

## UNDERSTANDING AND TEACHING FOR REGIONAL DIFFERENCES OF AGRICULTURE USING SATELLITE DATA

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### Commission VI

**KEY WORDS:** Agriculture Field, Regional Difference, Paddy Field, Field Size, Remote Sensing

### ABSTRACT:

Remote Sensing Laboratory, Field Science Center, Graduate School of Agriculture Science, Tohoku University starts at April 2004. For studies and education at the laboratory we are now developing the system of remote sensing and GIS. Our system consists of ordinary PCs, one digitizer and one color laser printer. The PCs are assembled by us for the optimal performance and the low cost. Gigabit LAN connects each PC, and one PC is used as file server to store common data such as maps, remote sensing images and GIS data. The file server has RAID system for safety storage from HD trouble. We use ARC/GIS as GIS software and many kinds of Remote Sensing software such as, ERDAS/Imagine, ENVI, eCognition, PG-Steamer and SILCAST. Using the developing system, we are understanding and teaching for regional differences of agriculture with the interpretation of satellite data analysis. Earth Remote Sensing Data Analysis Center (ERSDAC) made the Home Pages of Terra/ASTER Image Web Library 3 "The Major Airport of the World." [http://www.Ersdac.or.jp/ASTERimage3/library\\_E.html](http://www.Ersdac.or.jp/ASTERimage3/library_E.html). First, we check the Airport Data to use agricultural understanding for the world. Almost major airport is located in rural area and surrounded with agriculture field. To survey the agriculture field adjacent to the major airport has almost the same condition of human activities. The images are same size and display about 18km X 14km. We can easily understand field size and surrounding conditions. We study seven airports as follows, 1. Tokyo Narita Airport (NRT), Japan, 2. Taipei Chiang kai Shek International Airport (TPE), Taiwan, 3. Bangkok International Airport (BKK), Thailand, 4. Riyadh King Khalid International Airport (RUH), Saudi Arabia, 5. Charles de Gaulle Airport (CDG), Paris, France, 6. Vienna International Airport (VIE), Austria, 7. Denver International Airport (DEN), CO, USA. At the area of Tokyo Narita Airport, there are many golf courses, big urban area and small size of agricultural fields. At Taipei Airport area are almost same as Tokyo Narita Airport area and there are many ponds for irrigations. Bangkok Airport area also has golf courses and many ponds for irrigation water. Riyadh Airport area is quite different from others, and there are large bare soils and small agriculture fields with irrigation and circle shape. Paris Airport area and Vienna Airport area are almost agricultural fields and there are vegetated field and bare soil fields because of crop rotation. Denver Airport area consists of almost agriculture fields and each field size is very large. The advantages of ASTER data are as follows, 1. High-resolution and large swath, 2. Large wavelength and many bands, 3. High-level of geographical location, 4. Stereo pair images, 5. High performance data searching system, 6. High speed data delivery system, 7. Cheap price, 8. Seven years observation and large volume archive. A kind of project "Determination of Local Characteristics at Global Agriculture Using Archive ASTER Data" was started at middle of November 2005. We establish data processing system and get some results. Paddy rice fields analysis was started at first, we analyze 1) the Shonai Plains in Japan, 2) the Yangtze River delta in Middle-East China, 3) Mekong Delta in South Vietnam, 4) North-east Thai Plains, Thailand, 5) Sacramento Valley, California, USA. The results of this studies are as follows, 1) Using ASTER images, we can easily understand agricultural characteristics of each local area. 2) ASTER data are high accuracy for location, and the accuracy is suitable for global study without the fine topographical maps, 3) By five years observation of ASTER, there is huge numbers of ASTER scenes, but not enough volumes for cloud free data for seasonal analysis. It means that follow-on program of ASTER is necessary, 4) We need not only paddy field, but also all crop fields and all area, 5) The studies are necessary to international corroboration.

