Environmental Monitoring in East Asia

ENVIRONMENTAL MONITORING IN EAST ASIA

PROJECT NUMBER 11691147

REPORT OF RESEARCH PROJECT
– GRANT-IN-AID FOR SCIENTIFIC RESEARCH –

Grant-in-Aid for Scientific Research (B)(2)
April 1999 - March 2002

Edited by

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ENVIRONMENTAL MONITORING IN EAST ASIA

人工衛星の利用と現地植生調査による日韓中の環境測定と検討

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Contents

Preface

Forests play an important role in keeping environmental conditions suitable for life on earth. Even though vegetation varies largely in spatial and temporal scales, there are signs of rapid degradation in East Asia due to human activity and which affect the local climate. International collaboration in the EMEA (Environmental Monitoring in East Asia) project has been designed to promote cooperation in vegetation research with a particular focus on remote sensing and field research. It started in April 1999 and was conceived to last for a total of 3 years.

Remote sensing is widely used for the monitoring of forests, and the visible and near-infrared reflectance are commonly used for the identification and characterization of the vegetation. The reflectance data obtained at higher altitudes is some kind of average over a certain extension of area, but the atmosphere that lies between the sensor and the object affects the data. Therefore, in the interpretation of the remote sensing data, knowing the difference between the data obtained at different scales and distances is important.

This experiment was designed to determine the relationship between ground data and the estimate from satellite data. Test sites for remote sensing of trees and grass were located in Japan and China. Spectral data from Landsat, NOAA and a portable spectrometer have been used.

An International Symposium on Environmental Monitoring in East Asia was held every year. The symposium focused on giving an overview of current trends in environmental research and discussing recent scientific activities in East Asia. In these areas, we are facing problems of large-scale deforestation, and no immediate solutions have been proposed. In the midst of it, it was an opportunity for researchers from China, Korea and Japan to get together and discuss these issues.

20 March 2002

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Project

CATEGORY : Grant-in-Aid for Scientific Research (B) (2)

TERM OF PROJECT : April 1999 – March 2002

PROJECT NUMBER : 11691147

TITLE OF PROJECT : Environmental Monitoring in East Asia

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Outline

Forests cover large areas of the land surface. To consistently and repeatedly monitor forests over these large areas, it is desirable to use remote sensing data and automated analyzing techniques. While satellite imagery contains useful data about forest conditions, it is emphasized that field work remains essential when applying remote sensing techniques.

International collaboration in the EMEA project has been designed to promote cooperation in vegetation research with a particular focus on the remote sensing and field research.

1 Field works

In this research, spectral reflectance in the solar spectrum was measured synchronously and compared using different platforms: near ground, aerial and satellite. Spectral reflectance of ground vegetation was measured between 350 and 1050 nm using a portable spectrometer. Test sites for remote sensing of trees and grass were located in Japan and in China. Data from Landsat, NOAA and a spectrometer were used in this project.

1.1 Japan

We measured the spectra of trees at three different distances and scales:

1) individual leaves,

2) part of a tree seen from a distance of 40 m,

3) mixture of several different trees seen from a helicopter,

and investigated what affects the data during the scaling up of the measurements.

1.2 China

We measured two different types of vegetation in Inner-Mongolia: grass and trees. Using a portable spectrometer, a digital video camera, and an infrared CCD camera, reflectance of the major plant species was measured from different distances (0.1 m, 1 m, 100 m, and 1000 m).

2 Analysis of vegetation change using satellite data

Vegetation in forest is influenced by both elevation and topographical features. Especially in mountain areas this is clearly seen. However, it is very difficult to conduct field work in such areas. Therefore the research of forest vegetation activity by multispectral data from satellite has become necessary. Temporal changes of forest activity around Mt. Hakusan related to slope direction was analyzed using Landsat TM data.

3 Meetings

The main objective of the meeting was to discuss and present new results, as well as make plans for future work. The venues of the meetings have been as follows:

- 20 September 1999 at Chinese Academy of Sciences (China)
- 19 October 1999 at Kanazawa University (Japan)
- 6 - 7 January 2000 at Forestry Research Institute (Korea)
- 20 May 2000 at Chinese Academy of Sciences (China)
- 22 May 2000 at Chinese Academy of Forestry (China)
- 30 July 2000 at Kanazawa University (Japan)
- 9 -10 January 2001 at Forestry Research Institute (Korea)
- 18 June 2001 at Chinese Academy of Sciences (China)
- 24 September 2001 at Kanazawa University (Japan)

Meeting in Kanazawa (19 October 1999).

