

**HANDBOOK for detecting  
land cover changes  
with Landsat data archive**

**Jan 2011**

**Northwest Pacific Region  
Environmental Cooperation Center**

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## 1. Introduction

This HANDBOOK for detecting land cover changes with LANDSAT data archive (hereinafter referred to as “the handbook”) introduces procedures of detecting land cover changes with Landsat satellite imagery. Examples in Toyama Bay will be introduced in the handbook.

United States Geological Survey (USGS) announced on April 21, 2008 that they would provide all LANDSAT data archive for free, and it is possible to download any data for free from several websites including USGS.

There are many softwares for remote sensing data analysis that work under different operating systems. MultiSpec is the most commonly used software and it is a free software. There are no specific restrictions for its public use, and there are Windows and Macintosh version available.

In the following chapters, how to use MultiSpec for LANDSAT data analysis is introduced with examples.

## 2. Obtaining Landsat data

### 2.1 Websites for satellite data

Websites to download free LANDSAT data are shown in table 2.1-1.

table 2.1-1 List of websites to download free LANDSAT data

Websites	Data Providing Organization	URL
Global Visualization Viewer	USGS* <sup>1</sup>	<a href="http://glovis.usgs.gov/">http://glovis.usgs.gov/</a>
EarthExplorer	USGS	<a href="http://edcsns17.cr.usgs.gov/EarthExplorer/">http://edcsns17.cr.usgs.gov/EarthExplorer/</a>
New EarthExplorer	USGS	<a href="http://edcsns17.cr.usgs.gov/NewEarthExplorer/">http://edcsns17.cr.usgs.gov/NewEarthExplorer/</a>
Earth Science Data Interface	UMD* <sup>2</sup>	<a href="http://glcfapp.glc.f.umd.edu:8080/esdi/index.jsp">http://glcfapp.glc.f.umd.edu:8080/esdi/index.jsp</a>
Satellite Image Data Base(SIDaB)	MAFFIN* <sup>3</sup>	<a href="http://rms1.agsearch.agropedia.affrc.go.jp/sidab/index-ja.html">http://rms1.agsearch.agropedia.affrc.go.jp/sidab/index-ja.html</a>

\*<sup>1</sup> USGS: United States Geological Survey

\*<sup>2</sup> UMD: University of Maryland

\*<sup>3</sup> MAFFIN : Ministry of Agriculture Forestry and Fisheries Research Network

For image search for Toyama Bay area for 1972-2010 by websites above, the following results are shown (Chart 2.1-2). Since both Global Visualization Viewer and EarthExplorer provide the most data, this handbook will use EarthExplorer in the following chapter.

Table 2.1-2 Number of available LANDSAT images to cover Toyama Bay area in 1972-2010. Images with less than 50 % of cloud cover were searched.

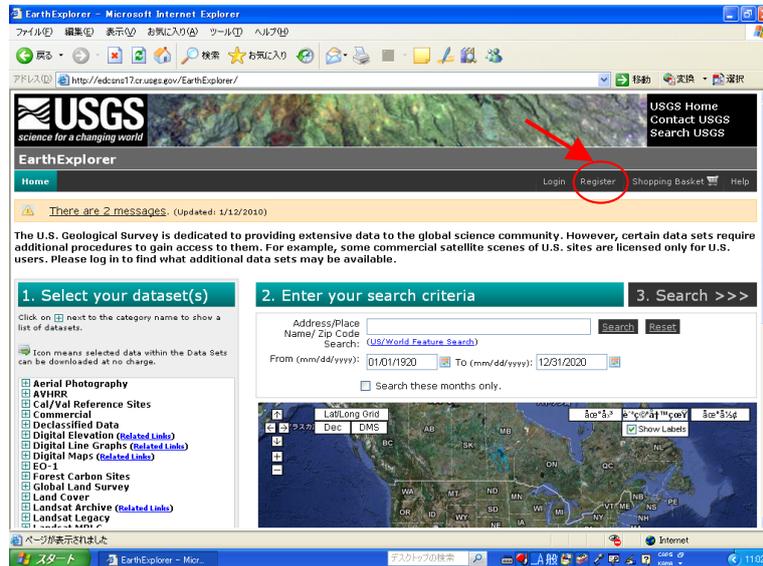
Websites	Sensor name	MSS WRS-1 path/row : 117/35	TM	ETM+ SLC-on
		WRS-2 path/row : 109/35		
Global Visualization Viewer		11	2	27
EarthExplorer		11	2	27
New EarthExplorer		1	1	1
Earth Science Data Interface		-	3	3
Satellite Image Data Base(SIDaB)		-	3	3

## 2.2 How to search Landsat data

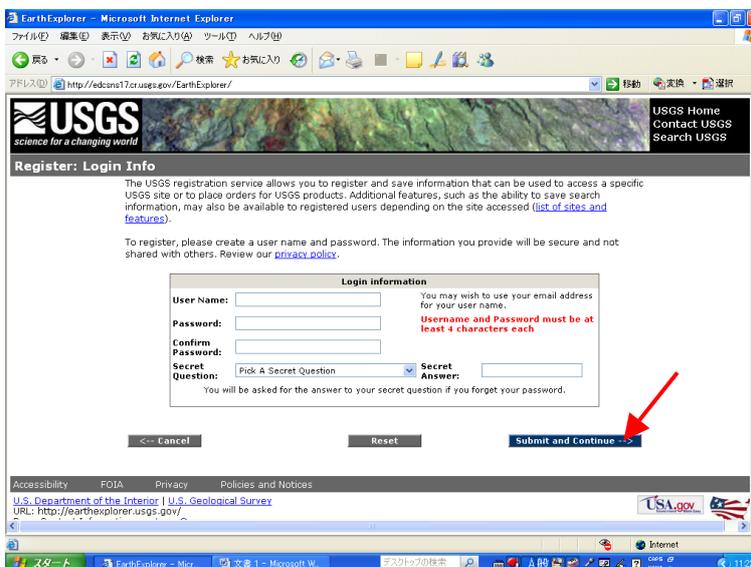
### 2.2.1. User registration

It is required to complete user registration to download Landsat data for free from USGS website. User registration is not necessary for image browsing. Steps for user registration are as follows:

- (1) Open the USGS website (<http://edcns17.cr.usgs.gov/EarthExplorer/>) and click “Register” (See the image below).



- (2) Enter your e-mail address and password.



User name --- Enter your e-mail address

Password --- Create password

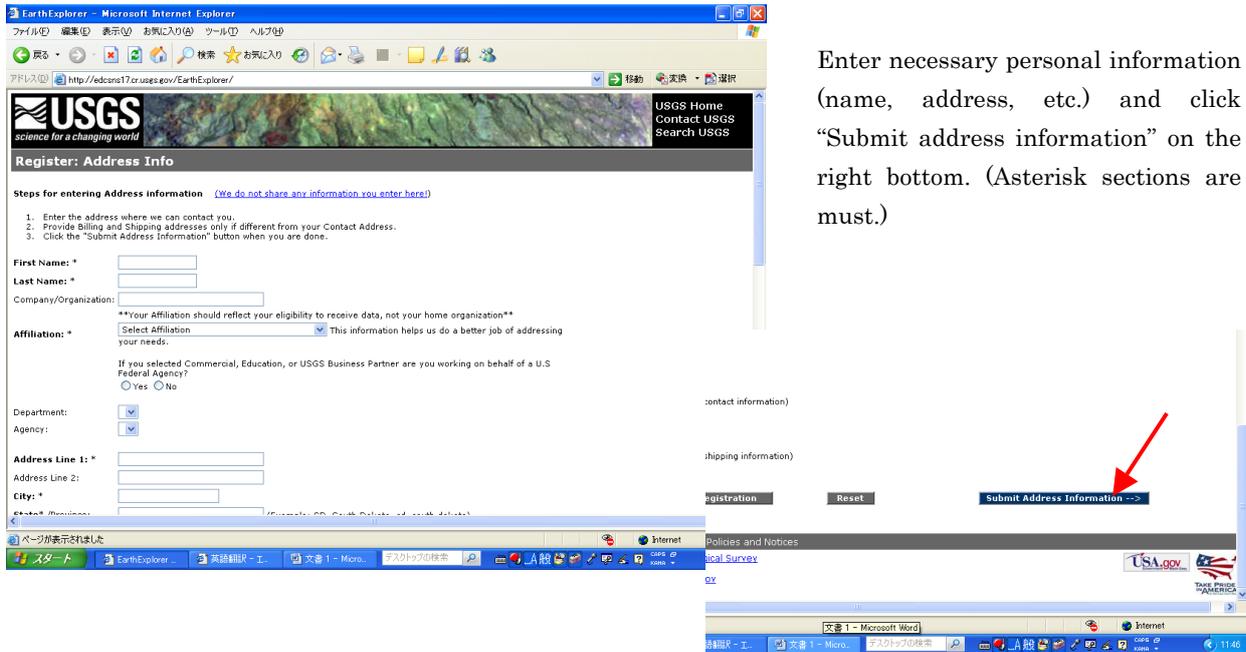
Password Confirmation --- Enter the same pass word

Secret Question --- Select a secret question to retrieve the password when forgotten

Secret Answer --- Enter the answer for your secret question

After filling in all sections, click “Submit and continue”.

(3) Enter your personal information.



Enter necessary personal information (name, address, etc.) and click “Submit address information” on the right bottom. (Asterisk sections are must.)

When “Thank you, you have successfully registered!” is shown on the screen, user registration is completed.

## 2.2.2. Searching for Landsat data

Landsat data search takes the following steps:

- Open the USGS website (<http://edcscns17.cr.usgs.gov/EarthExplorer/>),
- Login as with your username and password Follow the following 1 to 3 sequences.  
1.Select your dataset(s)-> 2.Enter your search criteria-> 3.Search>>>

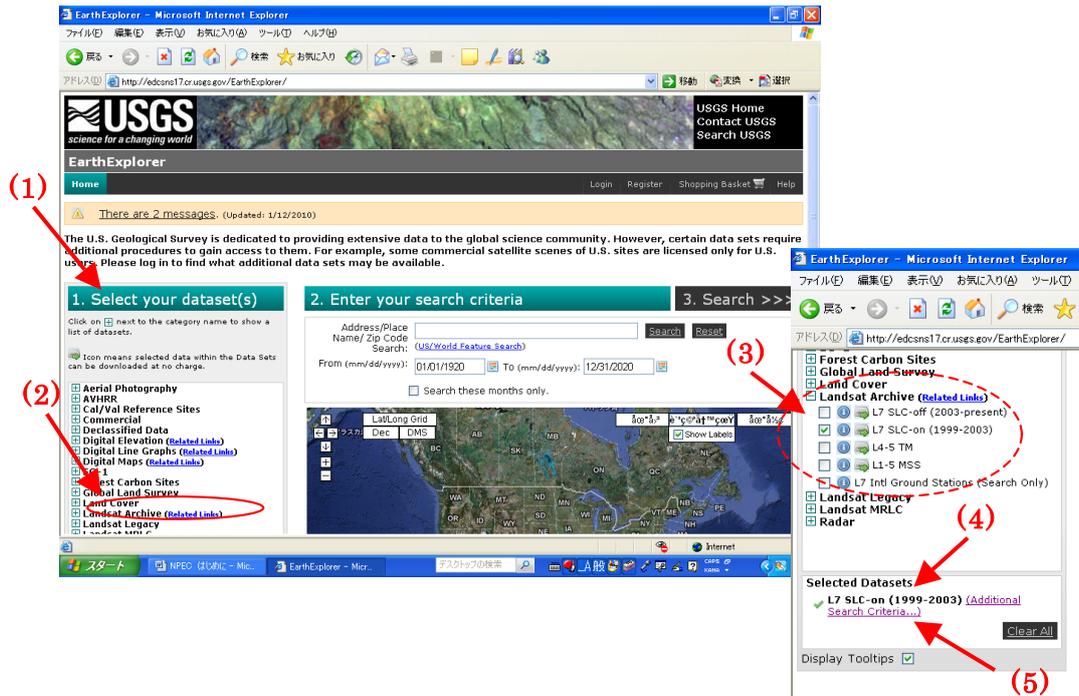
(1) In the “1. Select your dataset(s)” section, a list of satellite data is shown (See No. 1 in the image below).

(2) Click “+” in LANDSAT Archive, then more detailed classifications are shown (No. 2).

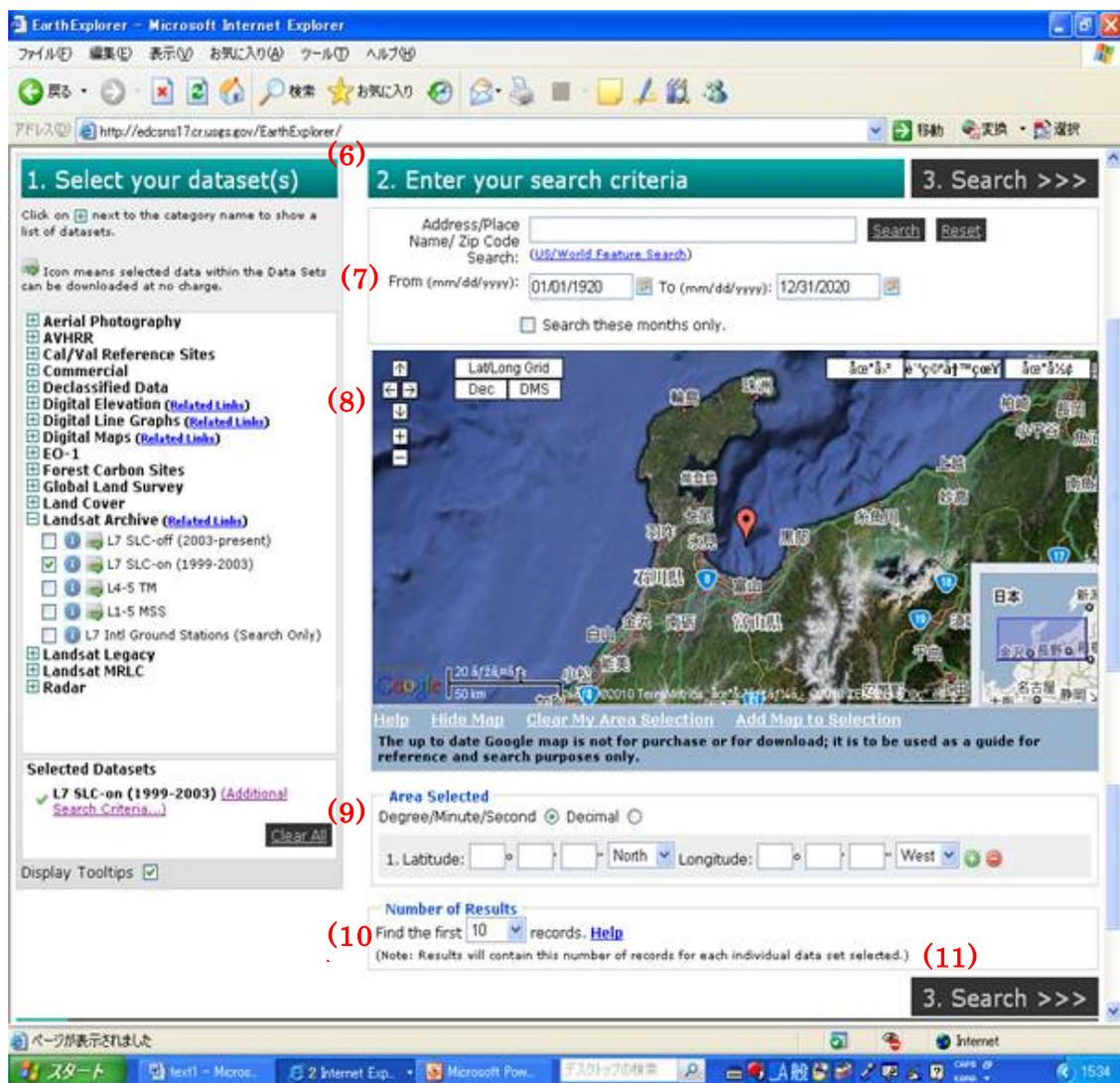
(3) Check the box of the sensor you want to search for (No. 3).  
 (You can choose more than 2 at a time.)

(4) Selected datasets are shown at the bottom (No. 4).

(5) If you want to set more details, such as cloud cover and paths and rows(パスロウ), click “Additional Search Criteria Dataset...”(No 5).

