Sep. 11 1975

Fig. 1 : Surface Current around the Place where vortex is found by GEK, Aug. 14 - Sep. 3, 1975

Fig. 2 : Surface Current by GEK, Sep. 8 - 16, 1975.

Fig. 3 : Hypothetical Stream Line of Kuroshio

Fig. 4 : Transparency Distribution (m), Sep. 11 and 12, 1975

Fig. 5 : Water Color Distribution, Sep. 11 and 12, 1975

Fig. 6 : Surface Salinity (%), Sep. 11 and 12, 1975

Fig. 7 : Kuroshio and Associated Coastal Current, Sep. 1975

Fig. 8 : The Relation Ship between the values of Band 4 and that of 5

Fig. 9 : Computer Output of Band 4 near mouth of Tenryu River

Fig. 10 : Computer Output of Band 4 near mouth of Kumano River
Identification of shorelines and progress of reclamation (1)

Figure's captions are found in page 13.
Identification of shorelines and progress of reclamation (2)

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8
Figure's Captions

Fig.1: Landsat-2 MSS Image Covering Ise Bay and Nagoya District.

Fig.2: Reclaimed areas at Northern part of Yokkaich and Southern part of Nagoya ports which are located to the western part of Ise Bay.

Fig.3: Reclaimed area in the western part of Nagoya port

Fig.4-7: Computer output of MSS-4, 5, 6 and 7 showing the coastal areas of Ise Bay

Fig.8: Computer output of MSS-4, 5, 6 and 7 showing Nagoya port
Sakurajima Island image is extracted from LANDSAT-1 CCT on 2-DEC-72. The area of the naked lava is divided from another area, where the vegetation has been grown up already. Furthermore two types of the lava are classified. One flowed out in 1914 and another by the big eruption in 1946. There are some area where the two classified are mixed.

A: Green; Vegetation grown up area
Brown; Naked lava

B: White; Showa lava (year 1946)
Light brown; Taisho lava (year 1914)
Geophysics and Related Fields

Atmospheric effects on measured values of MSS

\[ I_T = I_D + I_P \]
\[ I_P = I_A + I_{PF} \]
\[ I_D = \sum I_{Di} \]
\[ I_{PF} = \sum I_{PFi} \]

\[ YD = F(\theta) \]

Fig. Geo-1 Schematic representation of the model used for the computation.

<table>
<thead>
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<th>( \lambda = 0.55\mu )</th>
<th>( \lambda = 0.65\mu )</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Layers</td>
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</tr>
<tr>
<td>( I_D / I_T )</td>
<td>( I_P / I_T )</td>
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<tr>
<td>0.534</td>
<td>0.466</td>
</tr>
<tr>
<td>( I_D / I_T )</td>
<td>( I_P / I_T )</td>
</tr>
<tr>
<td>0.659</td>
<td>0.341</td>
</tr>
<tr>
<td>3 Layers</td>
<td></td>
</tr>
<tr>
<td>( \lambda = 0.75\mu )</td>
<td>( \lambda = 0.95\mu )</td>
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<tr>
<td>0.762</td>
<td>0.238</td>
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<tr>
<td>0.805</td>
<td>0.195</td>
</tr>
</tbody>
</table>

Table Geo-1

\( I_P \): Intrinsic radiance of the surface

\( I_P \): Path Radiance
\( I_T \): Total Radiance

Each value is obtained through numerical integration of Radiative Transfer Equation.