

UNDERSTANDINGS FOR REGIONAL CHARACTERISTICS OF AGRICULTURE USING TERRA/ASTER DATA

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ABSTRACT: Terra/ASTER has high resolution, large band numbers and stereoscopic ability. Using the advantages, the regional characteristics of agriculture were investigated using Terra/ASTER from 4 years ago in our laboratory. At almost paddy fields are uniform by repeated cultivation, and upland farming fields are very different at bare soil and high vegetation for the crop rotation. 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 fields area at global. The area of Mekong Delta in South Vietnam and Northeast Thai Plains are famous to produce exporting rice. At the area, there is enough temperature, but limitation of rice growth is water. Northeast Thai Plains 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. At upland farming fields, Tokachi Plain and Wein area have small size field, and Denver area in USA and Buenos area in Argentine have very large size field. At Paris area and Bretagne in France, field sizes are medium. Riyadh area in Saudi Arabia is very severe in water supply and irrigation systems are necessary. Jordan Valley in Jordan is also severe and there are many irrigation ponds.

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. From this time, we started the study of "Understandings for regional characteristics of agriculture using satellite data".

2. 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

The procedure is as follows. 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.

3. PADDY FIELD ANALYSIS

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 Plains, Thailand, 5) Sacramento Valley, California, USA.

The results of the Shonai Plains in Japan are listed in Fig. 1, and that of Sacramento (Central) Valley, California, USA are listed in Fig. 2. We perform almost same procedure to Yangtze River delta in Middle-East China, Mekong Delta in South Vietnam, and North-east Thai Plains, 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 fields area at global. The area of Mekong Delta in South Vietnam and Northeast Thai Plains are famous to produce exporting rice. At the area, there is enough temperature, but limitation of rice growth is water. Northeast Thai Plains 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 (Fig. 2), 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.

Table 1 Characteristics of Each

	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

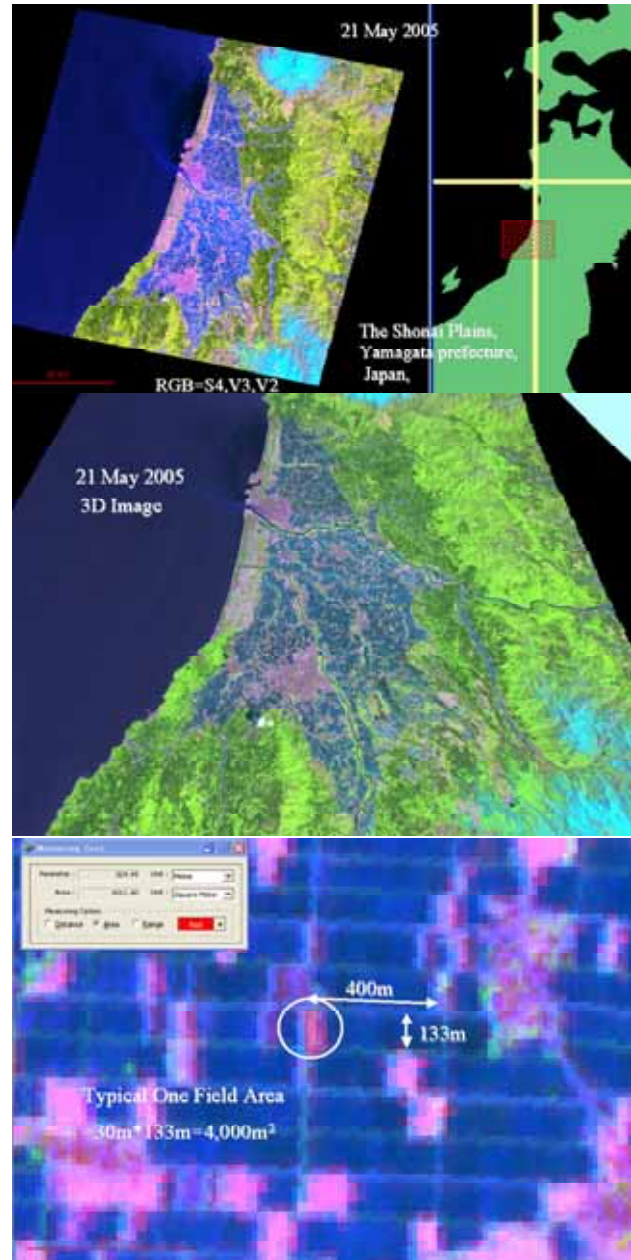


Fig. 1 Paddy fields of the Shonai Plains in Japan
Upper: Total scene of ASTER data and the map of location
Middle: 3D image of the Shonai Plains
Lower: Field size of the Plains