Meeting in Kanazawa (30 July 2000).

Meeting in Beijing (18 June 2001).

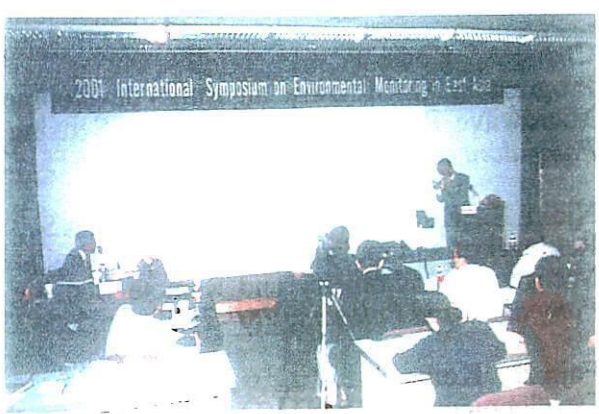
4 Symposiums

An International Symposium on Environmental Monitoring in East Asia was held every year. The symposium aimed to give an overview of current trends in environmental research and to discuss recent scientific activities in this field. The symposiums were opened to anyone interested in environmental issues, whether or not connected with a member of the EMEA project. The venues of the symposiums have been as follows:

- 20 - 21 October 1999 in Kanazawa (Japan)
- 31 July - 2 August 2000 in Kanazawa (Japan)
- 19 – 20 June 2001 in Beijing (China)
- 25 – 27 September 2001 in Kanazawa (Japan)

Symposium in Kanazawa (20 October 1999).

Symposium in Kanazawa (1 August 2000).



Symposium in Beijing (19 June 2001).

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Field Survey in Inner Mongolia

In late May 2000 and in late June 2001, we visited Hailar City. Fig. 1 shows a map of inner Mongolia. Hailar City is surrounded by hills on three sides, and situated at the converging point of the Greater Hinggan Mountains and the Mongolian highland. The Yumin River and the Hailar River flow across the vast Hulunboir prairie at the foot of the magnificent Hinggan mountains. Although riparian forests spread along rivers and many mono-cultural plantations such as poplar, birch, pine, and larch are scattered in the area east of Hailar, the vegetation is relatively simple and changing gradually from desert to step, step to grassland, grassland to forest along with the precipitation gradient from west to east.

We selected two major sites for observation: they are grasslands and forests. Using a spectrometer, a digital CCD camera, and an infrared video camera, reflectance of the major plant species was measured from different distances (0.1 m, 1 m, 100 m, and 300 m) at the sites. Detailed analysis of reflectance data will be finished by the end of 2002.

Photographs 1 - 3 show scenes of field research in Inner Mongolia.