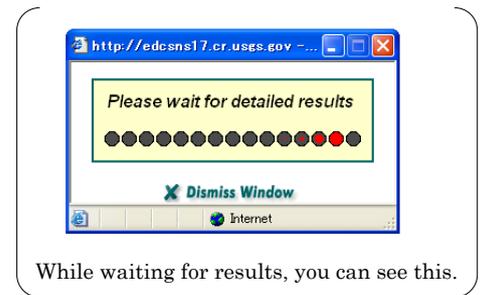
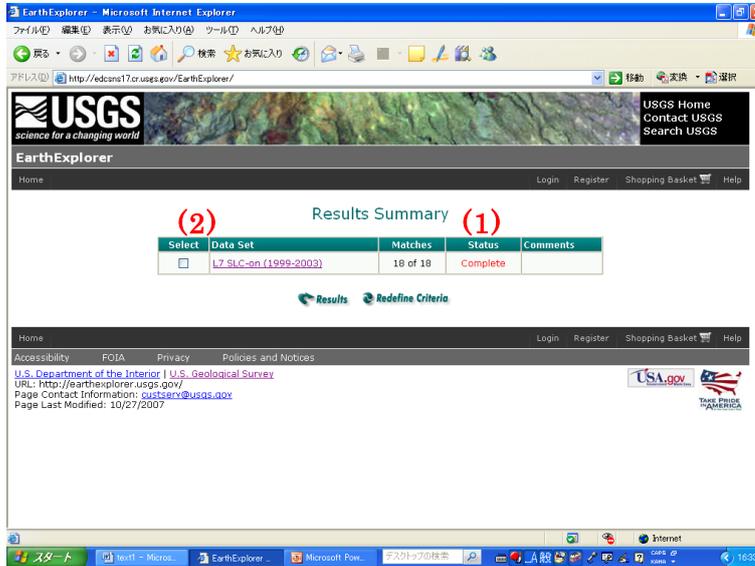


- (6) Move to the “**2. Enter your search criteria**” section (No. 6 in the image below).
- (7) Enter the search period (No. 7).
- (8) **Left-click** on the map to decide the search area. Then  is shown after the click (No. 8).
- (9) If you can set the latitude and the longitude of the searching area, set them in the “Area Selected” section (No. 9).
- (10) Choose the number of results you can see in the “Number of Results” section. (“10” is chosen in default configuration. If you select larger number, more scenes are shown.) (No. 10)
- (11) Click “**3.Search>>>**” to start the search (No. 11).

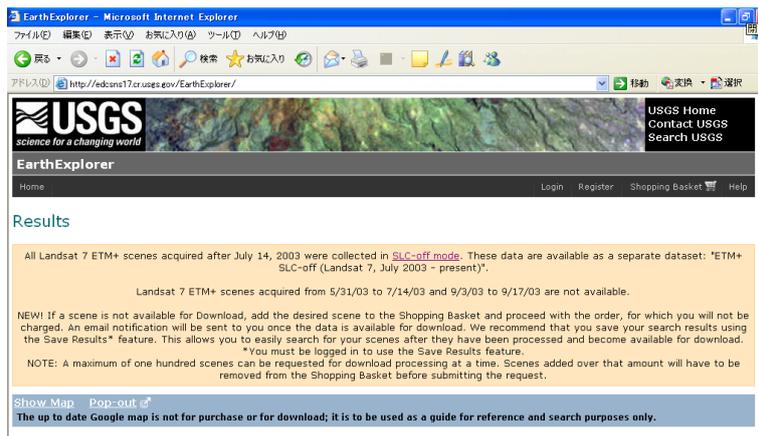


### 2.2.3. Displaying search results

- (1) After the search is completed, “*Complete*” is displayed in “*Status*” of “*Result Summary*” (No. 1 and 2 in the image below)
- (2) Check the box of “*Select*” and click on “*L7 SLC-on (1999-2003)*” in “*Data Set*” to display the results.



- (3) A list of the search results is shown (No. 3).



(3) L7 SLC-on (1999-2003)  
13 of 13 metadata records retrieved. Showing 1-10

	Preview Image	Show Footprint	Show All Fields	Exclude	Order	Qty	Price	Download	Landsat Scene Identifier	Date Acquired	WRS Path	WRS Row	Cloud Cover	Sun Elevation	Sun Azimuth	On Demand
1		Show	Show	<input type="checkbox"/>			N/A	Download	LE7109034199929280300	1999/10/19	109	034	1.50	39.6158676	155.7799377	N
2		Show	Show	<input type="checkbox"/>			N/A	Download	LE7109034200008790300	2000/03/27	109	034	0.67	48.8664436	142.0970306	N
3		Show	Show	<input type="checkbox"/>			N/A	Download	LE71090342000151EDC00	2000/05/00	109	034	0.01	65.3454206	123.2827301	N
4		Show	Show	<input type="checkbox"/>			\$0	Available by ordering	LE71090342000167EDC00	2000/06/15	109	034	0.02	65.8555298	119.4106293	Y
5		Show	Show	<input type="checkbox"/>			N/A	Download	LE71090342000279EDC00	2000/10/05	109	034	8.21	43.7429771	151.5735016	N

## 2.2.4. Ordering data

(1) When “download” is displayed in the “Download” section, you don’t have to take additional steps for download: Just click on each “download” (No. 1 in the image below).

When “Available by ordering” is shown, follow the next steps.

(2) Check the box in “Order” (No. 2).

L7 SLC-on (1999-2003)  
13 of 13 metadata records retrieved. Showing 1-10

	Preview Image	Show Footprint	Show All Fields	Exclude	Order	Qty	Price	Download	Landcat Scene Identifier	Date Acquired	WRS Path	WRS Row	Cloud Cover	Sun Elevation	Sun Azimuth	On Demand
1		Show	Show	<input type="checkbox"/>			N/A	Download	LE7109034199929250800	1999/10/19	109	034	1.50	39.6158676	155.7799377	N
2		Show	Show	<input type="checkbox"/>			N/A	Download	LE7109034200008750800	2000/03/27	109	034	0.67	48.8664436	142.0970306	N
3		Show	Show	<input type="checkbox"/>			N/A	Download	LE71090342000151EDC00	2000/05/30	109	034	0.01	65.3454208	123.2827301	N
4		Show	Show	<input type="checkbox"/>	<input type="checkbox"/>	1	\$0	Available by ordering	LE71090342000167EDC00	2000/06/15	109	034	0.02	65.8555298	119.4106293	Y
5		Show	Show	<input type="checkbox"/>			N/A	Download	LE71090342000279EDC00	2000/10/05	109	034	8.21	43.7429771	151.5735016	N

(3) Click “Add Selected Items to Shopping Basket” (No. 3).

Showing page 1 of 2

Go to page:  1 2 Next

Add Selected Items to Shopping Basket  
 Add All Retrieved Items to Shopping Basket  
 View Shopping Basket  
 Show All Records

Define Criteria  
 Result Summary  
 Hide Excluded Records  
 Restore All Excluded Records  
 Change Columns and Sort Order of Results  
 Show All Records - Text Format

Home Login Register Shopping Basket Help

Accessibility FOIA Privacy Policies and Notices

U.S. Department of the Interior | U.S. Geological Survey  
 URL: <http://earthexplorer.usgs.gov/>  
 Page Contact Information: [austser@usgs.gov](mailto:austser@usgs.gov)  
 Page Last Modified: 10/27/2007

(4) Then, “1” is shown in the box of “Qty” (No. 4).

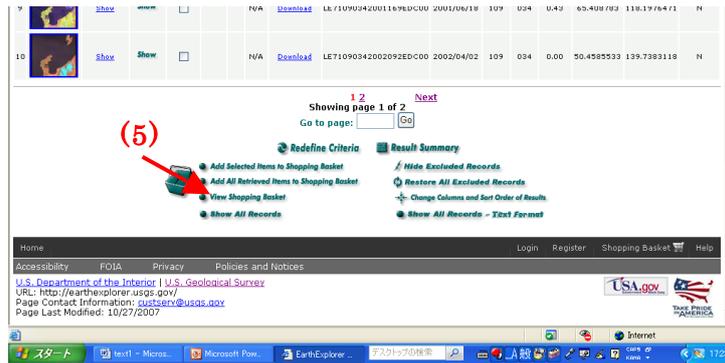
Earth Explorer - Microsoft Internet Explorer

http://edcsrc17cr.usgs.gov/EarthExplorer/

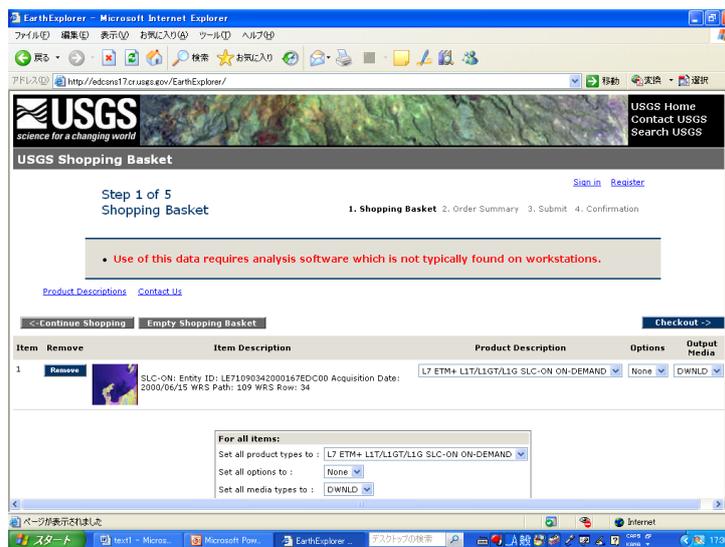
L7 SLC-on (1999-2003)  
13 of 13 metadata records retrieved. Showing 1-10

	Preview Image	Show Footprint	Show All Fields	Exclude	Order	Qty	Price	Download	Landcat Scene Identifier	Date Acquired	WRS Path	WRS Row	Cloud Cover	Sun Elevation	Sun Azimuth	On Demand
1		Show	Show	<input type="checkbox"/>			N/A	Download	LE7109034199929250800	1999/10/19	109	034	1.50	39.6158676	155.7799377	N
2		Show	Show	<input type="checkbox"/>			N/A	Download	LE7109034200008750800	2000/03/27	109	034	0.67	48.8664436	142.0970306	N
3		Show	Show	<input type="checkbox"/>			N/A	Download	LE71090342000151EDC00	2000/05/30	109	034	0.01	65.3454208	123.2827301	N
4		Show	Show	<input type="checkbox"/>	<input type="checkbox"/>	1	\$0	Available by ordering	LE71090342000167EDC00	2000/06/15	109	034	0.02	65.8555298	119.4106293	Y

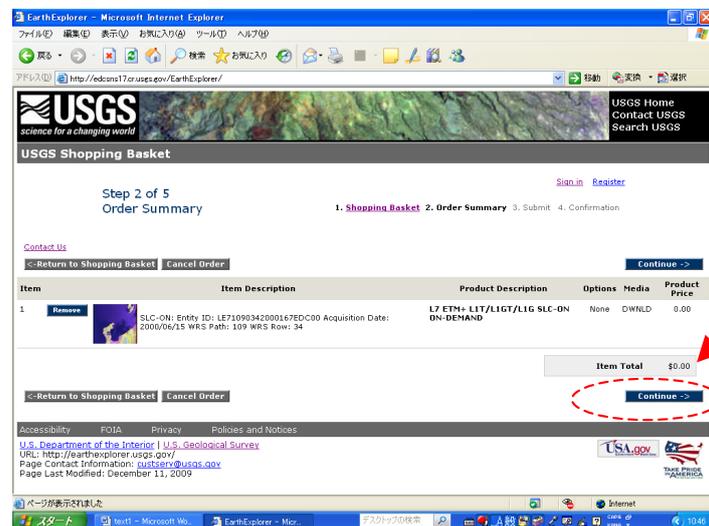
(5) Click “View Shopping Basket” (No. 5).



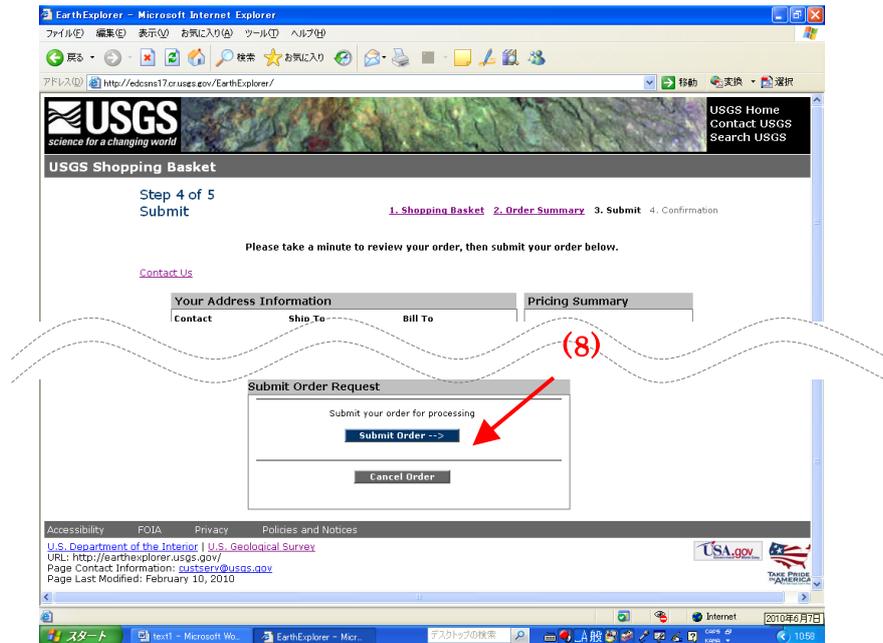
(6) Click “Checkout-->” (No. 6).



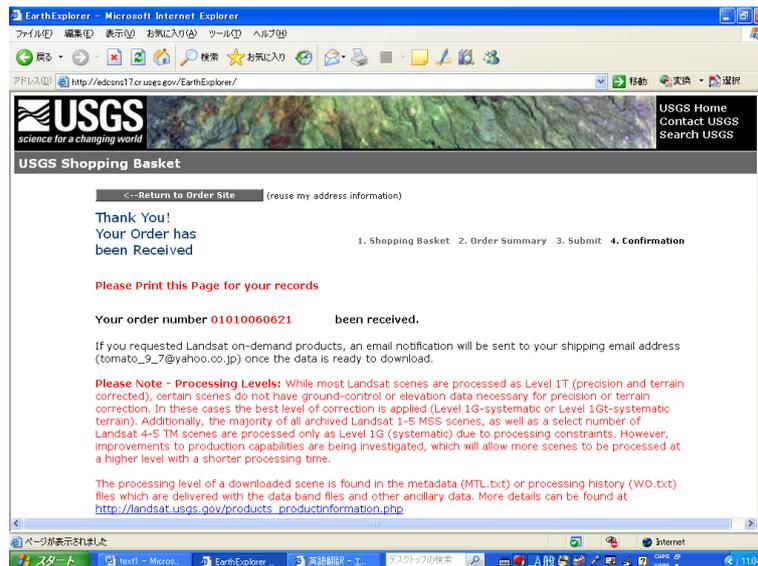
(7) Confirm that “Item Total” shows “\$0.00.” Then, click “Continue-->” (No. 7).



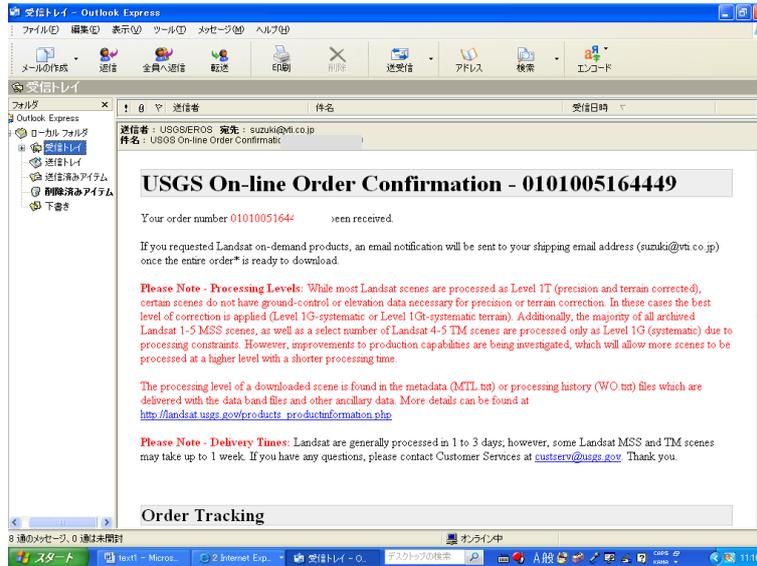
(8) Check the order item, and click “Submit Order-->” (No. 8).



(9) When your order is properly placed, the message below is shown.