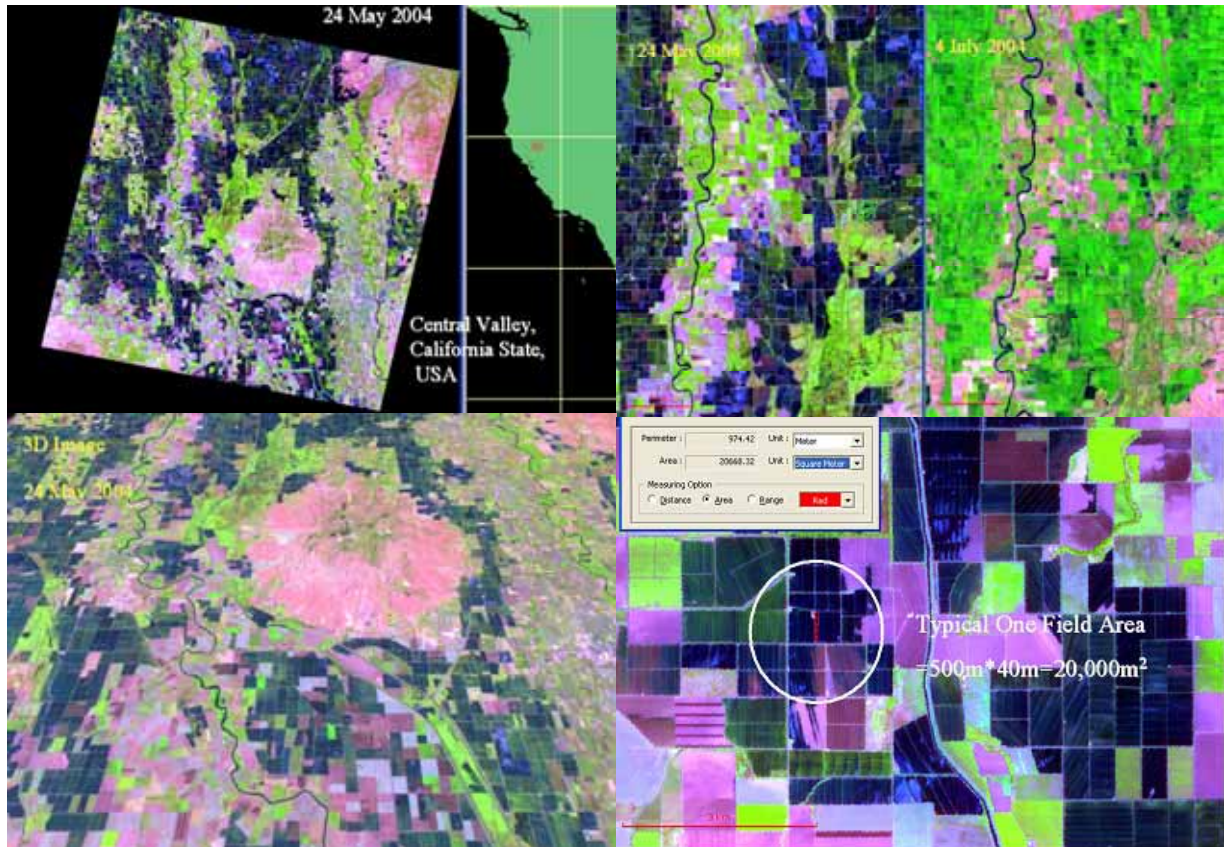


Fig. 2 Paddy fields of the Sacramento Valley, California, USA
 Upper left: Total scene of ASTER
 Lower left: 3D image of the Valley
 Upper right: The images of in May and July
 Lower right: Field size of the valley

4. UPLAND FARMING FIELD ANALYSIS

Target areas are Tokachi plain at Hokkaido in Japan, Riyadh area in Saudi Arabia, Jordan basin in Jordan, Bretagne area in France, Vienna area in Austria, Denver area in USA.

