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# PROBABILITY OF MONITORING AND ANALYZING SEA SHORE ENVIRONMENT IN YAP USING SATELLITE DATA

ISHIGURO Etsuji[1)], KASHIWAGI Sumitaka[1)], KIKUKAWA Hiroyuki[2)], HIGASHI Masataka[2)], YOSHINAGA Keisuke[2)], FUKUDA Ryuji[2)], and MORIYAMA Masao[3)]

**Abstract**

Remote sensing technique is the effective technology for monitoring and analyzing environmental changes on the Earth surface. We focused to clarify the environmental changes in the Yap islands and Ulithi atoll using satellite data, especially the distribution of water depth around the Yap islands and in the Ulithi atoll. One of these results was compared with the environment of near shore of Japan. To serve our purpose, the sea-truth data were collected using portable spectrometer.

Keywords: remote sensing, estimation of sea depth, turbidity, sea-shore

## Introduction

Remote sensing is the effective procedure to analyze and to monitor the environmental changes because of its potentials of monitoring the large area at the same time and of the time series analyzing. Many researchers and we have been clarifying several studies using satellite data[2-6, 9-11, 13)]. Especially, it was clarified that the water depth, shallower than 20 m, can be estimated by satellite data[1, 7, 8, 12)]. We reported that water depth shallower than 30 meters could be estimated by the satellite data[7)]. If the distribution of water depth is determined, it will help native people to easily find the waterway, and will help in evaluating the rising sea level in relation to the greenhouse effect.

This study was carried out as a project of the Research Center for the Pacific Islands in Kagoshima University. This project concerned clarify the self-reliance of islands, based on the Yap Islands in Micronesia.

## Principle of the Evaluating of Water Depth

It is assumed that the extinction coefficient of the sea water, $\alpha_\lambda$, is homogeneous vertically at each point. At the sea surface, radiance intensity, $I_0$, decreases in the sea water and becomes $I_1$ at the bottom. $I_1$ is expressed as $I_1=I_0\exp(-\alpha_\lambda h)$, where $h$ is the depth. As the radiance $I_1$ is reflected by the sea-bed, $I_1$ becomes $I_2$, $I_{21}=\gamma_\lambda I_1$, where $\gamma_\lambda$ denotes bottom reflection coefficient. When the radiance reaches the sea surfaces, the intensity becomes $I_3$, $I_3=I_2\exp(-\alpha_\lambda h)$. Then $I_3$ is expressed as $I_3=\gamma_\lambda I_0\exp(-2\alpha_\lambda h)$. $I_3/I_0$ is the reflectance at the sea surface. If the extinction coef-

1) Faculty of Agriculture, Kagoshima University. Kagoshima 890-0065, Japan.
2) Faculty of Fisheries, Kagoshima University. Kagoshima 890-0056, Japan.
3) Faculty of Technology, Nagasaki University. Nagasaki 852-8521, Japan

ficient of the water collected at the Yap and reflectance is measured, the depth can be evaluated.

## Methodology

### Sea Truth

Actual sea depths were measured by throwing the rope from the boat at several points. Spectral reflectances were measured by the handheld spectroradiometer (Model: 2703, Abe-sekkei Co. Japan), ranging from 400 nm to 1050 nm with 25 nm intervals. Sea sediments were collected on the same points and spectral reflectances were measured by the handheld spectrometer. Seawater, in the middle depth of each sampling point, was collected at the same time, and extinction coefficients of water, from 400 nm to 1100 nm, were measured by the spectrometer (Model: 121-0001, Hitachi Co.). These points were recognized and recorded by the handheld GPS instruments (Model: GPS-315, Magellan Co.). These points were shown in Figs.1 and 2 respectively.


Fig. 1. Sea truth point at Yap islands

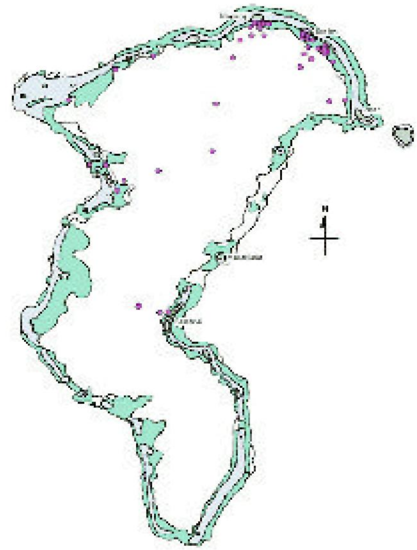

Fig. 2. Sea truth points at Ulithi atoll

### Image Analysis

To date, many satellites have been observing the Earth surface. These satellite data have been received only bases, Hatoyama, Japan, Beijing, China etc. These data, observing Yap islands, have been limited in use. Moreover, reflected and emitted radiation from ground objects cannot penetrate the clouds. From these reasons, we determined to use the satellite data of Landsat-2/Multi Spectral Scanner (MSS), Landsat-5/Thematic Mapper (TM) and MOS-1/MESSR.

Landsat-2/MSS data consists of 4 bands, i.e., Band-4 (0.5 to 0.6 μm), Band-5 (0.6 to 0.7 μm), Band-6 (0.7 to 0.8 μm), and Band-7 (0.8 to 1.1 μm). Landsat-5/TM data consists of 7 bands, Band-1 (0.45 to 0.52 μm), Band-2 (0.52 to 0.60 μm), Band-3 (0.63 to 0.69 μm), Band-4 (0.76 to 0.90 μm), Band-5 (1.55 to 1.75 μm), Band-6 (10.40 to 12.50 μm), and Band-7 (2.08 to 2.35 μm). On the other hand, MESSR is consists of 4 bands, Band-1 (0.51 to 0.59 μm), Band-2 (0.61 to 0.69 μm), Band-3 (0.72 to 0.80 μm), and Band-4 (0.8 to 1.1 μm). It has to be noted that