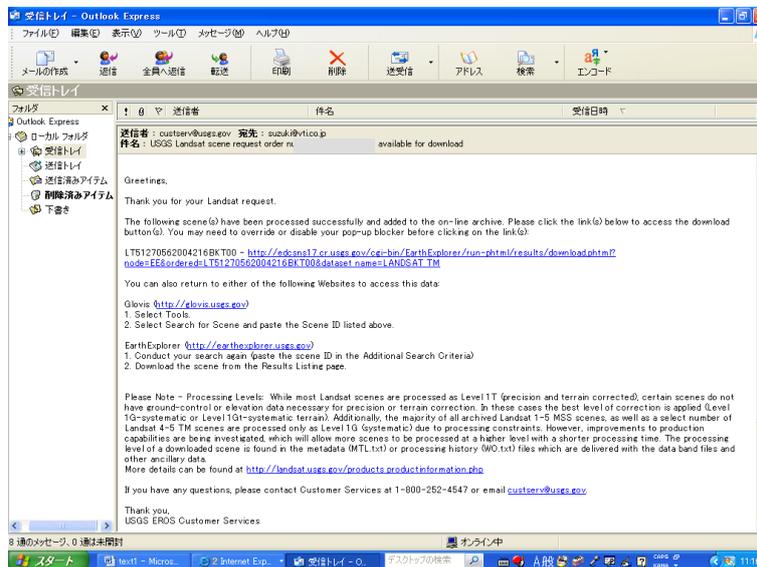


(10) An e-mail for order confirmation is sent to your registered address.



(12) Then, an e-mail for informing availability of download is sent to you.

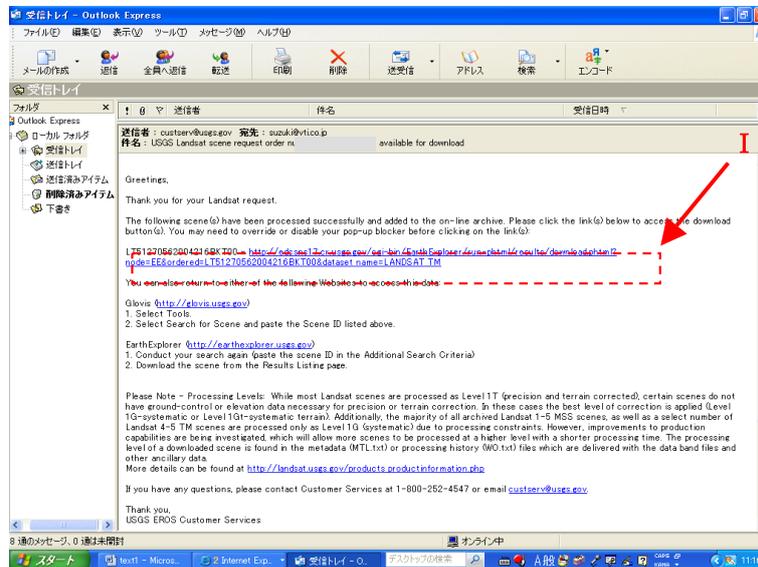
Time to receive this e-mail depends on size of data you ordered.



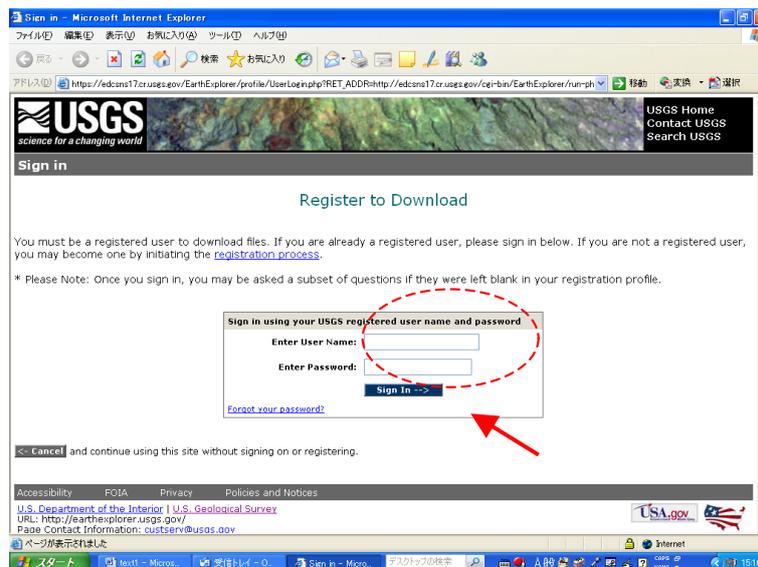
## 2.3 How to download Landsat data

(1) When you receive the informing e-mail for download availability, click the URL in the e-mail:

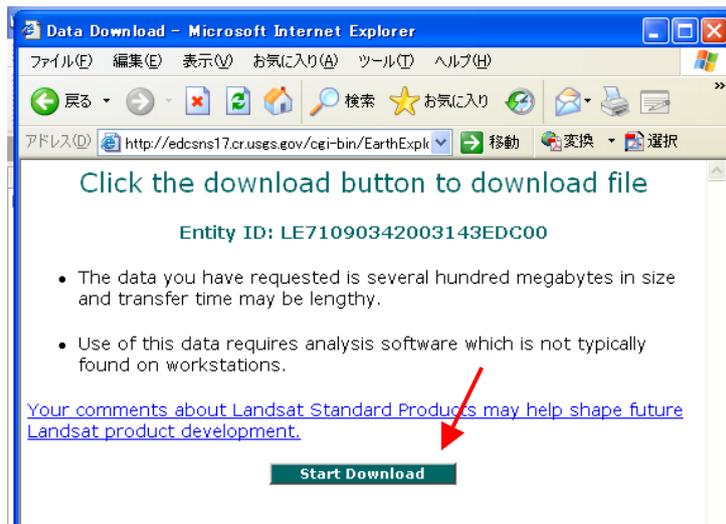
<http://edc.sns17.cr.usgs.gov/cgi-bin/EarthExplorer/run-phhtml/results/download.phtml?node=E&ordered=> (See No. I in the image).



(2) Enter your registered “User Name” and “Password.” Then, click “Sign In -->.”



(3) Click “Start Download” in the next page.



(4) For saving the file, click “Save” to start download.



### 3. Obtaining data analysis software

#### 3.1 How to obtain data analysis software (MultiSpec)

This handbook provides guidance on analyzing Landsat imagery for detecting land cover changes with MultiSpec, a free software developed in Purdue University (U.S.A.). MultiSpec is compatible with different forms of data and capable of exporting results with thematic maps and charts for other systems.

Its functions are supervised/non-supervised classification, major element analysis, statistical calculation, feature extraction and selection, thematic map development, with multispectral images.

MultiSpec is available on the website (<http://dynamo.ecn.purdue.edu/~biehl/MultiSpec/>). Latest information on revision and/or necessary documentation for MultiSpec is also available on the same website.

#### 3.2 System requirements for MultiSpec:

- 1) CPU: Pentium II or above
- 2) OS: Windows 2000/XP/Vista, Macintosh PowerPC/OSX 10.3 version or later
- 3) RAM: over 256 Mbyte (recommended)

#### 3.3 How to install MultiSpec (Windows version)

- (1) Double click "MultiSpecWin32z.exe" downloaded through the procedures introduced above.
- (2) When the window in Chart 3.3-1 is opened, click "Browse" to find where to install. When the name of the folder is shown under "Unzip to folder", click "Unzip" (Chart 3.3-1 selects "C:\¥MultiSpec.")



Chart 3.3-1 Installing MultiSpec

- (3) In the selected folder, “MultiSpecWin32” is created with program files as shown in Chart 3.3-2.

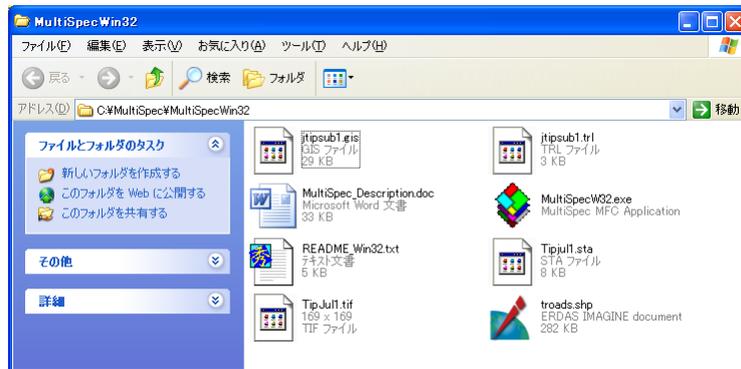


Chart 3.3-2 Program files created by installing MultiSpec

- (4) Double click “MultiSpecW32.exe”, then MultiSpec starts active (Chart 3.3-3).

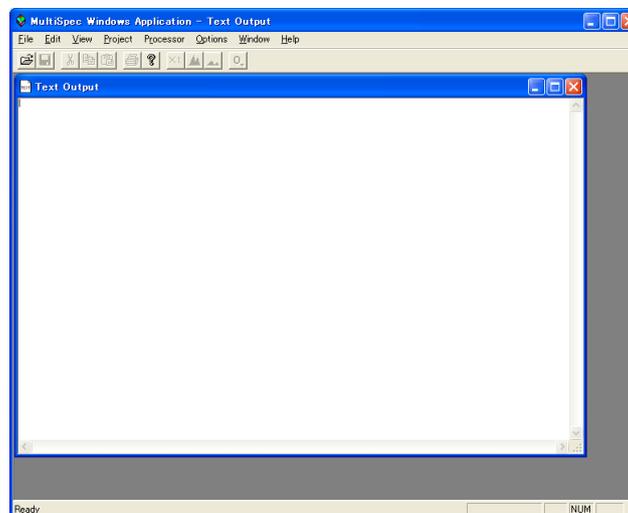


Chart 3.3-3 Starting of MultiSpec

#### 4. Example of data analysis

##### 4.1 Flow of analysis

In this chapter, an flow of Landsat data analysis is introduced. The theme is "Land Cover Classification Analysis in Toyama Bay area." Chart 4.1-1 shows the flow of the procedures.

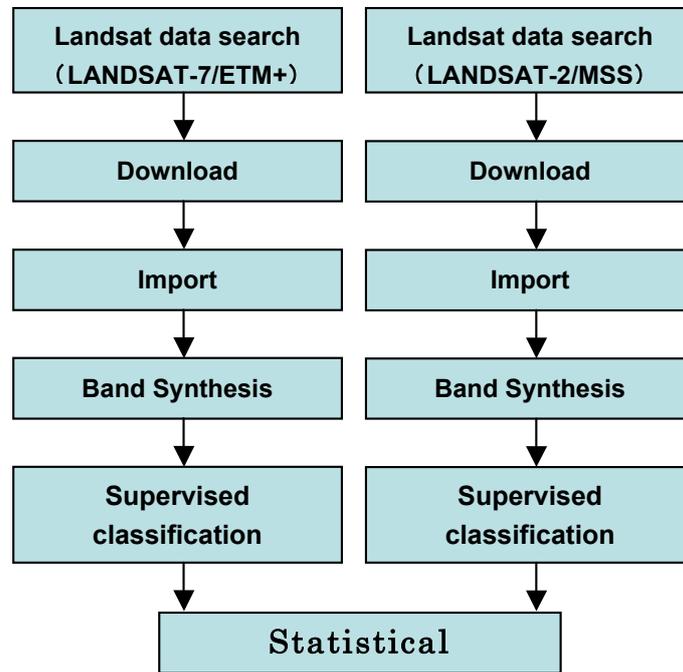


Chart 4.1-1 Procedures of Landsat data analysis

Chart 4.1-1 and 4.1-2 are Landsat data of Toyama Bay area including Nanao Bay obtained following the steps explained in Chapter 2.

Satellite	Sensor	Observed date	Path	Row	Scene ID	Resolution
LANDSAT-1	MSS	1973/5/27	117	34	LM11170341973147AAA02	80m
LANDSAT-7	ETM+	2001/5/17	109	34	LE71090342001137EDC00	30m

Chart 4.1-1 LANDSAT data around Nanao Bay area

Satellite	Sensor	Observed date	Path	Row	Scene ID	Resolution
LANDSAT-1	MSS	1972/10/5	117	34	LM11170341972279AAA03	80m
LANDSAT-7	ETM+	2000/10/5	109	34	LE71090342000279EDC00	30m

Chart 4.1-2 LANDSAT data around Toyama Bay area

## 4.2 Procedures of data analysis

### 4.2.1 Activating MultiSpec

(1) Double click “MultiSpecW32.exe” to activate MultiSpec (Chart 4.2.1-1).

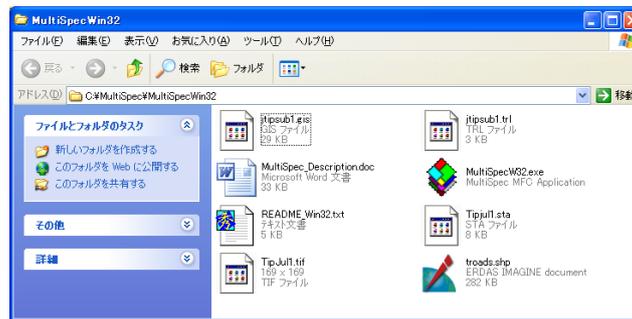


Chart 4.2.1-1. MultiSpec software

(2) The image of MultiSpec activation is shown in Chart 4.2.1-2.

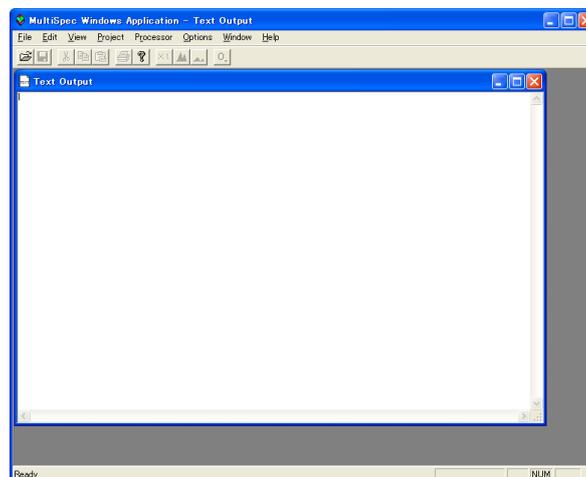


Chart 4.2.1-2 Activating MultiSpec

There are several menus of MultiSpec:

- File Menu: to open Image File or Project File, to printout, and to save in the disk file
- Edit Menu: to edit (cut, copy, paste, delete, etc.)
- View Menu: to open/close the toolbar and the status bar  
(Both bars are open in Chart 4.2.1-2.)
- Project Menu: to use for starting a new Project File  
“Project File” can memorize the processing procedures, save interim results of image analysis and class statistics, and stop analysis results. This file can re-analyze results later.
- Processor Menu: to use to select MultiSpec processor
- Options (Palette Menu): to use for pre-requisite processing
- Window Menu: to use for creating a new text and/or for selecting display format of a text window.

#### 4.2.2 importing LANDSAT data

**LANDSAT-7/ETM+** and **LANDSAT-2/MSS** downloaded following the steps explained in the previous section have information in TIF format by respective band.

##### 1. **LANDSAT-7/ETM+** taken on May 17, 2001

- L71109034\_03420010517\_B10.TIF : BAND 1 (Resolution - 30m)
- L71109034\_03420010517\_B20.TIF : BAND 2 (Resolution - 30m)
- L71109034\_03420010517\_B30.TIF : BAND 3 (Resolution - 30m)
- L71109034\_03420010517\_B40.TIF : BAND 4 (Resolution - 30m)
- L71109034\_03420010517\_B50.TIF : BAND 5 (Resolution - 30m)

(Note: BAND 6-8 are not used for supervised classification.)

##### 2. **LANDSAT-2/MSS** taken on May 27, 1973

- LM1117034007314710\_B4.TIF : BAND 4 (Resolution - 80m)
- LM1117034007314710\_B5.TIF : BAND 5 (Resolution - 80m)
- LM1117034007314710\_B6.TIF : BAND 6 (Resolution - 80m)
- LM1117034007314710\_B7.TIF : BAND 7 (Resolution - 80m)

For importing **LANDSAT-7/ETM+**, follow the next steps. You can take the same steps for importing **LANDSAT-2/MS** as well, although the file name and the number of bands and their combination are different.

(1) Select “Open Image” from “File Menu” and click (Chart 4.2.2-1).