At many Asian countries, main crop is paddy rice, and at almost Japanese plain, rice paddy is main land use. Hokkaido Island in Japan is high latitude and it is difficult to make rice because of low temperature. Upland farming is main subject at Tokachi plain. Fig. 3 is the ASTER image of Tokachi plain, and color composite is R.G.B=red, near infrared, short wave infrared. UL means upper left, UR is upper right, and LR is lower right. The elevation of the image area is from 0 to 500 m by ASTER DEM. Each field size in this area is larger than paddy field area in Japan. Therefore, it is very smaller than that of USA. In this area, main products are winter wheat, beans, potato, sugar beet, and vegetables.

At Riyadh area, rainfall is 25mm/year. It is very severe in water supply and irrigation systems are necessary. Fig. 4 is the ASTER image of Riyadh area and color composite is same Fig.3. Almost area is bare soil, vegetation area is very small and only irrigated area. The elevation of the image area is from 550 to 750m by ASTER DEM. The Circle shape objects at large scale image are the pivot irrigation system using underground water that is pumped up. Main products are winter wheat and vegetables.

Jordan basin has small rainfall at 270mm/year, almost rainfall is January to March in winter

season. Main products are winter wheat and barley, vegetables, and fruits. Fig 5 is ASTER image of Jordan basin, and the elevation of this area is from -400 to 800 m. Jordan basin is severe for rainfall and there are many irrigation ponds.

France is agricultural country, and products wheat, barely, corn, potato and sugar beet. We studied the ASTER image at Bretagne aera in France. The elevation of this area is from 0 to 400 m Middle right (MR) image is two season NIR image (r: 8 June 2005, G&B: 3 Sep. 2005). Red area has vegetation at early June and no vegetation at middle August, and the area is winter crop that is wheat. Sky blue area has no vegetation at early June and has vegetation at middle August, and the area is summer crop such as corn, potato and sugar beet. Field size is almost same to Tokachi area in Japan.

Austria is mountainous country and only eastern part has plain. At this area produces cereals, fruits and vegetables. Fig 6 is listed the ASTER image of Vienna aera at eastan partt of Austria. The elevation of this area is from 150 to 500 m. The image shows that forest remains at flats area and some fields are long and narrow.

Colorado Stats in USA is a part of great plain which elevation is 1000 to 2000m. Main agricultural products are corn, soybean, wheat, and cotton. Fig 7 is listed the ASTER image of Denver aera at Colorado Stats in USA. The elevation of the image area is from 1500 to 1700m by ASTER DEM. Field sizes are larger than other area such as Tokachi Plain, Vienna area, Jordan basin and Bretagne area. There are pivot irrigation systems in the images.

5. FUTURE PLAN

In Asian countries, there is local farming, and we hope to determine the farming system collaboration with the researcher of each area. We want to continue the study of “Determination of Local Characteristics at Global Agriculture Using Archive ASTER Data”