### 1. INTRODUCTION

Recently, the importance of terrestrial and marine field sciences might be realized in many countries including Japan, and remote sensing and GIS are powerful tools for the study. For this reason, Remote Sensing Laboratory, Field Science Center, Graduate School of Agriculture Science, Tohoku University in Japan started at April 2004, and at the time, there was nothing about Remote Sensing and Geographical Information System (GIS) tools [1]. First, we developed analytical system for the remote sensing and GIS using hand made PCs at the lowest cost.

In 1983, Dr. Joji IISAKA etc. published the beautiful color book named "World Agricultural Surveyed from Space" using LANDSAT/MSS images. Unfortunately it was written in Japanese, if it had been written in English, it would be the famous book in the world. More than 20 years from the publication, we hope to renew the book using Terra/ASTER data. ERSDAC made the HP of ASTER Image Web Library 3 "The Major Airport of the World." [http://www.Ersdac.or.jp/ASTERimage3/library\\_E.html](http://www.Ersdac.or.jp/ASTERimage3/library_E.html). Next, we check the Airport Data to use agricultural understanding for the world; At last we used Archive ASTER Data and analyzed the data for the purpose.

## 2. DEVELOPMENTS REMOTE SENSING SYSTEM USING GIS

For studies and educations at the laboratory, we developed the system of remote sensing and GIS. Our system consists of hand made PCs, one digitizer, one color laser printer and one scanner, and outline is listed Fig. 1. We assemble the PCs for the optimal performance and the lowest cost. A gigabit LAN connects each PC, and one PC is used for file server to store common data such as maps, remote sensing images, and GIS data. The file server has RAID system for safety storage from HD trouble. Main-use software is ArcGIS and ERDAS/Imagine and we use them jointly with floating licenses. Multi-Spec, eCognition, PG-Steamer of remote sensing software were already installed on some PCs and we hope some more software such as ENVI and ER-Mapper will be installed.

Our System has seven desktop PCs and two laptop PCs that connected Gigabit LAN using Hub in our room and 100-mega bps LAN to outside. Each desktop PC has 1.8 – 2.8 GHz CPU, 1 – 2 GB random access memory, high performance graphic board, and 100-200 GB hard disk. Our laboratory has two staffs, eight students, and some visitor scientists and/or students. Four desktop PCs were almost personal use; and these PCs can use Erdas/Imagine and ARC/GIS by floating license system. One desktop PC is a data server using RAID system and two desktop PCs for the use of more difficult analysis of remote sensing and GIS with high level performance and special analysis software, and manages the floating license.

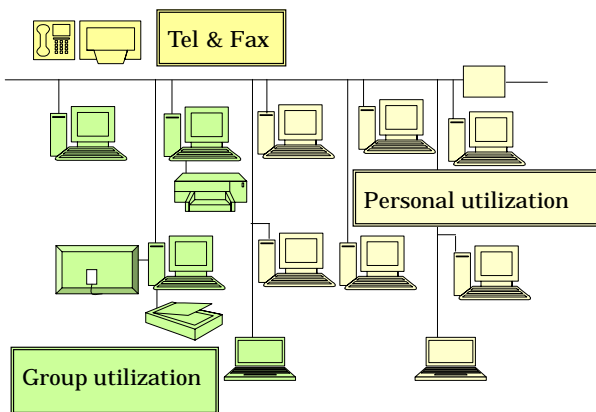


Fig. 1 Developing system of Remote Sensing Laboratory, Field Science Center, Graduate School of Agriculture Science, Tohoku University

## 3. AGRICULTURAL UNDERSTANDING FOR THE WORLD USING “THE MAJOR AIRPORT OF THE WORLD

Presently, remote sensing applications for agriculture are progressing and two books were published in Japan and Greek (Remote Sensing Society of Japan, 2003, and OECD, 2004). We would like to promote the interest in understanding agriculture using remote sensing techniques. ERSDAC made the Home Pages of Terra/ASTER Image for major airport is located in rural area and surrounding agriculture field. To survey the agriculture field adjacent to the major airport is almost the same condition of human activities.

The images are same size and display about 18km X 14km. We can easily understand field size and surrounding conditions.

