

STUDIES ON THE EVALUATION OF WATER DEPTH AROUND SEASHORE AND THE LAND CLASSIFICATION IN YAP ISLANDS USING SATELLITE DATA

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Abstract

Remote sensing technique is an effective technology for monitoring and analyzing environmental changes on the Earth surface. We have tried to clarify environmental changes in Yap islands using satellite data, especially, on the distribution of water depth around the Yap islands and land classification. To serve our purpose, a sea-truth and ground truth data were collected, using a portable spectrometer and a digital camera.

Key words: remote sensing, water depth, land classification, monitoring

Introduction

This project is a joint program with the Research Center for the Pacific Islands in Kagoshima University. The project seeks to enhanced the self-reliance of Yap Islands in Micronesia. Remote sensing is an effective procedure simultaneously to analyze and to monitor environmental changes because of its potentials to cover a large area and generate time series analysis. Many researchers have been undertaking studies using satellite data^{2,6,9-11,13}. Especially, it was clarified that the water depth, shallower than 20m can be estimated by satellite data^{1,7,8,12}.

If the distribution of water depth map can readily indicate a waterway easily for a native person and also evaluate the rising sea surface for purpose of understanding the greenhouse effect. And if a method of classification the land can be achieved, it will be possible to evaluate and analyze biomass and surface temperatures on the ground and thus the potential of yield of several crops. Our primary results highlights these methods to be effective for the Yap Islands.

Principle of the Evaluating of Water Depth

It is assumed that the extinction coefficient of the sea water α_λ , is homogeneous vertically at a point. At the sea surface, radiance intensity, I_0 , become I_1 at the bottom. I_1 are 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 , $I_2 = \gamma_\lambda I_1$, where γ_λ denotes bottom reflection coefficient. When the radiance reaches at 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 coefficient of the water collected at the

Yap and reflectance are measured, the depth will be evaluated.

Methodology

Sea Truth

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

Ground Truth

Spectral reflectances of the leaves of several crops and trees, grown in the Yap islands, were measured by handheld spectroradiometer. Making a land classification map for Yap islands, several points were surveyed. The data were recorded by digital camera and video camera. The points were recognized and recorded by handheld GPS instruments.

Image Analysis

In recent times, many satellites have been observing the Earth surface. Satellite data for the West Pacific have been received mainly at bases in Hatoyama, Japan, Beijing, China etc. Few data based on observing Yap islands have been available. Moreover, reflected and emitted radiation from ground objects cannot penetrate clouds. For these reasons, we determined to use the

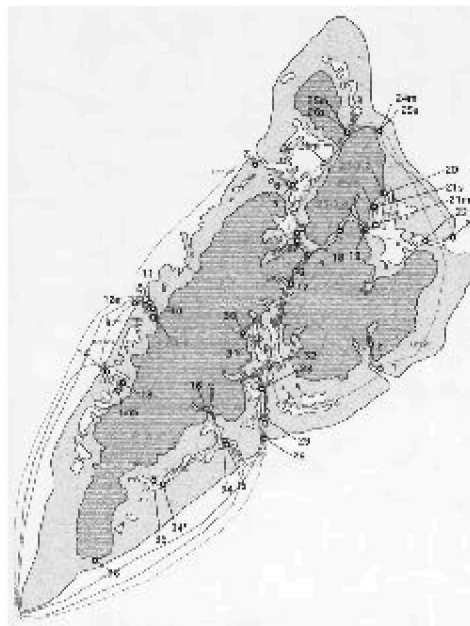


Fig. 1. Measured points in Yap.

