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APPLICATION OF SPACE TECHNOLOGY TO THE STUDY OF THE USE OF NATURAL RESOURCES IN THE REPUBLIC OF PANAMA

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16. Abstract

This paper is a review of the status of satellite remote sensing techniques used in the Republic of Panama up to November, 1977.

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APPLICATION OF SPACE TECHNOLOGY TO THE STUDY OF THE USE OF NATURAL RESOURCES IN THE REPUBLIC OF PANAMA

By Nidia Avila de Nichols*

INTRODUCTION

The present paper has been prepared by the Panamanian professional / ** Professor Nidia Avila de Nichols, as Panama's participation in the Regional Training Seminar on Applications of Remote Sensing by Satellite, held under the auspices of the United Nations and FAO, at La Paz, Bolivia, from December 1 to 9, 1977.

The paper consists of a compilation of information relating to the use of the remote sensing technique at the present time, November, 1977, in the Republic of Panama.

All of the information has been compiled with the kind cooperation of the technicians and professional staffs of the various public and private institutions, such as the personnel of the Instituto Geografico Tommy Guardia [Tommy Guardia Geographic Institute], CODEMIN, the Catastro [Census of Property], and the Negotiating Mission of the Ministerio de Hacienda y Tesoro [Ministry of Finance and Treasury]. Although the application of this technique is somewhat modest, given our limited resources, the fact that it is used gives us an insight into its future importance.

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*Regional Training Seminar on Applications of Remote Sensing by Satellite, December 1-9, 1977, La Paz, Bolivia

** Numbers in Margin indicate pagination in foreign text.

CONTENTS

I. FIRST ATTEMPTS AT USING THE TECHNOLOGY OF REMOTE SENSING IN THE REPUBLIC OF PANAMA, 1967-1973. /1*

In the republic of Panama, the coverage of the nation's territory with some type of remote sensors was begun with the acquisition of the first images with radar in 1967 by the Westinghouse Electric Corporation.[1] This first image (Figure 1) which covers part of the province of Darien, the San Blas section and the frontier with Colombia, was made at a scale of 1:170,000. The Raytheon Autometric Company converted it to a topographic map[2] at a scale of 1:250,000; see Figure 2. This topographic map was the first one made of the Darien area. The following slides show the transparencies obtained for preparing the topographic sheet. This map represented a landmark in the cartographic technique in Panama. Now it was possible to identify and to inventory cultural characteristics in the area of Darien which had hitherto been unknown, such as areas of settlement of rural and indigenous communities, and physical characteristics. The following slides show some of the physical elements which have been successfully recognized by the radar technique:[4]

a) Photography of the Darien area under study
b) Surface water and drainage water
c) Condition of the terrain
d) Geology
e) Surface materials
f) Configuration of the terrain
g) Hydrology
h) Areas of possible routes for the construction of an interocean canal.

In 1969, other images were taken in certain sections of the above-

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[1]Lasso, Julio E., and Villareal, Noe, La Fotografia Aerea y sus Aplicaciones ("Aerial Photography and Its Applications"), Thesis, University of Panama, School of Geography and History, 1974.

[2]ibid.

[3]Discussion with cartographer Leticia Guardia of the Instituto Geografico Tommy Guardia of Panama, November, 1977.

[4]Slides made from the transparencies in the Map Library of the Instituto Geografico Tommy Guardia.

*Numbers in margin indicate pagination in original foreign text.

mentioned area, this time at a scale of 1:140,000 and 1:212,000, by /2
the Sample Strip and the IAGS.[5]

In August, 1972, the Canal Zone and its environs were covered with images at 1:200,000 by Goodyear Aerospace.[6]

All of these efforts were carried out through contracts with foreign companies; see Figure 3.

In November, 1972, Daedalus Enterprises began a series of flights under contract with the IAGS and the EROS programs in Panama, to collect multispectral data in the Canal Zone and surrounding areas. This was the first time that multispectral and thermal infrared images were taken at low altitude in Panamanian territory. The Daedalous system used its DS-1250 consisting of a scan head with double optical channels equipped with a thermal infrared detector and a 10-channel spectrometer, which provided 11 channels of spectral coverage in the region from 0.38 μm to 14.0 μm.