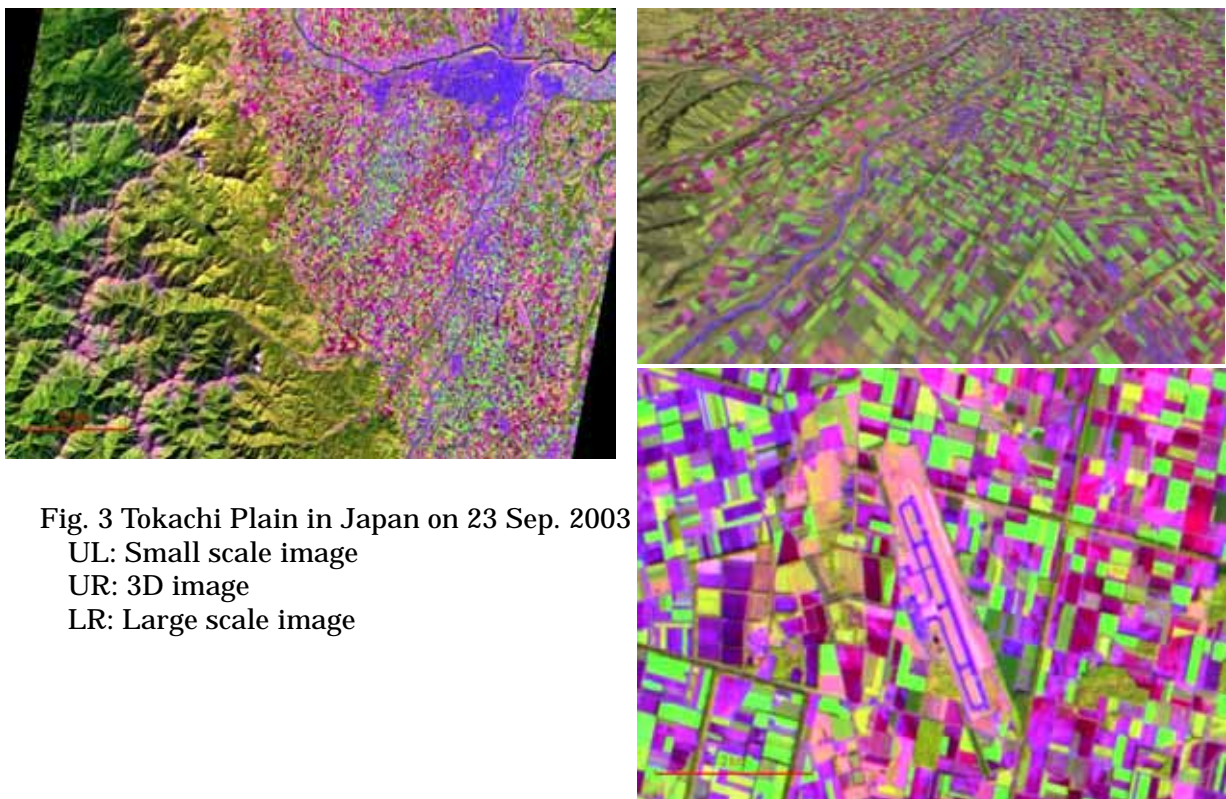


Fig. 3 Tokachi Plain in Japan on 23 Sep. 2003
UL: Small scale image
UR: 3D image
LR: Large scale image

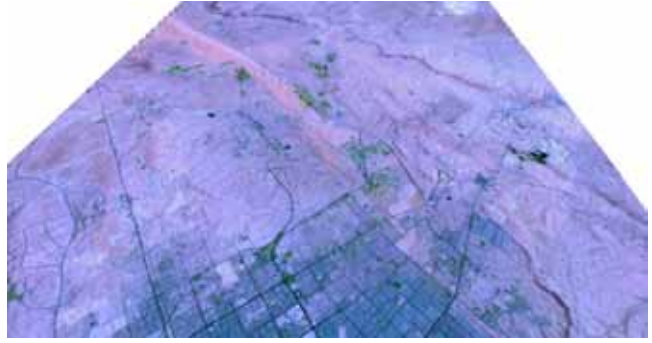
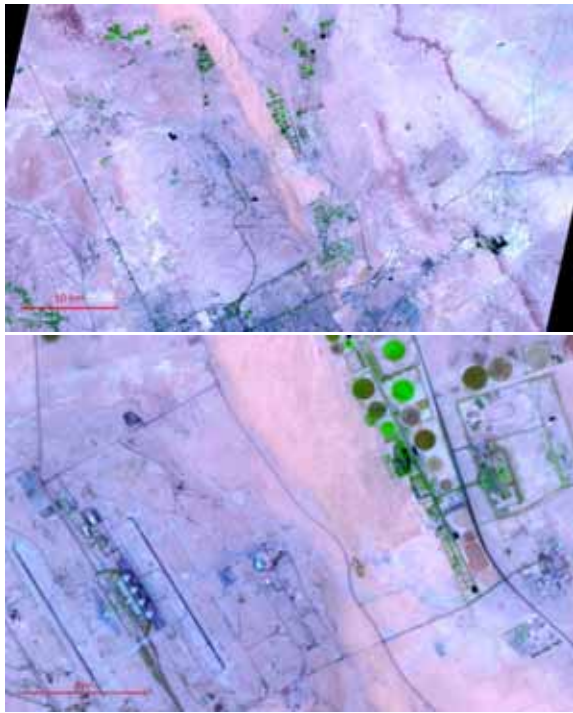