1. Tokyo Narita Airport (NRT), Japan
2. Taipei Chiang kai Shek International Airport (TPE), Taiwan
3. Bangkok International Airport (BKK), Thailand
4. Riyadh King Khalid International Airport (RUH), Saudi Arabia
5. Charles de Gaulle Airport (CDG), Paris, France
6. Vienna International Airport (VIE), Austria
7. Denver International Airport (DEN), CO, USA

At the area of Tokyo Narita Airport, there are many golf courses, big urban area, and small size of agricultural fields. At Taipei Airport area are almost same as Tokyo Narita Airport area and there are many ponds for irrigations. Bangkok Airport area also has golf courses and many ponds for irrigation water. Riyadh Airport area is quite different from others, and there are large bare soils and small agriculture fields with irrigation and circle shape. Paris Airport area and Vienna Airport area are almost agricultural fields and there are vegetated field and bare soil fields because of crop rotation. Denver Airport area consists of almost agriculture fields and each field sizes are very large.



Fig. 2 ASTER images of main international airport made by ERSDAC

- Upper: Tokyo Narita Airport (NRT), Japan  
 Lower: Denver International Airport (DEN), CO, USA

#### 4. IMAGE INTERPRETATION OF ARCHIVE ASTER DATA

We want to more precision understanding of the local characteristics using ASTER data. First we check the advantages of ASTER data, and the results are as follows,

1. High-resolution and the large swath
2. Large wavelength and many bands
3. High-level of geographical location
4. Stereo pair images
5. High performance data searching system
6. High speed data delivery system
7. Cheap price
8. Large volume archive by seven years observation

A kind of project “Determination of Local Characteristics at Global Agriculture Using Archive ASTER Data” was started at middle of November 2005. We establish data processing system and get some results. The procedure is listed in Fig. 3. At first, we survey target and request the data at level 1A data for analyses using ASTER Ground Data System (GDS). Next, The level 1 data are processed to ortho image of ENVI format with UTM coordination and made to Digital Elevation Model (DEM). At last, we use the data for understanding localities of agriculture using package software such as ENVI, Erdas/Imagine, and PG-Steamer.

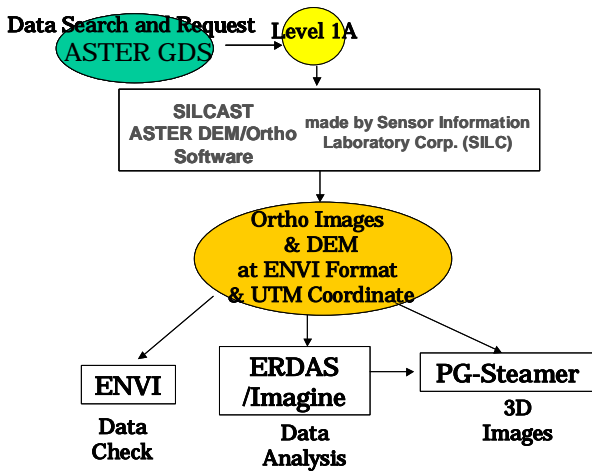


Fig. 4 Data processing procedure and using software

Paddy rice fields analysis was started at first, we analyze four areas in Asia and one area in America, as follows;

- 1) The Shonai Plains in Japan,
- 2) The Yangtze River delta in Middle-East China,
- 3) Mekong Delta in South Vietnam,
- 4) North-east Thai Plaines, Thailand,
- 5) Sacramento Valley, California, USA.

The results of the Shonai Plains in Japan are listed in Fig. 5, and that of Sacramento (Central) Valley, California, USA are listed in Fig.6. We perform almost same procedure to Yangtze River delta in Middle-East China, Mekong Delta in South Vietnam, and North-east Thai Plaines, Thailand. The results of five areas are listed in Table 1.