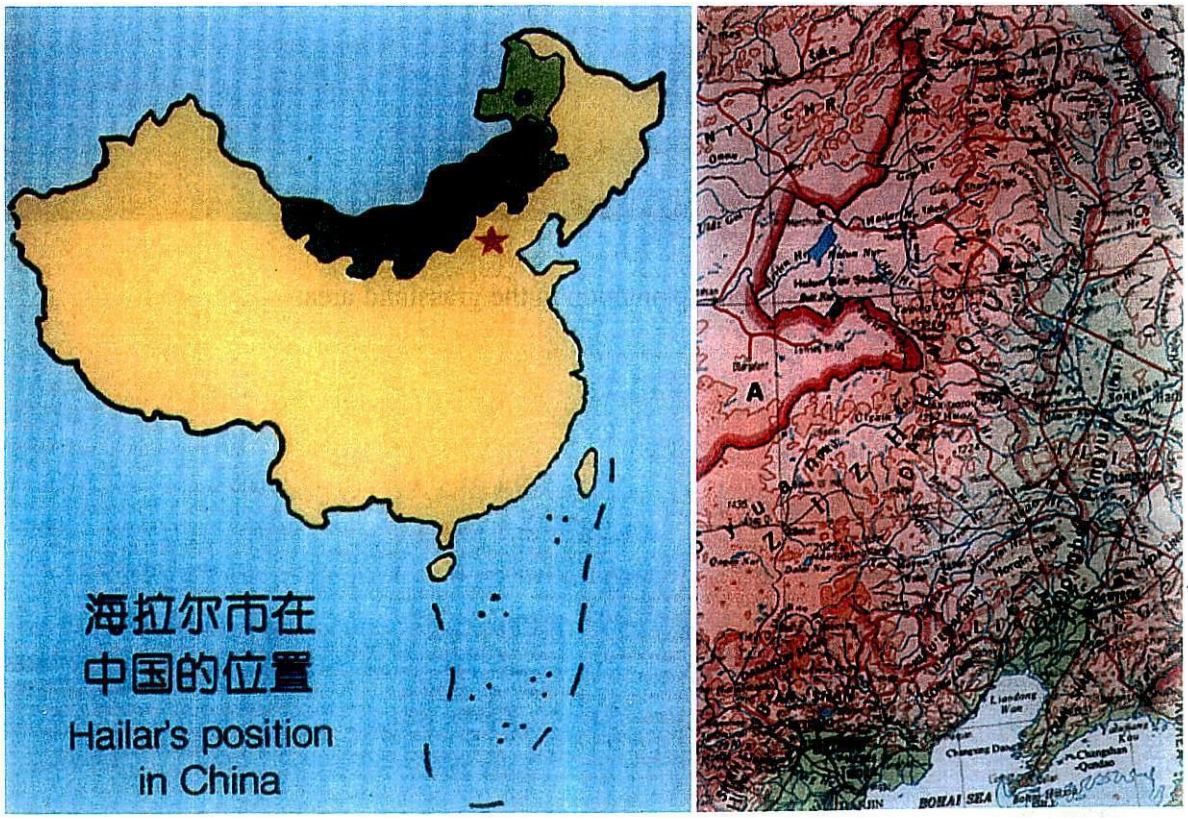

Fig. 1. Map of Inner Mongolia.

Photo 1. Simultaneous data acquisition using a spectrometer, a digital CCD camera, and an infrared video camera.

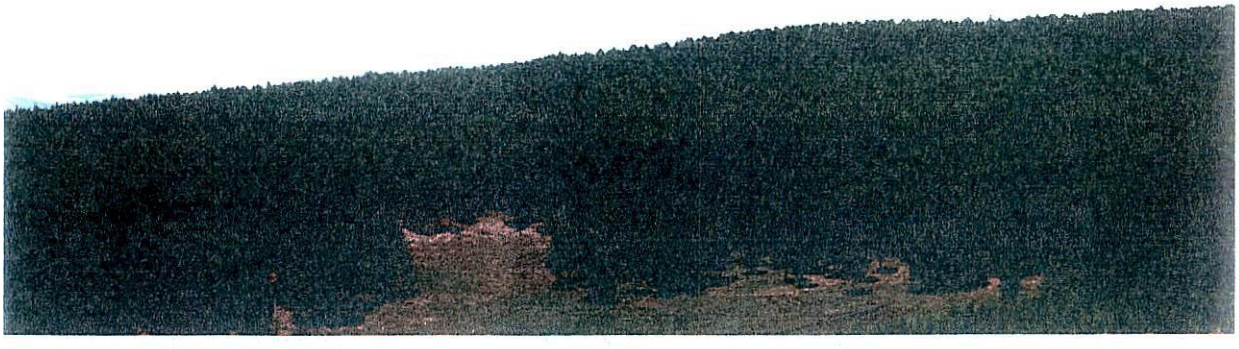

Photo 2. Pine plantation in the grassland area.