Fig. 4 Riyadh area in Saudi Arabia
on 28 April 2006
UL: Small scale image
UR: 3D image
LL: Large scale image



Fig. 5 Jordan basin in Jordan
UL: Small scale image on 16 Aug. 2005
LL: 3D image on 19 Mar. 2006

UR: Small scale image on 19 Mar. 2006
LR: Large scale image on 16 Aug. 2005

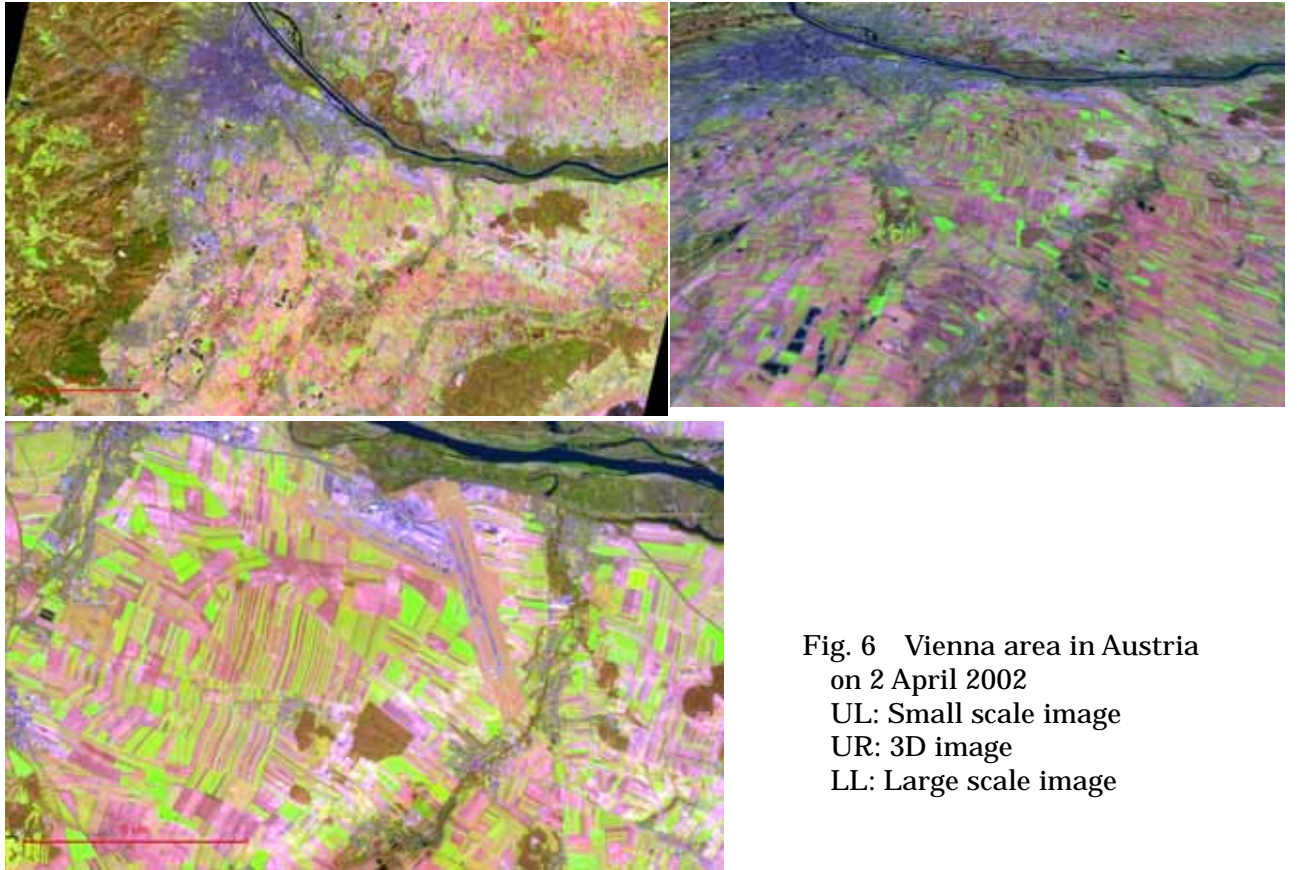


Fig. 6 Vienna area in Austria
 on 2 April 2002
 UL: Small scale image
 UR: 3D image
 LL: Large scale image