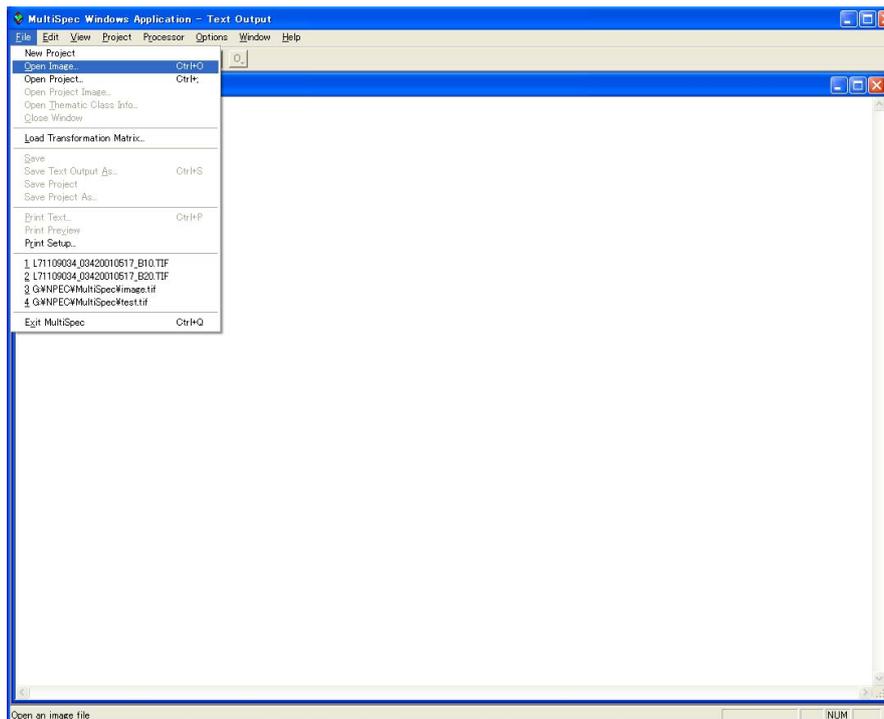


Chart 4.2.2-1 Displaying images

- (2) When options are displayed, select “L71109034\_03420010517\_B10.TIF” and click “Open” (Chart 4.2.2-2).

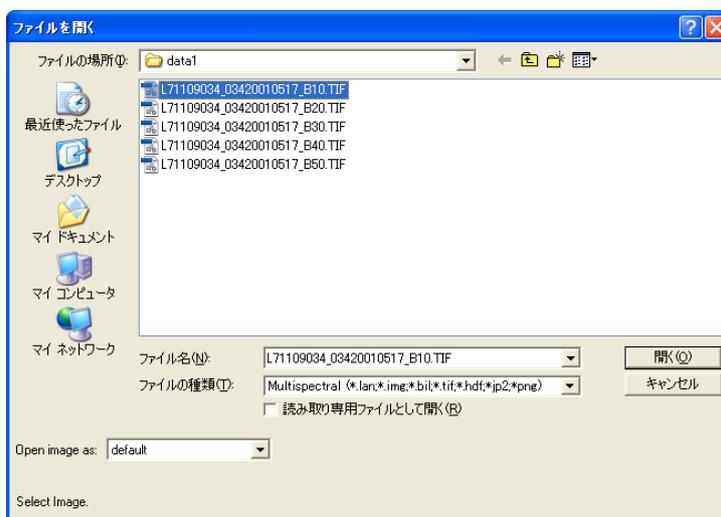


Chart 4.2.2-2 Selecting a file

- (3) Chart 4.2.2-3 shows how to set display specifications: size of an image file, number of synthesized images, and/or format, etc. Be careful with the values to enter, otherwise you cannot open images properly. When using the TIF File, you do not have to set anything in this page, just click “OK.”

Parameters in Display Specifications:

Area to Display: To set a displayed area of an image

Display: To select display color channel.

There are 4 types: 3-Channel Color; 2-Channel Color, 1-Channel Color and Side by Side Channel (Black and white color for each band)

Magnification: To set a scale of an image

Enhancement: To set enhancement of an image

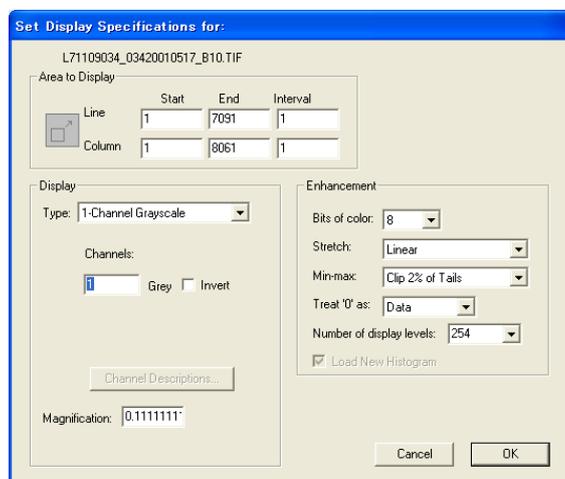


Chart 4.2.2-3 Setting Display Specifications

(4) Chart 4.2.2-4 shows how to set histogram specifications. Just click “OK”, unless you need to change values.

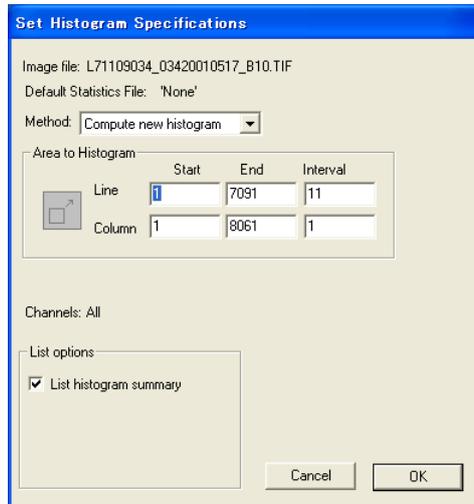


Chart 4.2.2-4 Setting Histogram Specifications

Parameters in Histogram Specifications:

Method: to set histogram

Compute new histogram: to create a new histogram

Select default statistics: to set the default histogram file

(5) After you click “OK” on Histogram Specifications, an image is displayed (Chart 4.3.2-5).

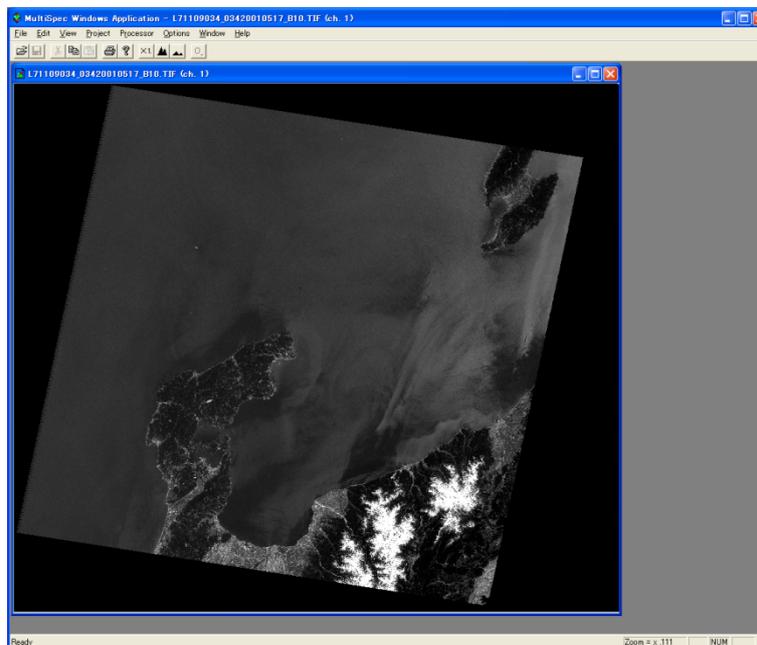


Chart 4.2.2-5 Example of an image

#### 4.2.3 Creating color images of LANDSAT data

As input LANDSAT data has different bands, it is necessary to synthesize these bands to process Land Cover Classification and create color images. Steps for this task are as follows.

- (1) With BAND 1 image on screen, select “Open Image” in “File Menu” and click.

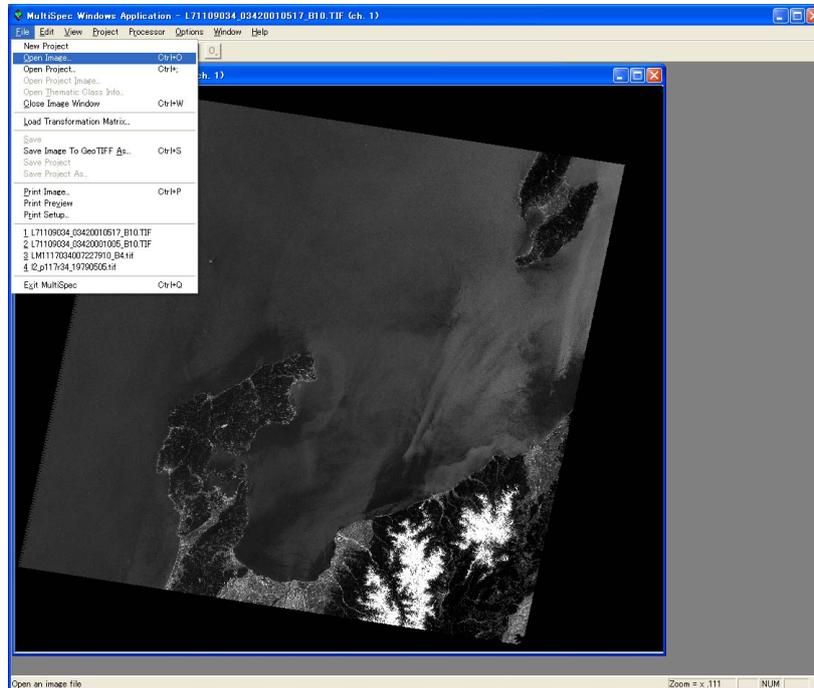


Chart 4.2.3-1 Single-band image

- (2) Check “Link to active image window” on the bottom and select “L71109034\_03420010517\_B20.TIF”, then click “Open” (Chart 4.2.3-2).

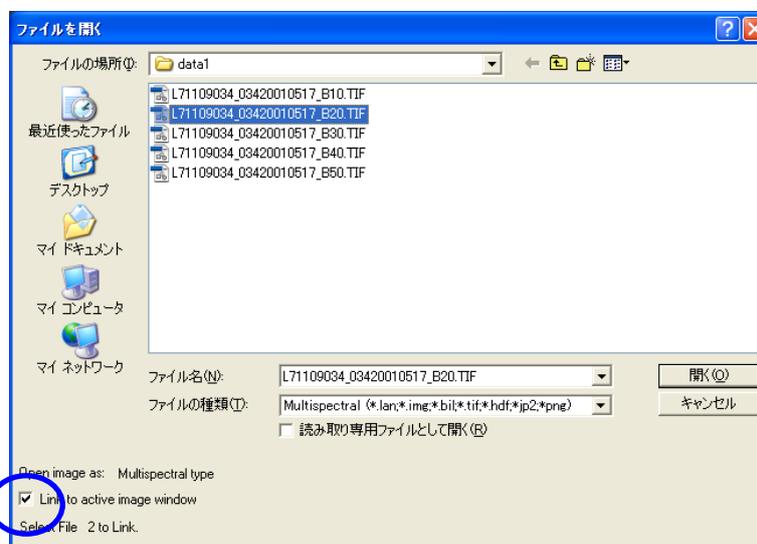


Chart 4.2.3-2 Creating a color image -1

(3) Next, select “L71109034\_03420010517\_B30.TIF” and click “Open.” Repeat it until L71109034\_03420010517\_B50.TIF (Chart 4.2.3-3).

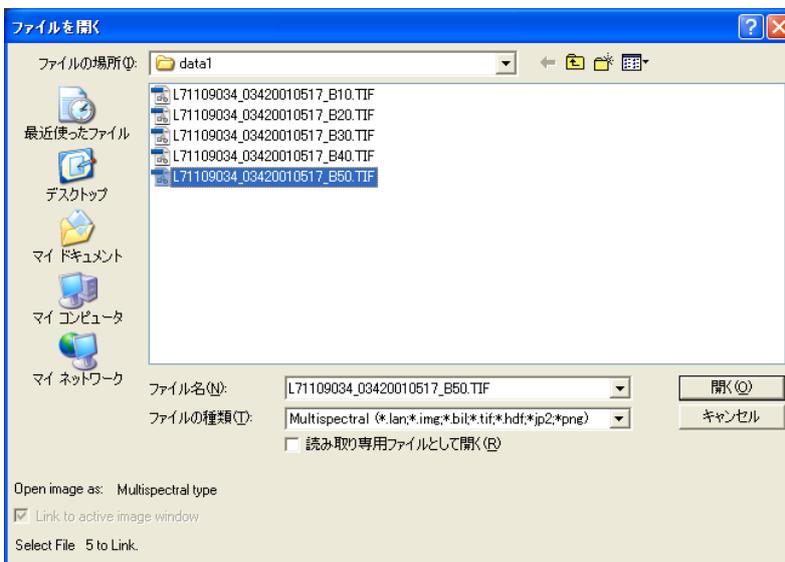


Chart 4.2.3-3 Creating a color image-2

(4) Then, click “Cancel” (Chart 4.2.3-4).

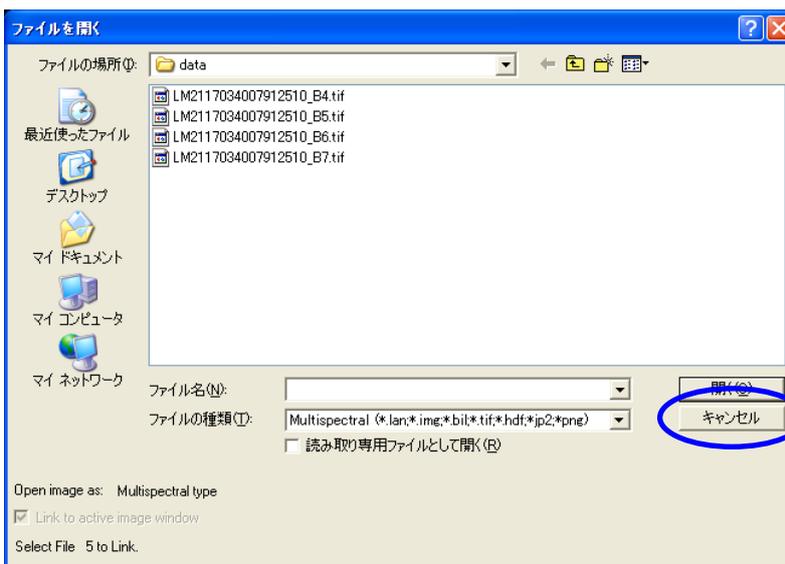


Chart 4.2.3-2 Creating a color image-3

(5) Make sure that “L5-L71109034\_03420010517\_B10.TIF” is surely indicated on top. This means that the number of layers is 5 (5 bands- from BAND 1 to BAND 5) (Chart 4.2.3-5).

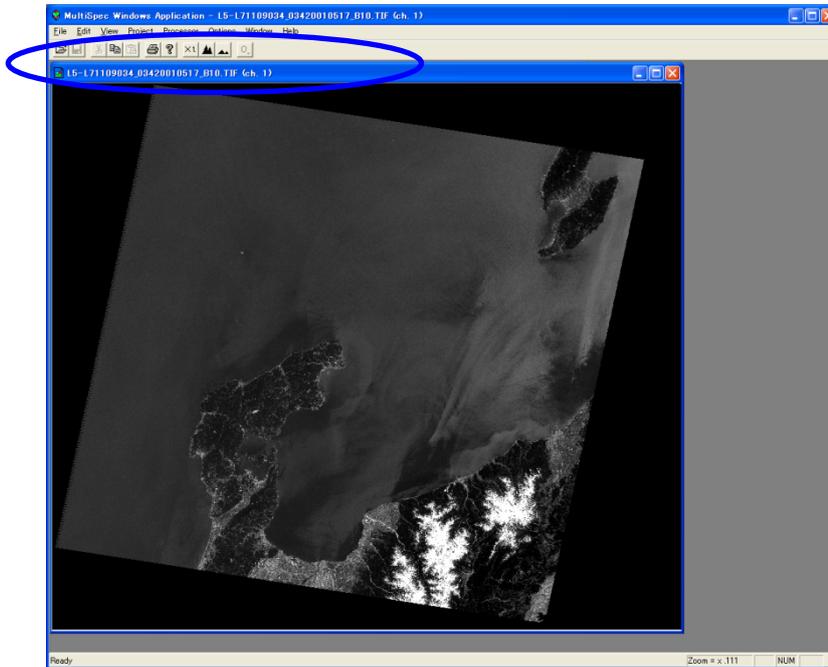


Chart 4.2.3-5 Creating a color image-4

(6) Save the multiple-layered image. Click “Processor Menu” and select “Reformat” and then “Change Image File Format” (Chart 4.2.3-6).