The Shonai Plains is typical paddy fields area in Japan, and has well-developed irrigation and drainage systems. The

Yangtze River delta in Middle-East China is the famous paddy

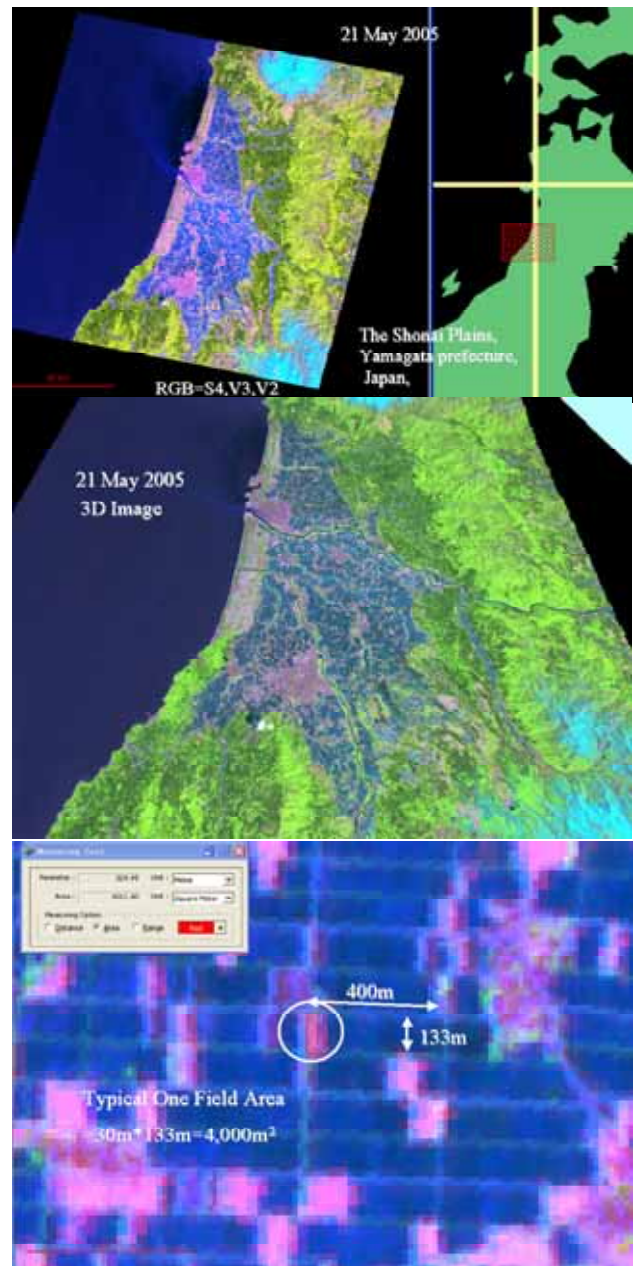


Fig. 5 Paddy fields of the Shonai Plains in Japan

Upper: Total scene of ASTER data and the map of location

Middle: 3D image of the Shonai Plains

Lower: Field size of the Plains

fields area at global. The area of Mekong Delta in South Vietnam and Northeast Thai Plaines are famous to produce exporting rice. At the area, there is enough temperature, but limitation of rice growth is water. Northeast Thai Plaines have severe dry season, and at the season, rice cannot grow. Mekong Delta area is attached South China Sea and has a big river. At the area, rice grows not only in rainy season but also dry season. Sacramento Valley, California, USA is also very famous commercial rice producing area. At the area each paddy field size is almost ten times larger than Japanese large paddy field. We can easily understand that it is very difficult to make the rice at same cost in Japan and USA.