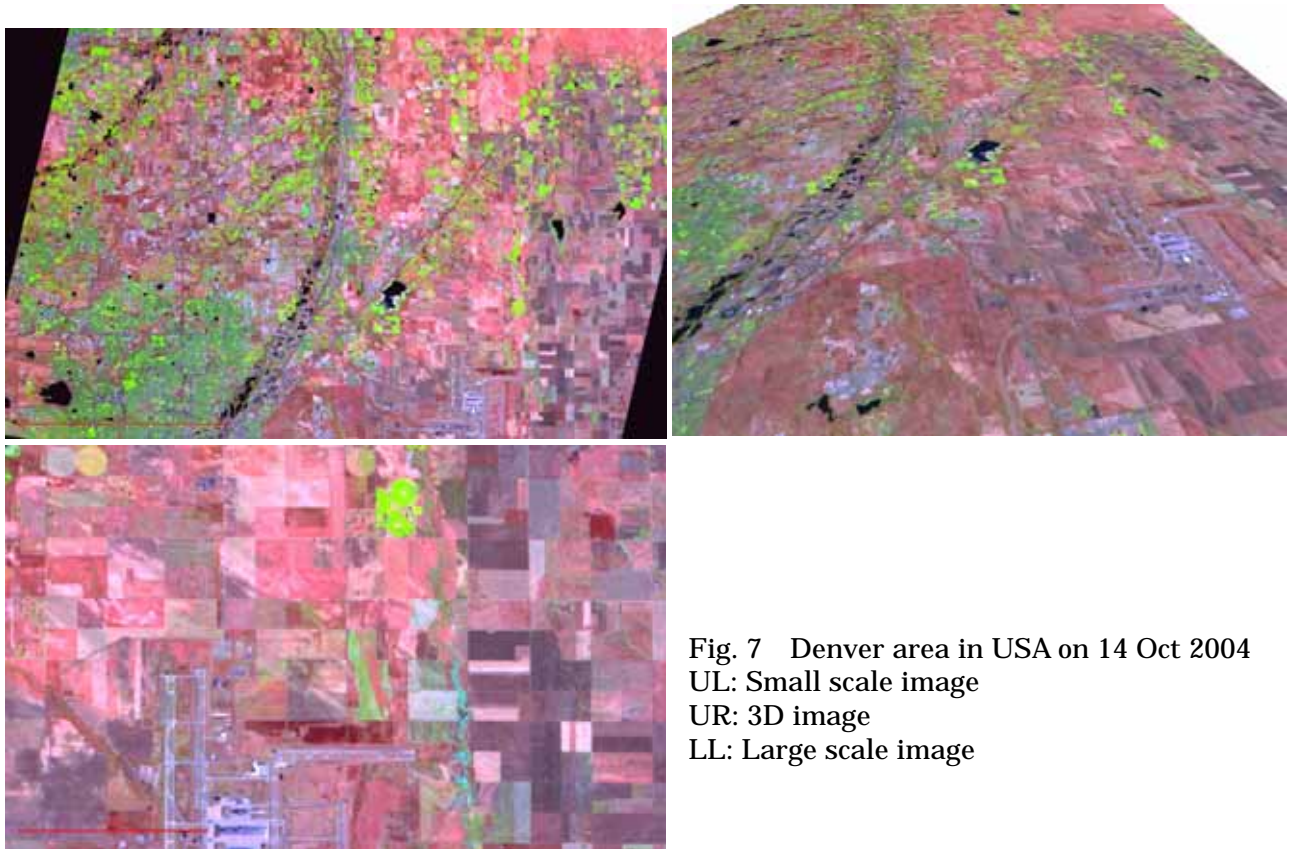


Fig. 7 Denver area in USA on 14 Oct 2004
 UL: Small scale image
 UR: 3D image
 LL: Large scale image