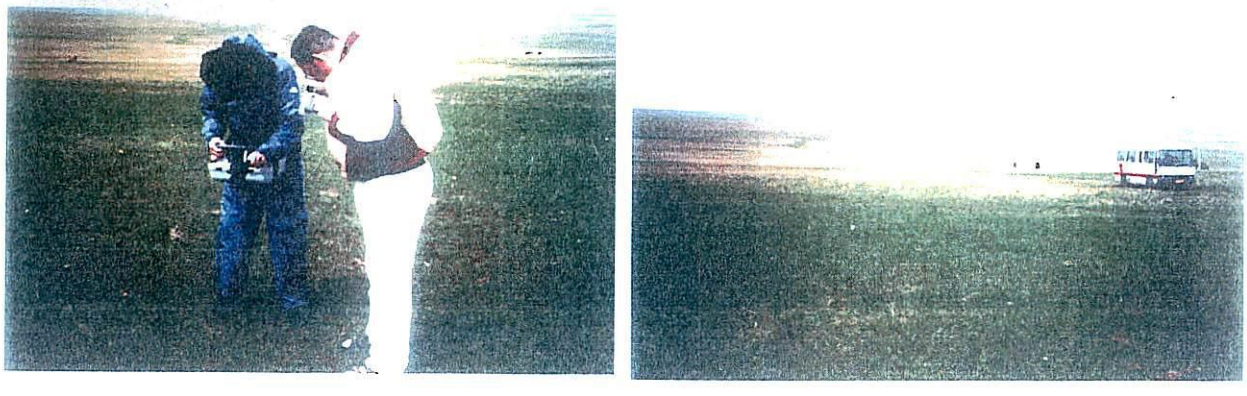

Photo 3. Grassland.

The visible and near-infrared reflectance are commonly used for the identification and characterization of the vegetation. The reflectance data obtained at higher altitudes is a kind of average over a certain extension of area. Therefore, in the interpretation of the remote sensing data, knowing the differences between the data obtained at different scales and distances is important. Fig. 2 presents the outline of simultaneous satellite, airborne and on site measurements. Vegetation spectra was measured at visible and infra-red bands at different altitudes. The Landsat TM instrument collects data with a surface resolution of 30 m over the site. The helicopter hovers above the site at an altitude from 150 to 300 m and acquires radiometric and image data. The tower is a platform to set up various instruments for close range observations. The goal of this experiment is to perform all measurements simultaneously when the Landsat satellite flies over the area.

The higher resolution of the aerial photograph as compared to the lower spatial resolution of the satellite imagery, provides additional elements, such as size, shape, structure of smaller details such as crowns and parts of tree crowns, which can be essential for recognition and measurements.

Fig. 3a shows a visual satellite image around the center of Kanazawa city. Two circles show the Kenrokuen garden, and Kakuma campus of Kanazawa University. Fig. 3b shows vegetation activity (NDVI) calculated using satellite data. Although there is little vegetation around the center of Kanazawa city, Kenrokuen garden is covered by green vegetation. On the other hand, though mountainous area is covered by green vegetation, there are few forests at Kakuma campus of Kanazawa University. Fig. 4 shows the same areas photographed from helicopter. From this observation distance, individual trees in each area can easily be distinguished. The general relocation plan of Kanazawa University to Kakuma area is now continuing, which is seen as a large construction area depleted of vegetation.