The processing of the information provided a set of multispectral data with which a new technique of multispectral processing was investigated for the semi-automatic discrimination of objectives and classification of the various features. The results of this study showed that a variety of terrestrial features in the tropical areas can be reliably distinguished and coded in color by the use of these multispectral techniques of differentiation and distribution among channels. The technique uses all solid state analog processors and operates on the data as originally recorded, in such a way that no conversion or digital calculation is necessary, and all of the discriminations shown can be carried out in real time[7]; see Figure 3b.

In 1973, photographs and space images were taken by means of ERTS-1 /3

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[5]Lasso and Villareal, op. cit.

[6]Ibid.

[7]Ory, Thomas R.; Esperimentos de Procesamiento Analogo sobre Datos del Scanner Multiespectral Recogidos en Panama ("Experiments on Analog Processing of data from the Multispectral scanner collected in Panama"), Daedalus Enterprises, Inc., Ann Arbor, Michigan, 1972.

satellite (now renamed Land-satel) is 80% complete; this was accomplished with only nine images (see Figures 4 and 5). At a later date one more image was obtained, so that the entire country was covered with ten images.[8] These images could not be used, owing to excessive cloudiness.

The coverage of the country with Skylab images is 50%; see Figure 6.

II. RECENT APPLICATIONS OF SPACE TECHNOLOGY TO THE STUDY OF THE USE OF NATURAL RESOURCES OF THE EARTH IN PANAMA, 1974-1977.

Owing to the fact that the application of space technology in Panama is so recent, its use has been quite limited. Nevertheless, the development of this technology coincides with the initiation of Panama of natural resource studies in a much more systematized and intensive form. The National Development Plan for 1976-1980 numbers among the purposes and objectives of a plan, "harmony among different regions of the country and the actions taken to develop and integrate them," in such a way that every project for the development of the country has a regional base or is based on a regional study; hence, remote sensing technology is an ideal tool for investigation.

The most noteworthy investigative studies which have made use of this technique in Panama are the following:

1) Program of investigation of Cerro Colorado: mining project.

Gregory Geoscience was given a contract in 1973 to study the area of Cerro Colorado, in the Province of Chiriqui, with ERTS-1 images. The area of copper deposits had been discovered by conventional field methods; so that the use of ERTS-1 technology a posteriori was for the purpose of identifying similar neighboring areas, or similar neighboring geologic areas, based on the photographic characteristics of the area.

[8] Discussion with geographer Noe Villareal, of the Instituto Geografico Tommy Guardia.

under study.

/4

In August, 1973, only four ERTS-1 images relating to the area were sufficiently free of clouds to be analyzed. As the multispectral scanner of ERTS-1 covers information in four bands of the electromagnetic spectrum, there were four black-and-white copies for each image which represented reflectance in the green, red, and two regions of the infrared band. Figure 7 represents the area covered by ERTS-1 used in the study. Frame 1 shows the materials used in the interpretation.

Cloudiness situations, created by local problems of atmospheric interference from clouds [and] from heat and smoke in areas of conflagration, covered a large part of the images to be interpreted, and effectively limited their use. Other technical limitations discovered were the lack of lines between North 75°E and North 135°E.[9]

The interpretative technique[10] used was:

1) Transfer of the information directly from 1:500,000 scale to base maps.

2) Projection of the multispectral scanner bands from 9" x 9" and 70 mm transparencies to 1:100,000 base maps.

3) Stereoscopic and pseudo-stereoscopic examination of 9" x 9" transparencies at a scale of 1:1,000,000 using a Wild ST4 stereoscope and the Zeiss-Jena interpretoscope. Stereoscopic viewing of variable quality was possible for almost all of the area of study owing to the fact that the overlapping orbits of the images were slightly displaced

4) Ex periment with equipment for color weeding* using the Spectral Data Corporation's additive color viewer (the results were negative) and the 1[2]s density slicer.

As a general principle, the tonal and structural information by

[9] Gregory Geoscience Ltd., Analyses of ERTS-1 Images for tne Central Corderilla in the Vicinity of Cerro Colorado, Western Panama, 1974.