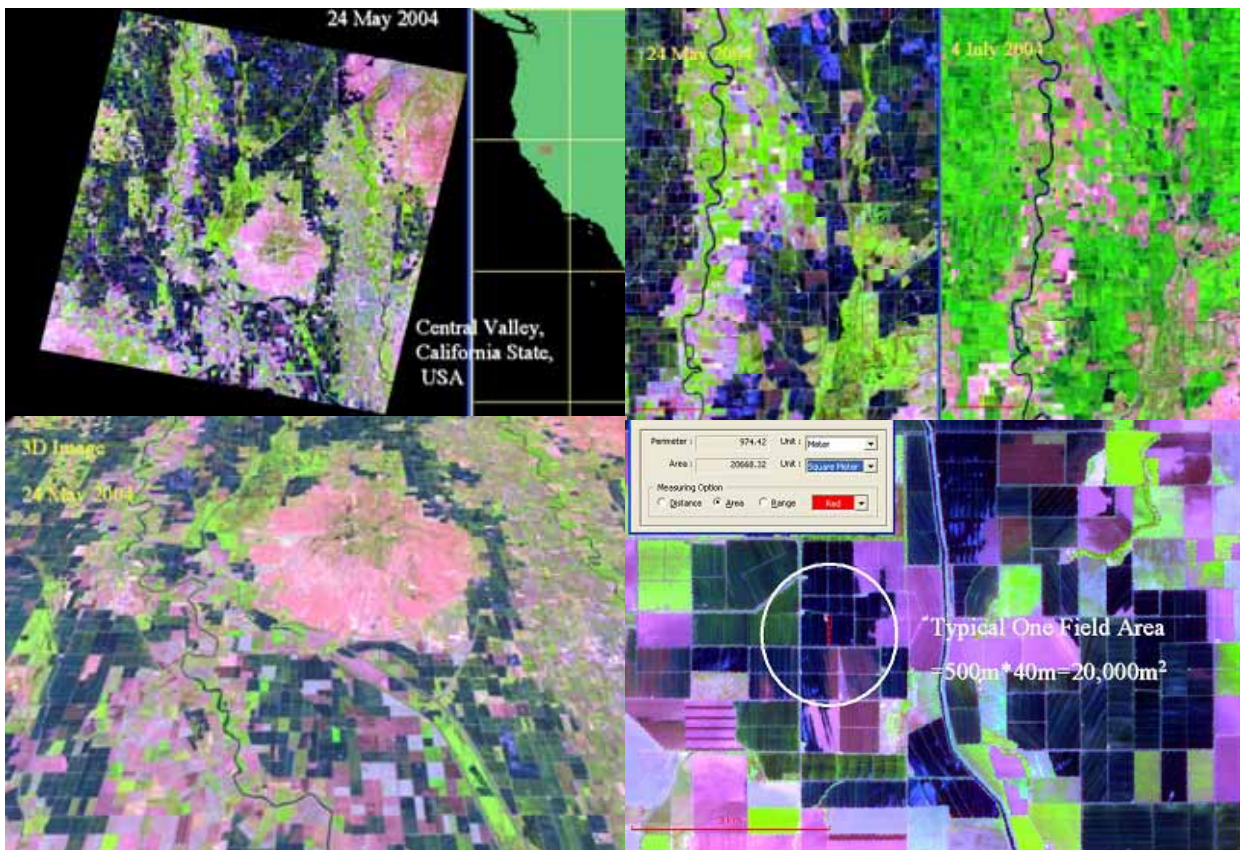


Fig. 6 Paddy fields of the Sacramento Valley, California, USA

Upper left: Total scene of ASTER data and the map of location  
 Upper right: The images of in May and July  
 Lower left: 3D image of the Valley, California, USA  
 Lower right: Field size of the valley

Table 1 Characteristics of Each Paddy Field

	Regional Topography	Growing Season	Field Size	Field Shape
Shonai, Japan	Mountainous	Summer	Middle	All Rectangle
MW-China China	Almost Flat	Summer	Middle	Half Irregular Half Rectangle
NE-Thai, Thailand	Very Flat	Rainy	Small	Almost Irregular Same Rectangle
Mekong Delta, Vietnam	Very Flat	Rainy	Mainly Small Minority Large	Rectangle
California USA	Almost Flat	Summer	Large	Almost Rectangle Same Irregular

### 5. CONCLUSIONS

The study of “Determination of Local Characteristics at Global Agriculture Using Archive ASTER Data” is developing and we have some results until now. The conclusions of the study at now are as follows,

- 1) Using ASTER images, we can easily understand agricultural characteristics of each local area.
- 2) ASTER data are high accuracy for location, and the accuracy is suitable for global study without the fine topographical maps.
- 3) By five years observation of ASTER, there is huge numbers of ASTER scenes, but not enough volumes for cloud free data for seasonal analysis. It means that follow-on program of ASTER is necessary.
- 4) We need not only paddy field, but also all crop fields and all area.
- 5) The studies are necessary to international corroboration.

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