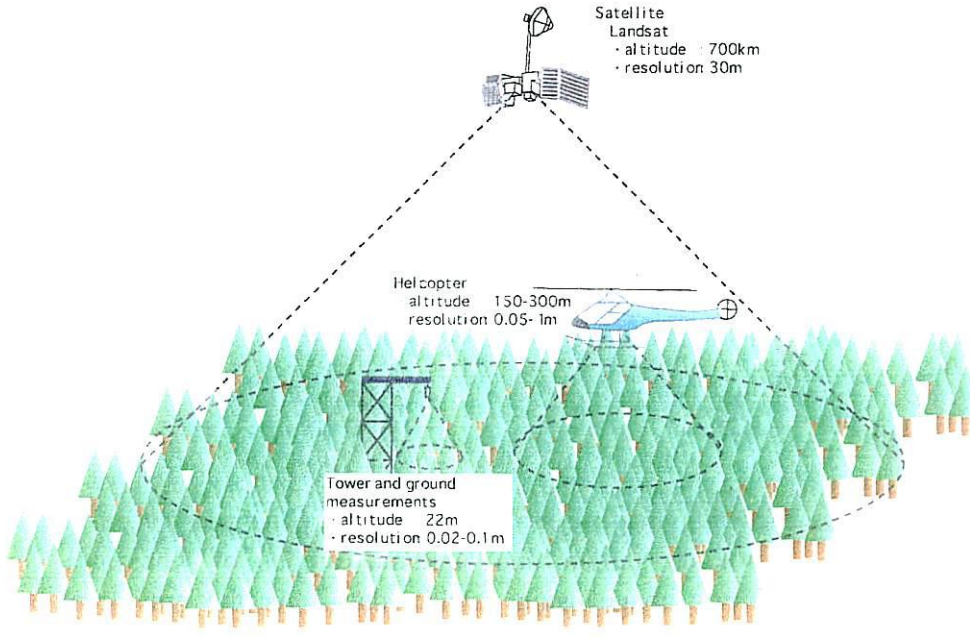

Fig. 2. Outline of simultaneous satellite, airborne and on site measurements. Vegetation spectra was measured at visible and infra-red bands at different altitudes.

a Visible band image

b NDVI Image

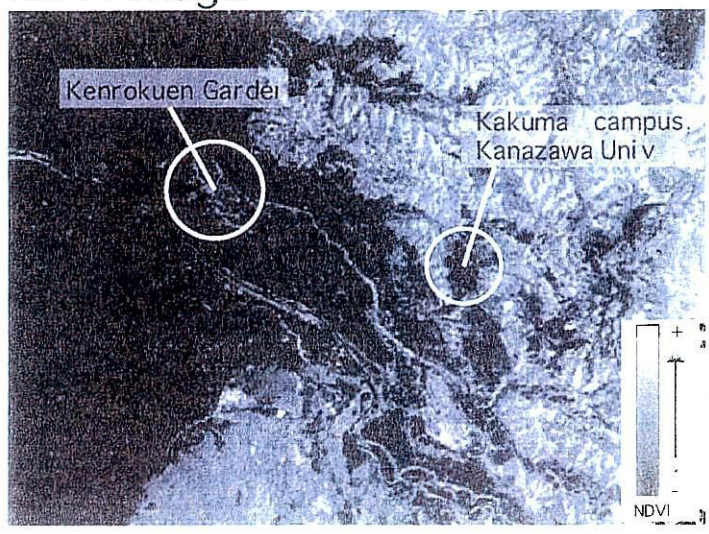

Fig. 3. (a) A visual satellite image around the center of Kanazawa city in May 2000. The two circles show the Kenrokuen garden, and Kakuma campus of Kanazawa University. (b) Vegetation activity (NDVI) image using satellite data. As the gray level becomes lighter, vegetation activity increases.

a b

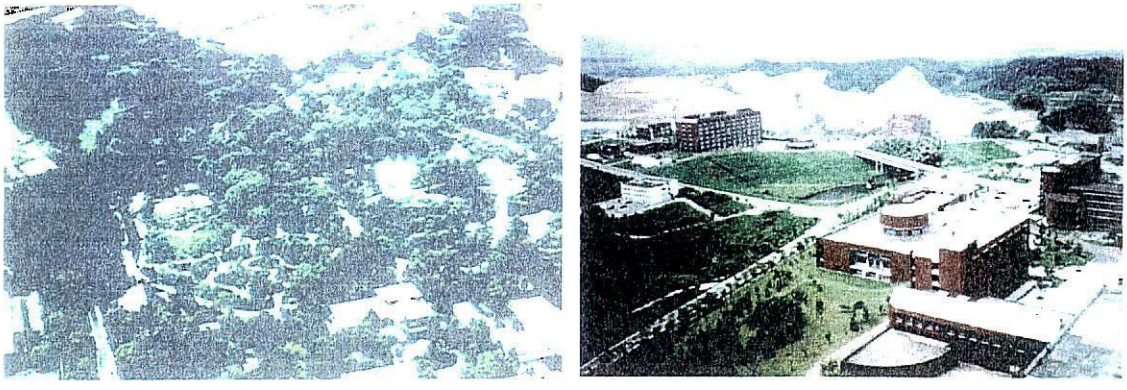

Fig. 4. The same areas photographed from helicopter in August 2000.
(a) The Kenrokuen garden. (b) Kakuma campus of Kanazawa University.

Different data sources, like land survey, aerial photography and satellite imagery can be used depending on the level of detail required and the extension of the area under study. However, there still seem to be gaps in the application of remote sensing techniques for forest monitoring. We can say that this project contributes to be a better understanding of the use of remote sensing imagery for forest monitoring.

Fig. 5. Monitoring of vegetation from a helicopter.

Contents of Proceedings