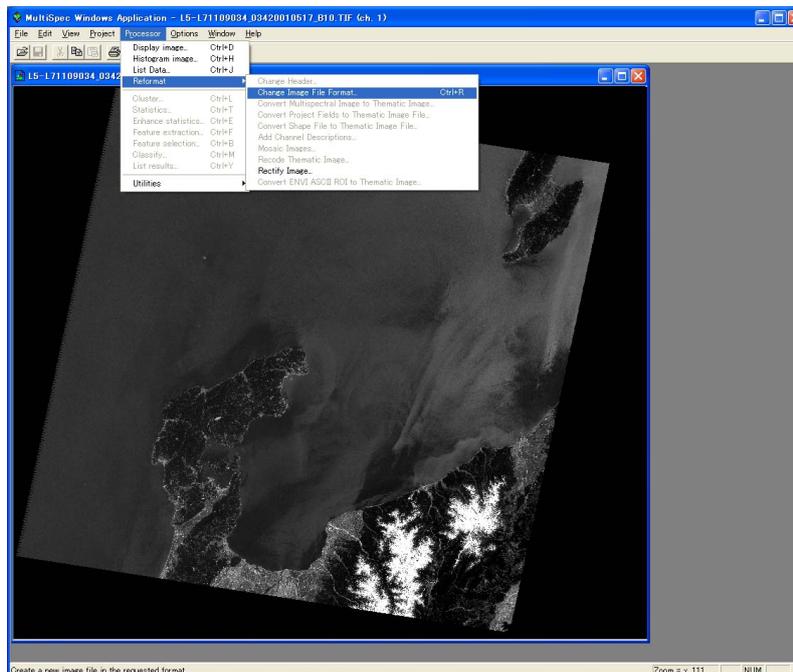


Chart 4.2.3-6 Saving a color image-1

(7) Just click “OK”, unless you need to change values. (Chart 4.2.3-7).

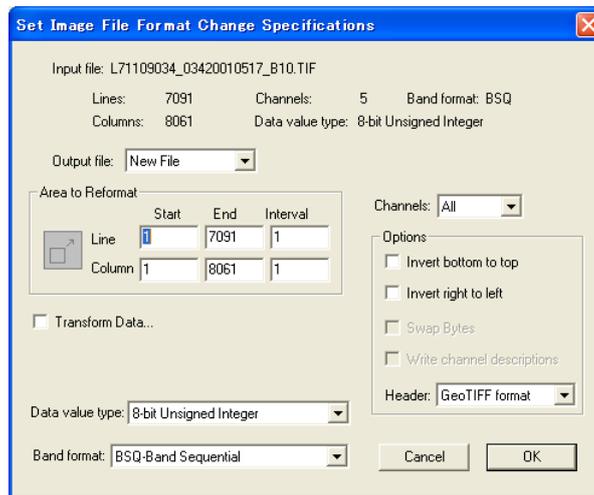


Chart 4.2.3-7 Saving a color image-2

(8) Set an output file and click “Save”. “17\_p109r34\_20010517.tif” is selected in the example (Chart 4.2.3-8).

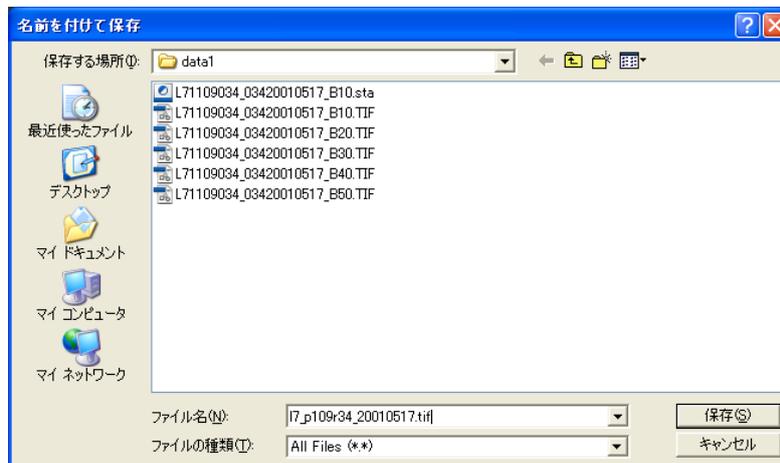


Chart 4.2.3-8 Saving a color image-3

(9) Percentage of data processing status is shown until completed. Then, the window disappears automatically when the processing is done (Chart 4.2.3-9).

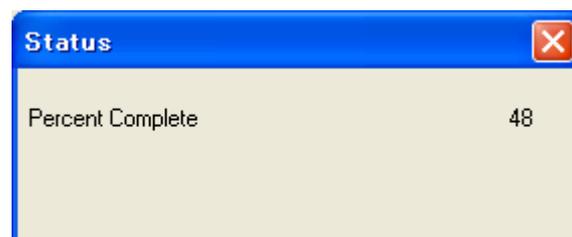


Chart 4.2.3-9. Saving a color image-4

- (10) When a color image is created, click “X” on the right top and close the window (Chart 4.2.3-10).

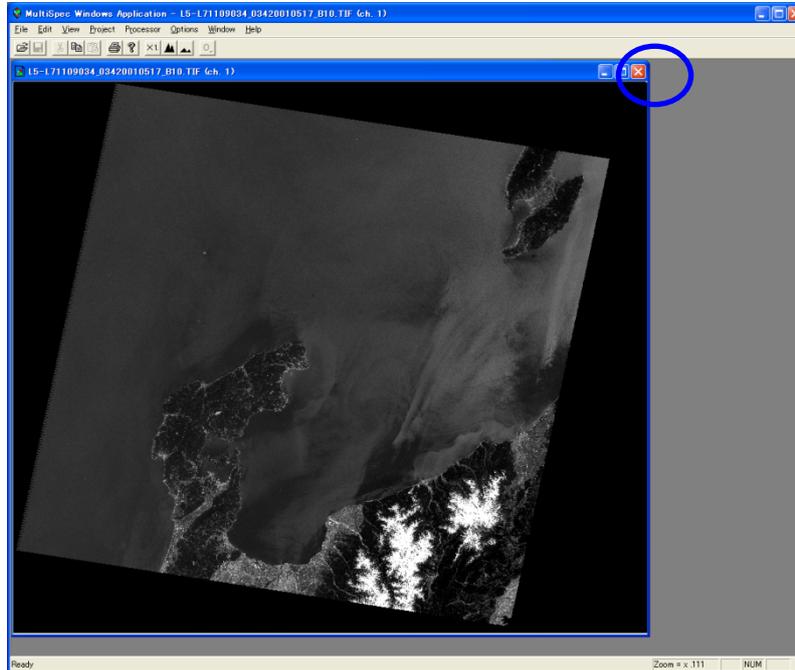


Chart 4.2.3-10 Closing the color image window

- (11) Select “Open Image” from “File Menu” and click (Chart 4.2.3-11).

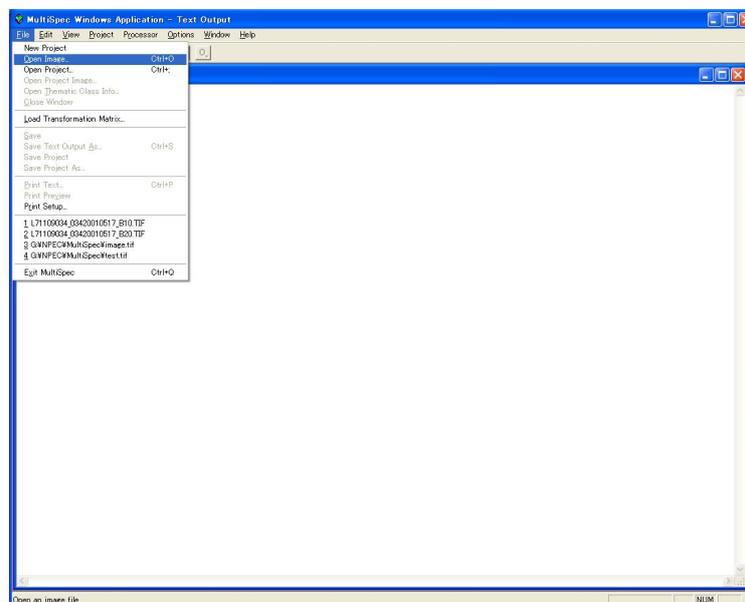


Chart 4.2.3-11

(12) Select the created “17\_p109r34\_20010517.tif” and click “Open” (Chart 4.2.3-12).

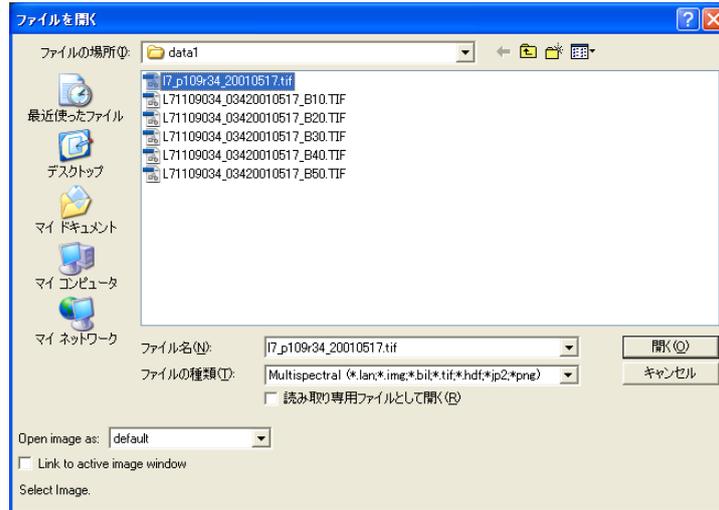


Chart 4.2.3-12 Selecting an image

(13) Set “Channels”: 5 in Red; 4 in Green; and 3 in Blue. Then, click “OK” (Chart 4.2.3-15).

This band combination is used to create “Middle-infrared image, and it is suited for classifying land cover into water, agricultural and paddy fields and bare lands. The following band combinations are also available for supervised classification in case of Landsat-7/ETM+.

- R:G:B = Band 3:Band 2:Band 1 is called “true color” and it shows objects in the same color that human eyes would normally see. This band combination is suited for classifying land cover into water, urban area, agricultural field, golf course and forest.
- R:G:B = Band 4:Band 3:Band 2 is called “false color” and it enhances vegetation in red. This band combination is suited for classifying land cover into paddy field, agricultural field and forest.

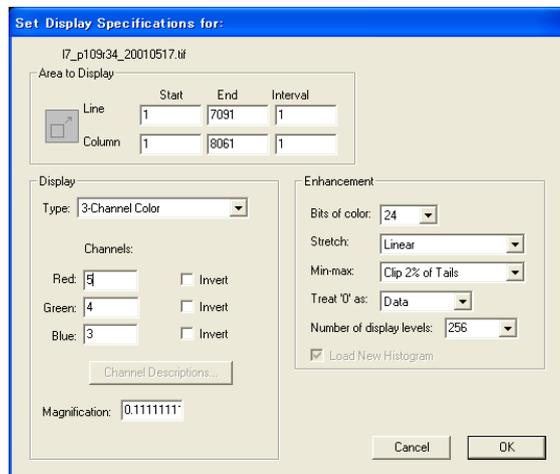


Chart 4.2.3-13 Setting Display Specifications

(14) Do **NOT** set anything in Histogram Specifications, just click “OK” (Chart 4.2.3-14).

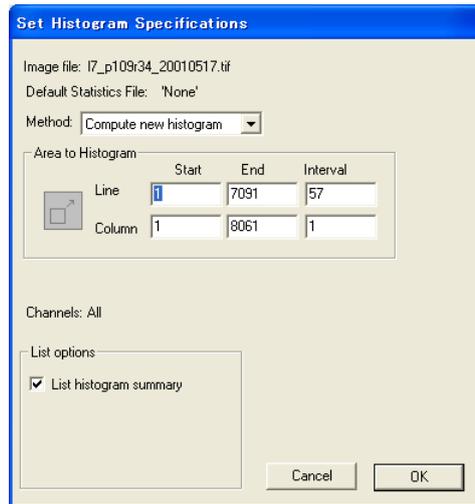


Chart 4.2.3-14 Setting Histogram Specifications

(15) Then, a color image is displayed on screen (Chart 4.2.3-15).

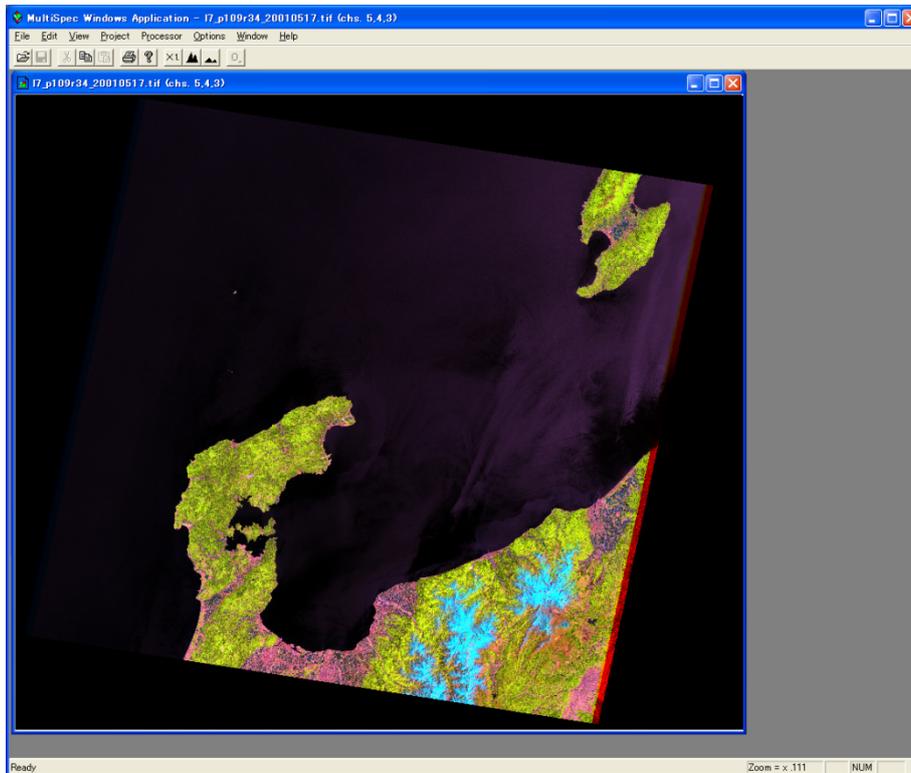


Chart 4.2.3-15 Example of a color image

#### 4.2.4 Supervised classification

In this chapter, the procedures of how to apply supervised classification to the color image created in the previous section are introduced.

- (1) Select “Statistics” in “Processor Menu” and click “OK” (Chart 4.2.4-1).

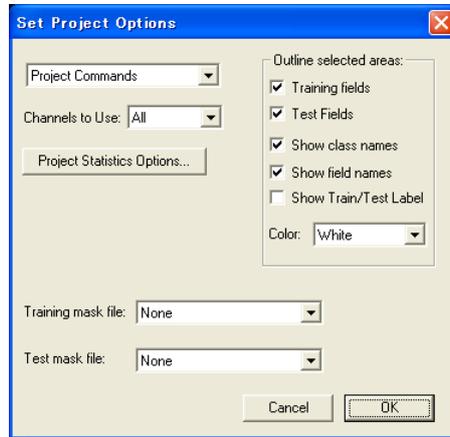


Chart 4.2.4-1 Statistics

- (2) Then, a new window “Select Field” is shown on the right side (Chart 4.2.4-2).