[10] - - [Translator's note: Omitted from foreign text].

* [Translator's note: Sp. "ensachamiento" may be misprint for "ensanchimiento" = expansion.]

density slicing and visual discrimination were of little use because of the poor quality of the images and the lack of contrast. The poor definition of contrasts resulting from the mist and smoke eliminated the possibility of spectral contrasts. It was possible to identify the contrasts between the forest and the plains, as a result, Cerro Colorado and Cerro Mogla were identified by the use of spectral contrasts. The 15
structural analysis was based on classification of the linear and curvilinear characteristics identified in the four spectral bands of the image. The area free of clouds was divided into seven segments, with which individual maps were prepared for each segment at a scale of 1:100,000. Other types of analysis carried out have not been divulged.

2) Program of Investigation of Cerro Pando: geothermal project[11].

Starting in 1975, the Corporacion de Desarollo Minero de Panama (Panama Mining Development Corporation) (CODEMIN), has been investigating the existence of geothermal deposits in Cerro Pando. During 1976-1977. these studies were carried out with the participation of the British government, United Nations and the Instituto de Recursos Hidraulicos y de Electrificado [Institute of Water Resources and Electrification] (IRHE).

The studies carried out to investigate the geothermal potential in the area of Cerro Pando have focussed on geological, geochemical, hydrologic, perforation and geophysical activities. The progress in the geological studies is the most noteworthy, since, in the period between October, 1976, and October, 1977, a preliminary geologic map was prepared which covers a surface area of 60,000 hectares, as well as a structural map with data obtained from the stereoscopic study of images of the area and field verifications. See Figure 8.

3) Program of Land Use in the Province of Boca del Toro[12]

This is a first attempt on the part of the Instituto Tommy Guardia to draw up topographic maps of the area of the province of Bocas del Toro without field checking, using Skylab images, (to determine physi-

[11]CODEMIN, Report, October 1976-1977

[12]Discussion with geographer Noe Villareal, of the Instituto Geografico Tommy Guardia.

changes in land use [sic]). This attempt, however, begun in September, 1977, has not been completed; analysis using a multispectral differentiator shows changes in the coastline, growth in villages and changes in cultivated areas. /6

III. EXPECTATIONS FROM THE APPLICATION OF REMOTE SENSING TECHNOLOGY TO THE STUDY OF THE USE OF NATURAL RESOURCES BY THE PANAMANIAN AUTHORITIES.

The Panamanian authorities consider that:

- the technology of remote sensing offers a set of opportunities for investigation which are highly desirable for the plans of national development;

- the various governmental sectors agree in indicating that the Instituto Geografico Tommv Guardia should be the institution responsible for the organization and administration of the use of the technology of remote perfection*;

- for this purpose the Instituto Geografico Tommy Guardia has established a small section whose assignment is to compile and evaluate the pertinent information. It is hoped that in the near future, this section will increase in the resources necessary to establish the principles of application of the technology to the use of natural resources.

- for this reason, the Panamanian government encourages professionals and technicians to attend international seminars and training program[s] so that the projects of national development are carried out by interdisciplinary and interministerial task forces, whose components or members, by virtue of their technical training, are capable of applying whichever technology is the most appropriate on the basis of time, effort, and economy, while giving consideration to the philosophy of national development.

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*Translator's note: Sp. "perfeccion"; probably an error for "percepcion", = sensing.

IV. References

I. Lasso, Julio E., and Villareal, Noe.: La Fotografia Aerea y sus Aplicaciones ("Aerial Photography and its Applications"), Thesis, University of Panama, School of Geography and History, 1974.

2. Ory, Thomas R.: Esperimentos de Procesamiento Alalogo sobre Datos del Scanner Multiespectral Recogidos en Panama ("Experiments on Analog Processing of Data from the Multispectral Scanner Collected In Panama"), Daedalus Enterprises, Inc., Ann Arbor, Michigan, 1972.

3. Gregory Geoscience Limited, Analyses of ERTS-1 Images for the Central Corderilla in the Vicinity of Cerro Colorado, Western Panama, 1974.

4. CODEMIN, Report, October 1976-October, 1977.