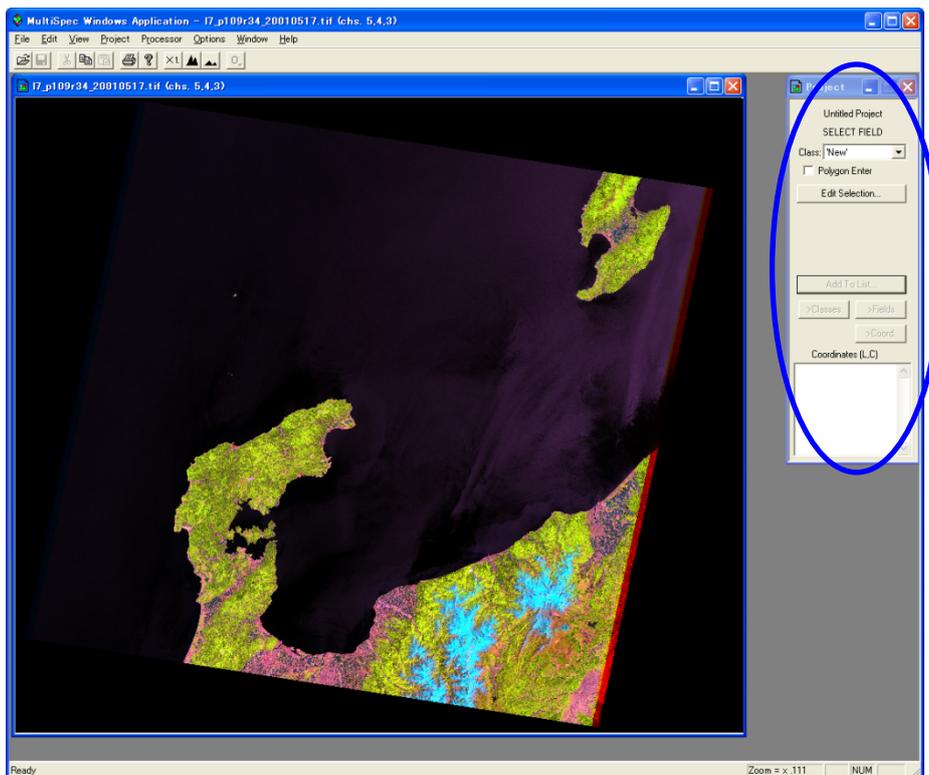


Chart 4.2.4-2 Setting training areas-1

- (3) Set a training area: Make the image “17\_p109r34\_20010517.tif active” (click on the screen), then drag the mouse to set an area (Chart 4.2.4-3).

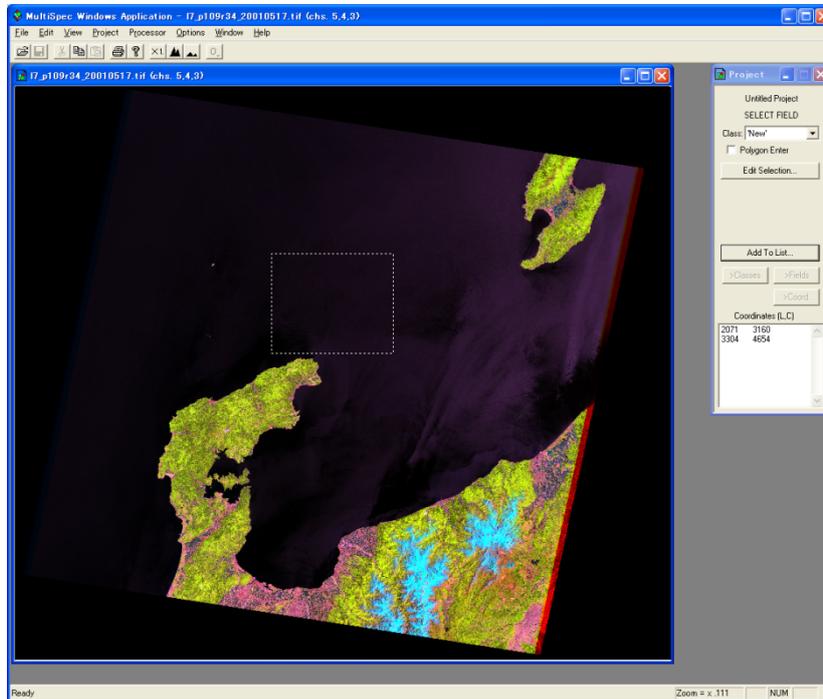


Chart 4.2.4-3 Setting training areas-2

- (4) Click “Add to List” in the “Select Field” window and enter “water” in the “Enter Class Name” section. Then, click “OK” (Chart 4.2.4-4).  
 (Note: Do **NOT** change the “Class” section and keep “New.”)

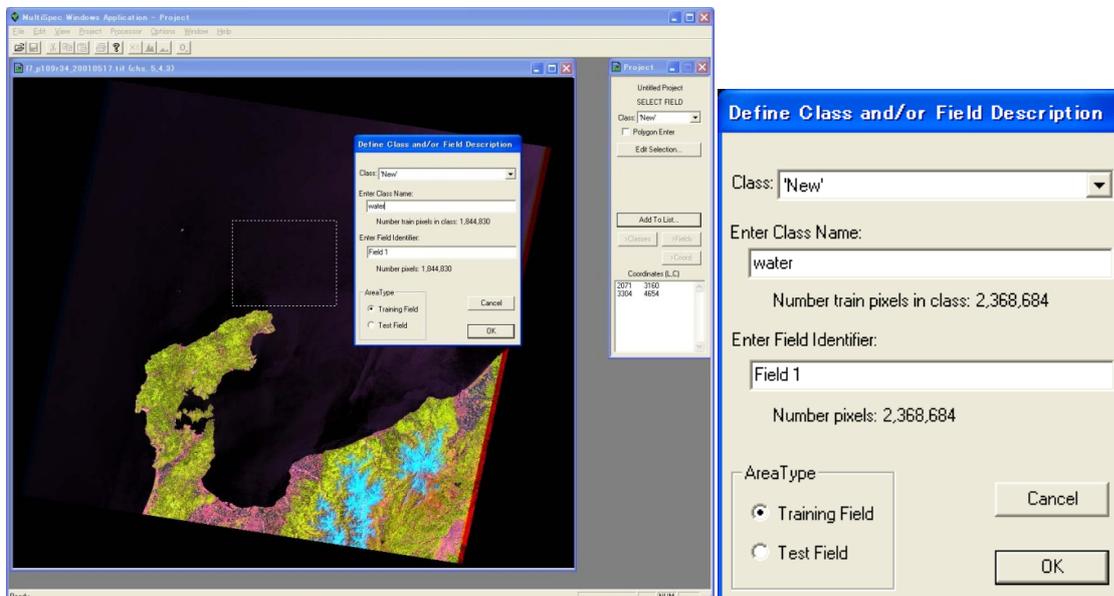


Chart 4.2.4-4 Setting training areas-3

(5) The training area (water) is displayed on screen (Chart 4.2.4-5). Set other training areas\* with the same procedures shown in the previous section.

Use the following icons to zoom in-out when setting training areas.

 : Original scale     : Zoom in     : Zoom out

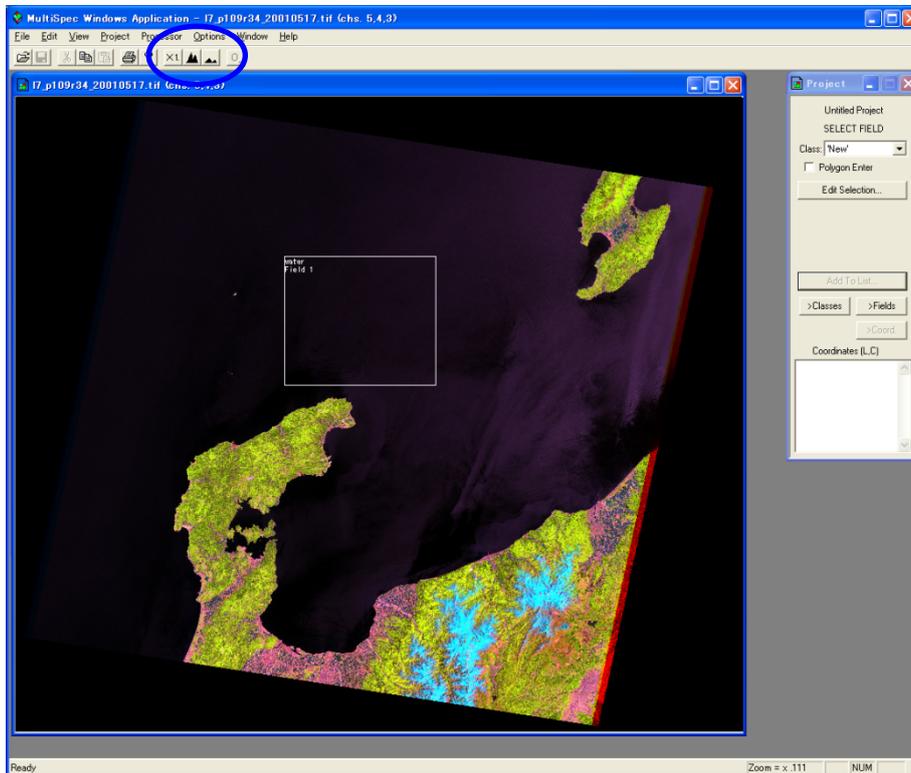


Chart 4.2.4-5 Setting training areas-4

\*Setting of training areas should be done with grand truth data such as vegetation map and topographic map. This sample uses vegetation map and topographic map provided by Japan Map Center Foundation as references for supervised classification.

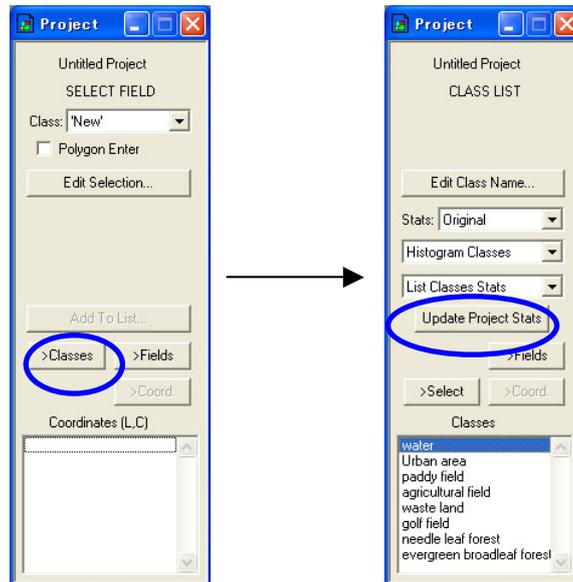
(6) Training areas set are as follows (see Chart 4.2.4-1 and Figure 4.2.4-6).

Table 4.2.4-1. Training areas and classification

Field Identifier	Class Name
Field 1	water
Field 2	urban area
Field 3	paddy field
Field 4	agricultural field
Field 5	waste land
Field 6	golf field
Field 7	broad leaf forest
Field 8	Needle leaf forest



(7) Update statistic information in each supervised classification by clicking 「Classes」 then 「Update Project Stats」 .



Char 4.2.4-7 Updating statistic information in each classification area.

(8) Now, click “Classify” in “Processor Menu” to apply supervised classification.

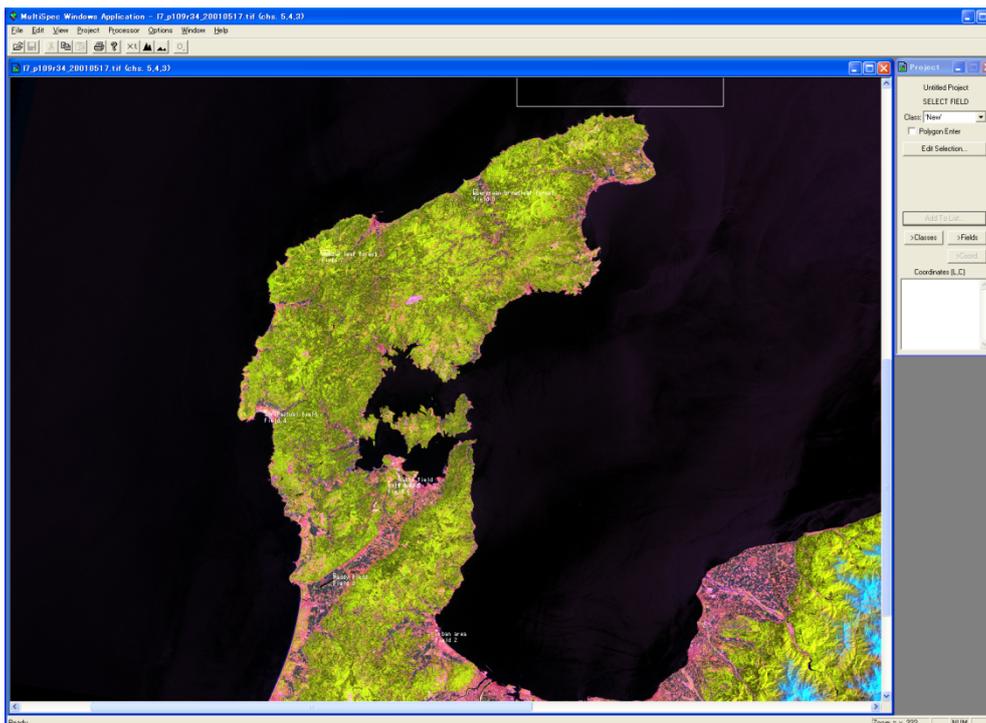


Chart 4.2.4-8 Supervised Classification

- (9) MultiSpec has six algorithms for supervised classification. In this handbook, the most common Maximum Likelihood method for data processing is used.  
Check “Desk file” under “Write classification results to” and click “OK” (Chart 4.2.4-8).

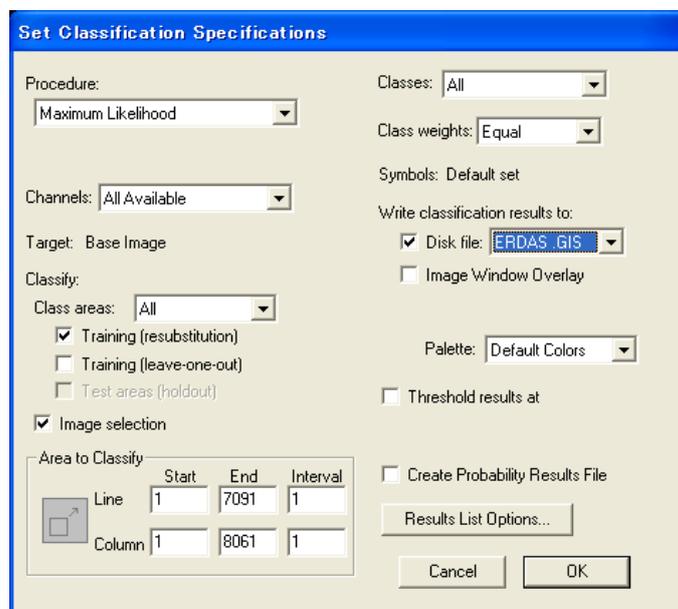


Chart 4.2.4-9 Window of statistical data processing-1

- (10) In case not updating statistic information in the previous section, the following pop up window is displayed (Chart 4.2.4-10). Then, click “OK.”

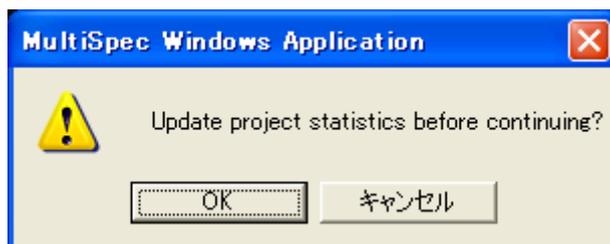


Chart 4.2.4-10 Window of statistical data processing-2

- (11) Click “Save” with the default file name (Chart 4.2.4-10).

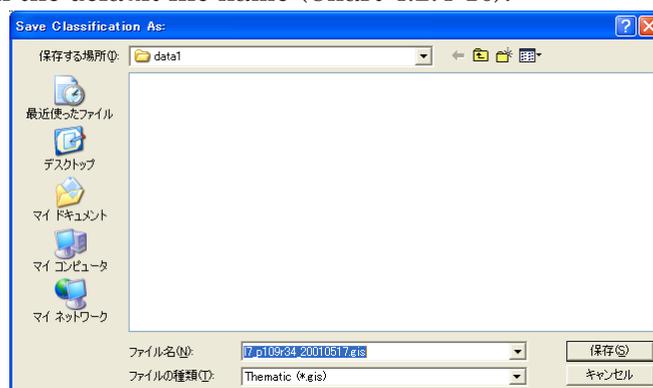


Chart 4.2.4-11 Saving Output file



(15) Click “OK” (Chart 4.2.4-15).

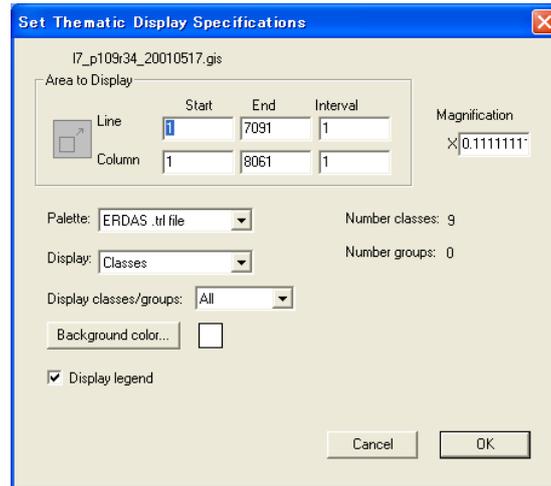


Chart 4.2.4-15 Displaying images of supervised classification-2

(16) An image of supervised classification is displayed. The colors used are the default set.

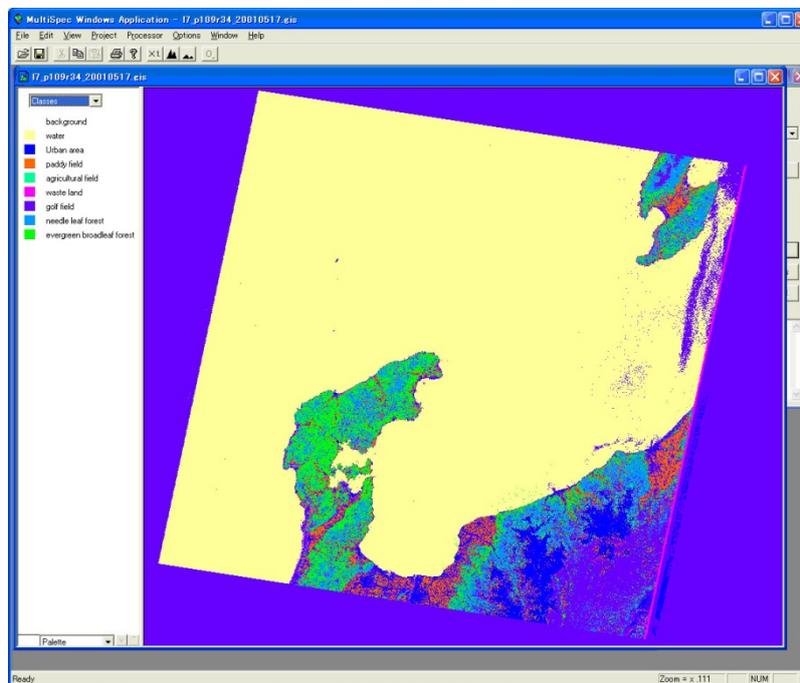


Chart 4.2.4-16 Example of supervised classification image

(17) For changing colors, double click the color you want to change. Then, the color palette is shown on screen. Click a new color on the palette, and it is reflected on the image automatically (Chart 4.2.4-17).

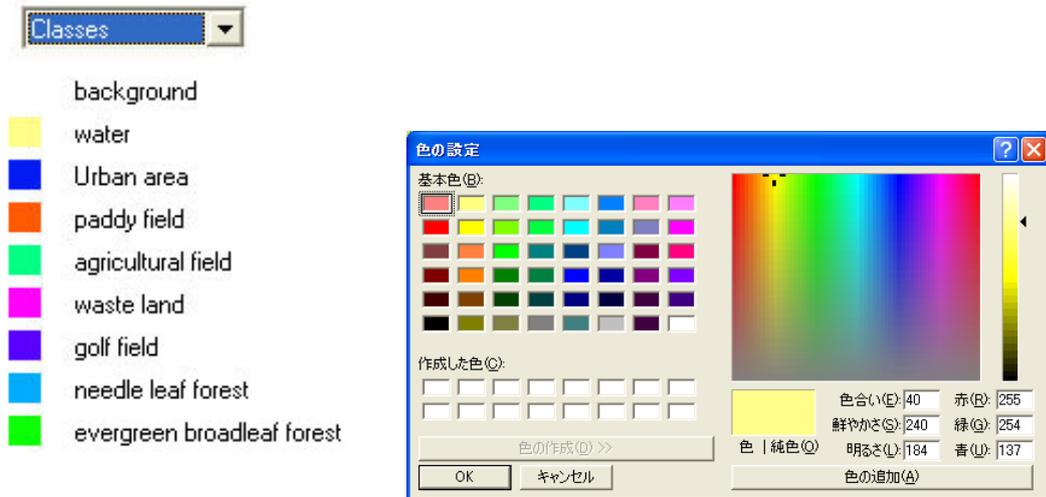


Chart 4.2.4-17 Category change-1

(18) Changed color(s) are reflected in the revised image (Chart 4.2.4-18).

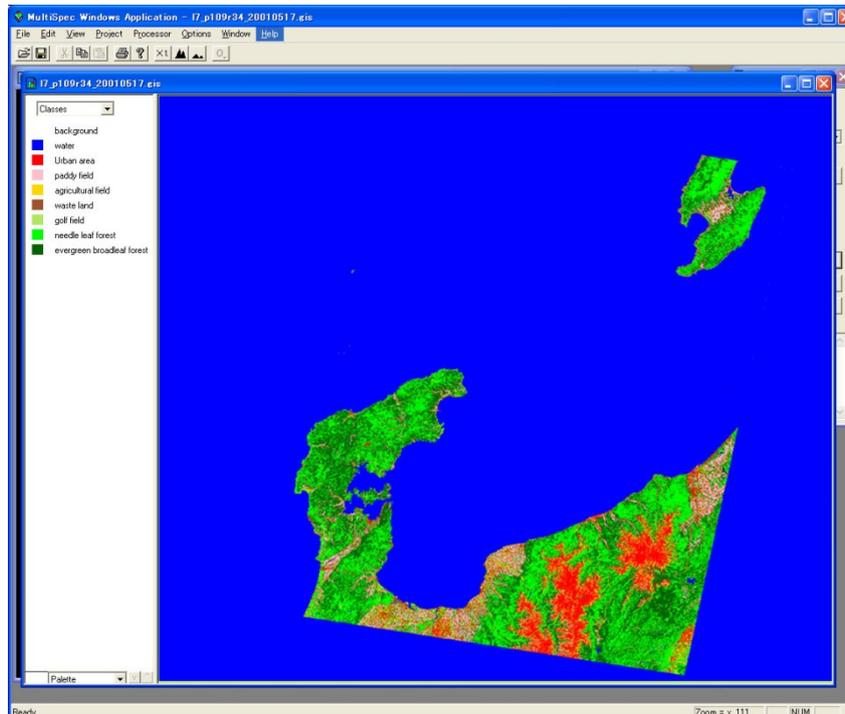
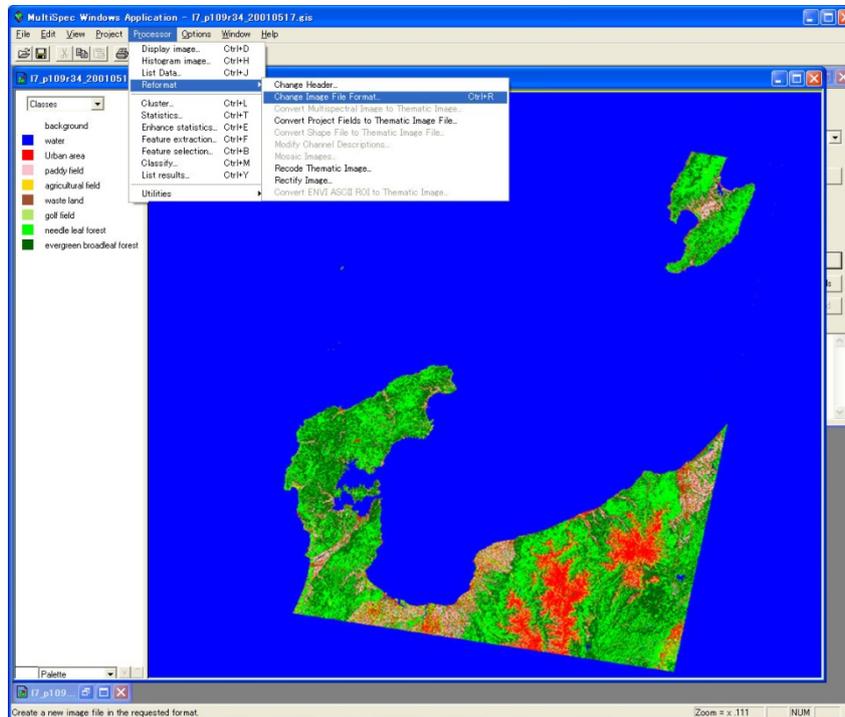


Chart 4.2.4-18 Category change-2

#### 4.2.5 Clipping the region of interest (ROI)

This chapter introduces the steps of how to clip the region of interest (ROI) in the supervised classification images.

- (1) Select “Change Image format” in “Reformat” from “Process Menu” (Chart 4.2.5-1).



☒ 4.2.5-1 Clipping the Region of Interest(ROI)

- (2) Set the image size of ROI. “Line” indicates the vertical position and “Column” indicates the horizontal position for clipping. Chart 4.2.5-2 shows an example for Line : 3291pixel – 5433, and Column : 1396 – 4029. After setting the position, click “OK”.

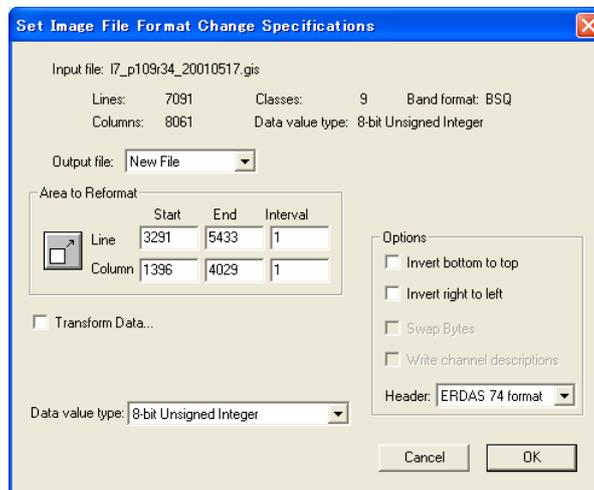


Chart 4.2.5-2 Setting the clipping position of ROI

- (3) Set the output file. Chart 4.2.5-3 selects “cut\_17\_p109r34\_20010517.gis.” Then, click “OK”.

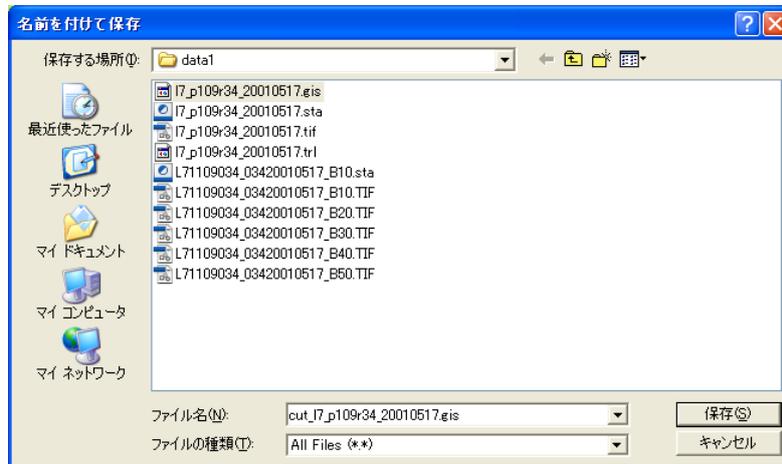


Chart 4.2.5-3 Output file

- (4) Open the created clipping file. Select “Open Image” in “File Menu” and select the created file “cut\_17\_p109r34\_20010517.gis” (Chart 4.2.5-4).

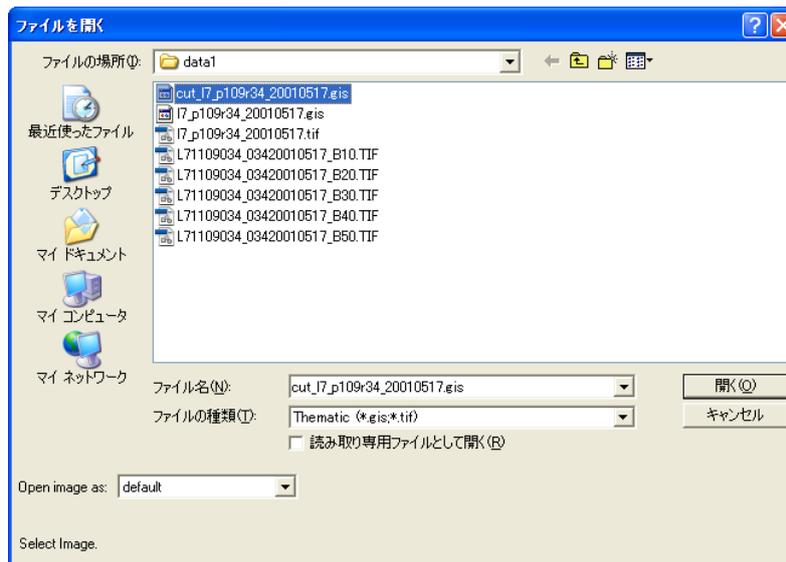


Chart 4.2.5-4 Selecting an image

(5) Information of the selected image is shown on screen (Chart 4.2.5-5). Click “OK”.

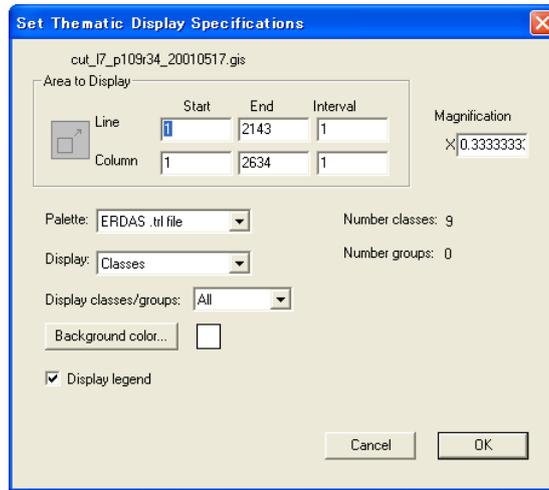


Chart 4.2.5-5 Information of the image

(6) The selected image is displayed (Chart 4.2.5-6).

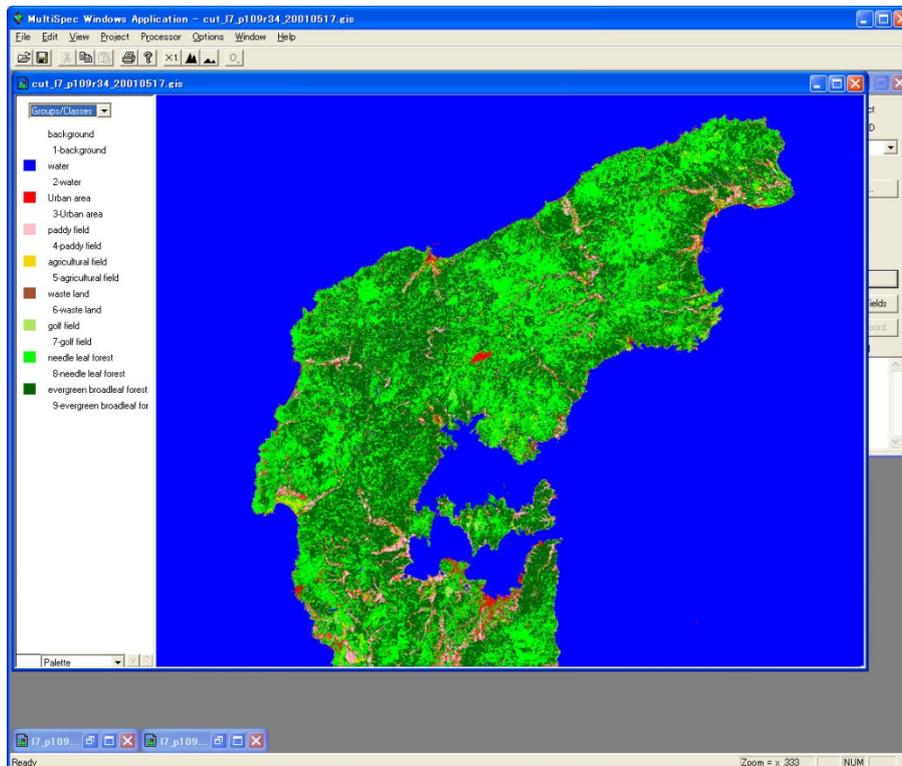
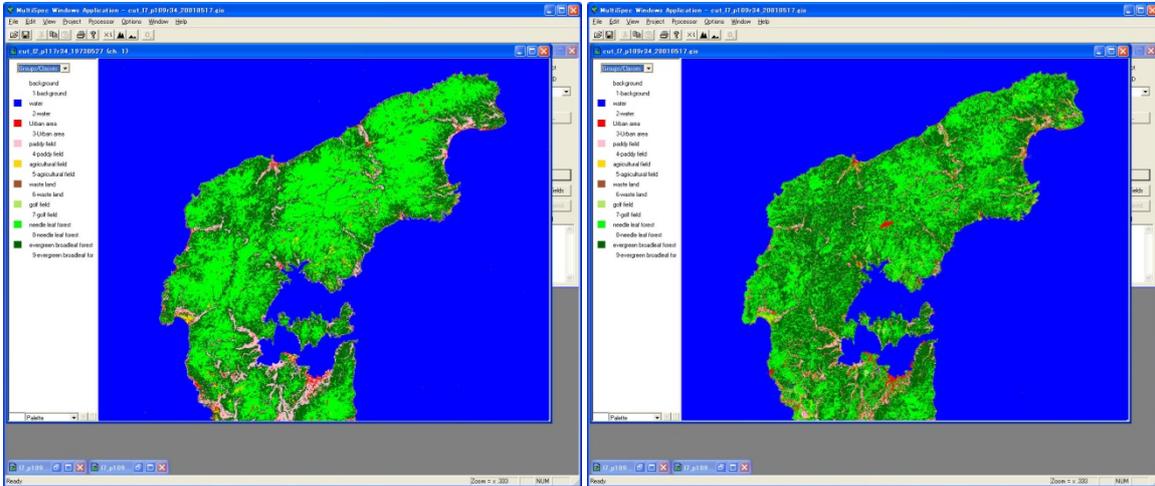


Chart 4.2.5-6 Clipped image by ROI

#### 4.2.6 Statistical data processing after supervised classification

This section introduces the procedures of statistical data processing for each pixel in supervised classification images created in the previous section.

- (1) the Statistical data processing is applied to the supervised classification of LANDSAT-7/ETM+ and LANDSAT-2/MSS images created by the same method as shown in the previous section.



LANDAT-2/MSS (taken on May 27, 1973) LANDAT-7/ETM+ (taken on May 17, 2001)

Chart 4.2.6-1 Created images with supervised classification

- (2) Make the images active for statistical data processing (click on the screen), and select “List results” in “Processor Menu”. Chart 4.2.6-2 shows an example of selecting LANDSAT-7/ETM+.

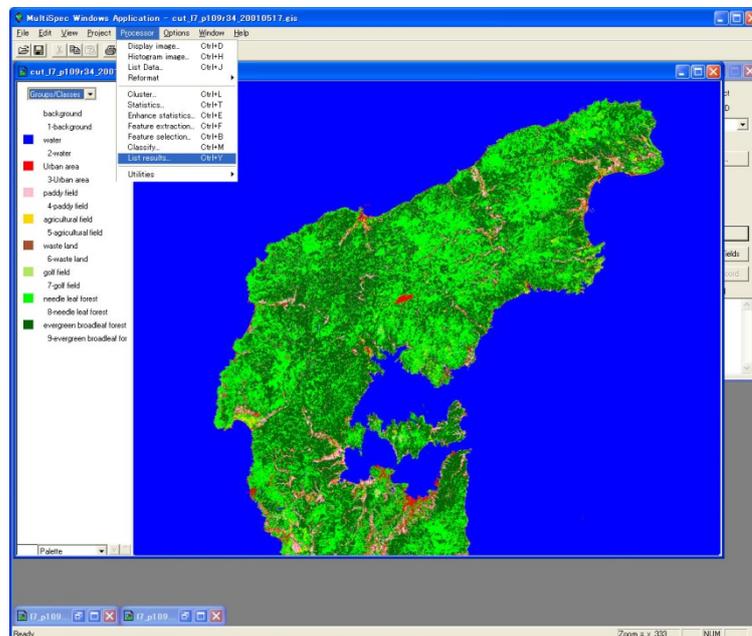


Chart 4.2.6-2 Statistical data processing-1

- (3) Set the following things as Chart 4.2.6-3 shows.
- List results for following areas : Image selection
  - Output result to : Disk file

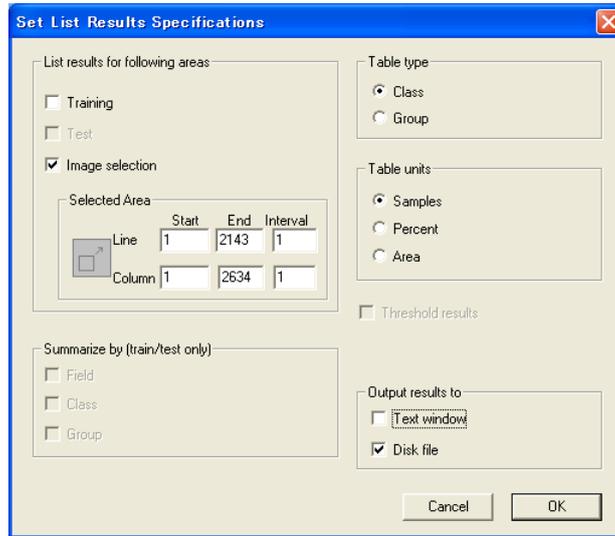


Chart 4.2.6-3 Statistical data processing-2

- (4) Set the output file. An example in Chart 4.2.6-4 selects “cut\_l7\_p109r34\_20010517.txt.”

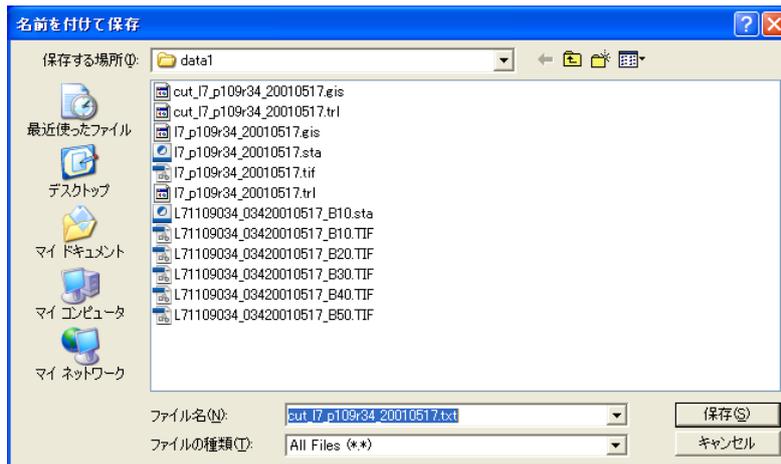


Chart 4.2.6-4 Result files of statistical data processing

(5) "cut\_l7\_p109r34\_20010517.txt" is a textfile, and can be viewed with text editors as below.

List Results 06-13-2010 22:13:08 (MultiSpecWin32\_3.25.2010)

Input Parameters:

Image file = 'cut\_l7\_p109r34\_20010517.gis'

Thematic Image Classes

- 0: background
- 1: water
- 2: Urban area
- 3: paddy field
- 4: agricultural field
- 5: waste land
- 6: golf field
- 7: broad leaf forest
- 8: needle leaf forest

Output Information:

CLASS DISTRIBUTION FOR SELECTED AREA

	Thematic Image Class	Number Samples	Percent	Area (Sq. meters)
1	background	0	0.00	0.0
2	water	3,734,513	66.50	3,361,061,700.0
3	Urban area	74,300	1.32	66,870,000.0
4	paddy field	93,447	1.66	84,102,300.0
5	agricultural field	25,988	0.46	23,389,200.0
6	waste land	4,035	0.07	3,631,500.0
7	golf field	2,527	0.04	2,274,300.0
8	broad leaf forest	777,148	13.84	699,433,200.0
9	needle leaf forest	903,751	16.09	813,375,900.0
	Total	5,615,709	100.00	5,054,138,100.0

0 CPU seconds for results listing. 06-13-2010 22:13:08

- (6) Apply the same statistical data processing to the other LANDSAT-2/MSS image (**cut\_l2\_p117r34\_19730527.txt**).

List Results 06-14-2010 22:13:08 (MultiSpecWin32\_3.25.2010)

Input Parameters:

Image file = 'cut\_l2\_p117r34\_19730527.gis'

Thematic Image Classes

- 0: background
- 1: water
- 2: Urban area
- 3: paddy field
- 4: agricultural field
- 5: waste land
- 6: golf field
- 7: broad leaf forest
- 8: needle leaf tree forest

Output Information:

CLASS DISTRIBUTION FOR SELECTED AREA

	Thematic Image Class	Number Samples	Percent	Area (Sq. meters)
1	background	0	0.00	0.0
2	water	935,648	66.51	3,368,296,800.0
3	Urban area	6,820	0.48	24,552,000.0
4	paddy field	37,944	2.70	136,598,400.0
5	agricultural field	6,121	0.43	22,035,600.0
6	waste land	1,932	0.13	6,955,200.0
7	golf field	0	0.00	0.0
8	broad leaf forest	242,253	17.22	872,110,800.0
9	needle leaf tree forest	175,985	12.51	633,546,000.0
	Total	1,406,693	100.00	5,064,094,800.0

0 CPU seconds for results listing. 06-14-2010 22:13:08

As a result, interannual change in forest area is detected (See Table 4.2.6-1).

	1973	2001	change (based in 1973)
Broadleaf-tree area (km <sup>2</sup> )	872.11	699.43	-172.68
Needleleaf-tree area (km <sup>2</sup> )	633.55	813.38	179.83
Total (km <sup>2</sup> )	1505.66	1512.81	7.15

Table 4.2.6-1 Secular change of forest area in Nanao Bay area

LANDSAT data in Toyama Bay area (Table 4.1-2) is also processed. Then, the images of Land Cover Classification with supervised classification can be viewed. (Chart 4.2.6-1 and 4.2.6-2).

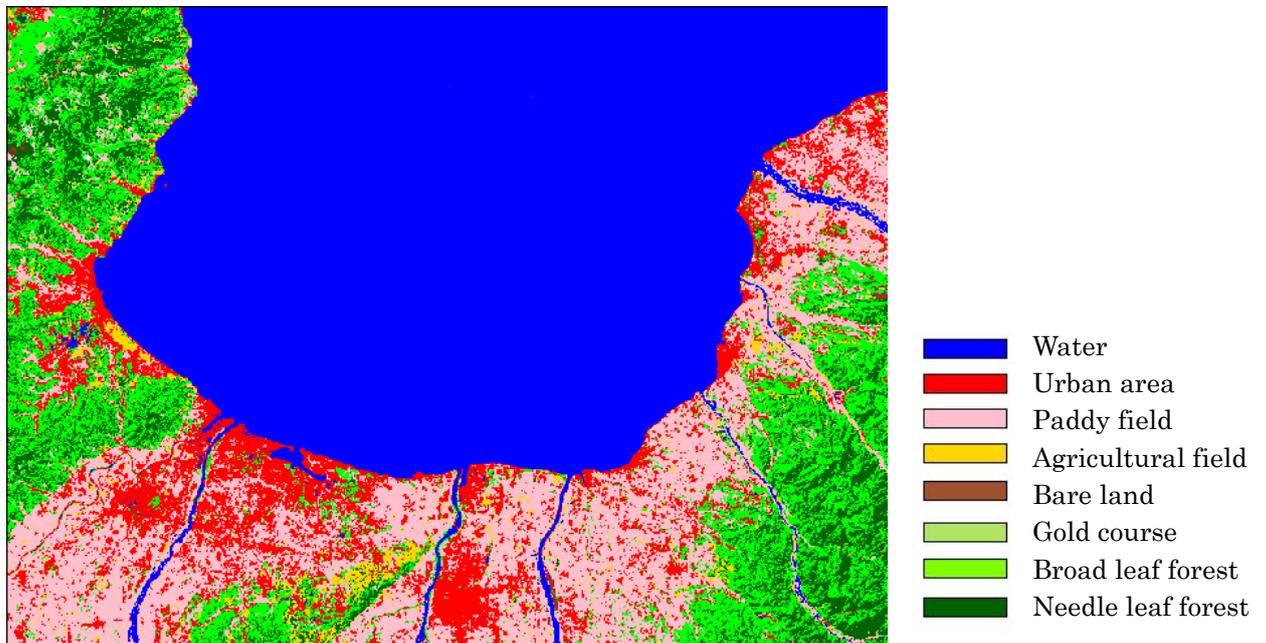


Chart 4.2.6-1 Result of Land Cover Classification with supervised classification by LANDSAT data (taken on Oct. 5, 1972)

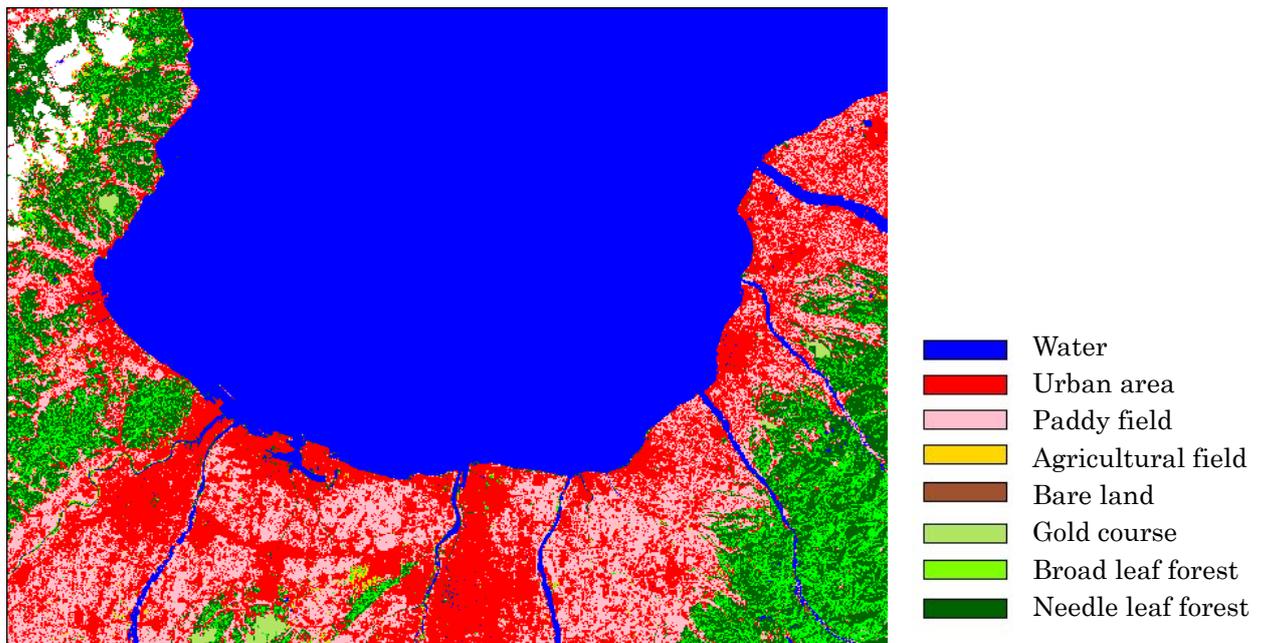


Chart 4.2.6-2 Result of Land Cover Classification with supervised classification by LANDSAT data (taken on Oct. 5, 2000)

Using the results of the supervised land cover classification shown above, interannual change of land cover in Toyama Bay area is analyzed. The result of the analysis is shown in Table 4.2.6-2.

	1972	2000	change (based in 1972)
Water area (km <sup>2</sup> )	975.55	905.72	-69.83
Rice field (km <sup>2</sup> )	349.19	262.37	-86.82
Urban area (km <sup>2</sup> )	218.08	445.27	227.18
Vegetable field (km <sup>2</sup> )	29.67	12.13	-17.54
Golf field (km <sup>2</sup> )	0.00	5.68	5.68
Wasteland (km <sup>2</sup> )	3.24	3.44	0.20
Broadleaf-tree area (km <sup>2</sup> )	248.35	98.35	-150.00
Needleleaf-tree area (km <sup>2</sup> )	143.82	207.24	63.42
Others (cloud) (km <sup>2</sup> )	0.00	26.10	26.10
Total (km <sup>2</sup> )	1967.90	1966.29	-1.61

Chart 4.2.6-2 Secular change of land cover in Toyama Bay area

The analysis result shows that as time passes (from 1972 to 2000), urban area including new golf fields has been significantly expanded, and agricultural area (rice and vegetable fields) and water area have been decreased. Also, while broad-tree area has been considerably decreased, needle-tree area has been increased.

## 5. References

The software “MultiSpec” used in the handbook is a free software which was developed by Purdue University, U.S.A. Although, there are no restrictions for its public use, all rights of the software are reserved by the Purdue University, USA.

Agriculture, Forestry and Fisheries Research Information Technology Center also provides overview of MultiSpec Manual and sample data in Japanese (<http://www.affrc.go.jp/satellite/MultiSpec/>).