EDUCATIONAL FRAMEWORK OF REMOTE SENSING FOR FIELD SCIENCE CENTER, TOHOKU UNIVERSITY

G. Saito[a], F. Namiwa[a], D. Kunii[a], K. Imai[a], T. Sugihara[a]

[a]Graduate School of Agricultural Science, Tohoku University,
1-1 Tutumidori-amamiyamachi, Aoba-ku, Sendai, 981-8555, Japan, - genya@bios.tohoku.ac.jp

Commission VI, WG VI/1

KEY WORDS: Capacity Building, Data Infrastructure, Image Understanding, Change Detection, Crop Management, Land Use Mapping

ABSTRACT:

Field Science Center, Tohoku University is located in the west side of Miyagi Prefecture in Japan and included flat and mountainous area. The site has been used for experimental farm, grassland, and forestry of the university since 1947. There are forest, grassland, agriculture field, paddy and others, and the total area of our center is about 2,000 ha. Recently, the importance of terrestrial and marine field sciences might be realized in 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 established at April 2004 and started the lectures for remote sensing from this time. At the time, there was nothing about remote sensing and Geographical Information System (GIS) tools. First, we developed educational and analytical system for the remote sensing and GIS using hand made PCs at the lowest cost. During the system development, we are also starting to create GIS database for Field Science Center that named Digital Field Science Center. 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 large size scanner. We assemble the PCs for the optimal performance and the lowest cost. A gigabit LAN connects each PC, and one PC used for file server for store common data such as maps, remote sensing images, and GIS data. File server has RAID system for safety storage from HD trouble. Main-use software is Arc/GIS, ERDAS/Imagine and Leica Photogrammetry Suite, and we use them jointly with floating licenses. The remote sensing programs of ENVI, eCognition and PG-Streamer were already installed on some PCs. Free software as Multi-Spec and 3DEM is also installed each PC. We found a paper map of vegetation and forest management map which was created at the Field Science Center about 50 years ago, and the map was scanned for making raster file. The map does not have geographical information and we can understand only shape of fields. Using 1/25,000 of digital topographical maps of geographical survey Institute in Japan, we found several corresponding points that meant same points of the two maps. Satellite data are mainly taken by optical sensor such as Landsat/TM, Terra/ASTER and ALOS/AVNIR2. The ASTER data are orthonized by Silcast and then used for analysis. Other data were geo-corrected and geo-referred using ASTER data. The data are used for land cover analysis and biomass determination. Aerial hyper spectral imaging data of 190 bands were taken at late in July, middle August late, in September and late November in 2007. We could success to add geographical information, and the raster map of Field Science Center was listed on the 1/25,000 of digital topographical map. Japan Forest Technology Association took newly aerial photo at October 2002, and we use the photos. This image are 4 lines acquisition, and each line has 6 or 7 photos. First, scanning the photos by large size scanner. Next, we orthonized the photos at each line using Leica Photogrammetry Suite. At last, we mosaic the photos using same software, and highlighted field Center area. The operations were performed using Aisa System and organized by Earth Remote Sensing Data Analysis Center. Airplane flied form north to south at 3000m altitude. The resolution is 3m and swath width is 900m. We checked vegetation and condition of agricultural field in the field center. The lectures of remote sensing at undergraduate and graduate university course were started at 2004. The both lectures almost same contents, because both students are not familiar with remote sensing. Those lectures are at 3rd grade at undergraduate and 1st graduate students and for the lectures, we made the textbook named “Hand Book of Agricultural Remote Sensing.” Recently, almost students have their own note PCs, and the students practice remote sensing using Multi-Spec software, ASTER data and the PCs in the lectures

1. NTRODUCTION

Field Science Center, Tohoku University is located in the west side of Miyagi Prefecture in Japan and included flat and mountainous area. The site has been used for experimental farm, grassland, and forestry of the university since 1947. There are forest, grassland, agriculture field, paddy and others, and the total area of our center is about 2,000 ha.

Recently, the importance of terrestrial and marine field sciences might be realized in Japan, and remote sensing and GIS are powerful tools for the study (Remote Sensing Society of Japan, 2003. and OECD, 2004). For this reason, Remote Sensing Laboratory, Field Science Center, Graduate School of Agriculture Science, Tohoku University in Japan established at April 2004 and started the lectures for remote sensing from this time. At the time, there was nothing about remote sensing and Geographical Information System (GIS) tools. First, we developed educational and analytical system for the remote sensing and GIS using hand made PCs at the lowest cost. During the system development, we are also starting to create GIS database for Field Science Center that named Digital Field Science Center

2. DEVELOPED SYSTEM

2.1 Hardware

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 large size scanner(Fig. 1) We assemble the PCs for the optimal performance and the lowest cost. A gigabit LAN connects each PC, and one PC used for file server for store common data such as maps, remote sensing images, and GIS data. File server has RAID system for safety storage from HD trouble.

Our system has more than ten 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 100-1000 GB hard disk. Recently CPU is Dual Core Processor. One desktop PC is a data server 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 Four desktop PCs are no specific user and others are almost personal use.

2.2 Software

Main-use software is Arc/GIS, ERDAS/Imagine and Leica Photogrammetry Suite, and we use them jointly with floating licenses. The remote sensing programs of ENVI, eCognition and PG-Streamer were already installed on some PCs. Free software as Multi-Spec and 3DEM is also installed each PC. We can use freely ERDAS/Imagine, Leica Photogrammetry Suite and Arc/GIS by floating license system. We can use all software at personal PCs.

3. CREATION OF DIGITAL FIELD SCIENCE CENTER

3.1 Map Data

We found a paper map of vegetation and forest management map which was created at the Field Science Center about 50 years ago (Fig.3), and the map was scanned for making raster file. The map does not have geographical information and we can understand only shape of fields. Using 1/25,000 of digital topographical maps of geographical survey Institute in Japan, we found several corresponding points that meant same points of the two maps. We could success to add geographical information, and the raster map of Field Science Center was listed on the 1/25,000 of digital topographical map (Fig 3).

3.2 Satellite data

Satellite data are mainly taken by optical sensor such as Landsat/TM, Terra/ASTER and ALOS/AVNIR2. The ASTER data are orthonized by Silcast and then used for analysis. Other data were geo-corrected and geo-referred ed using ASTER data. The data are used for land cover analysis and biomass determination.

Fig. 5 is 3D images of the center area using Landsat/TM image and DEM and the Fig. is easily understood seasonal changes at the aria.

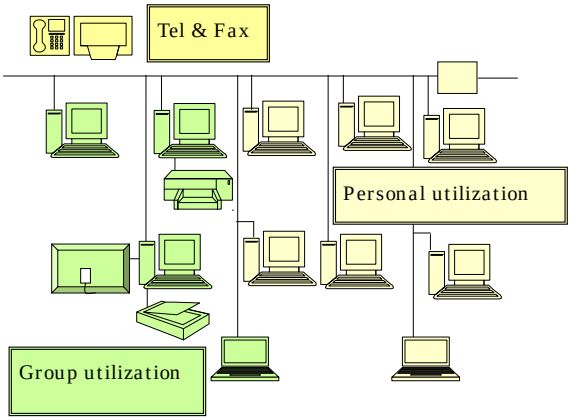

Figure 1. Hardware of education and research

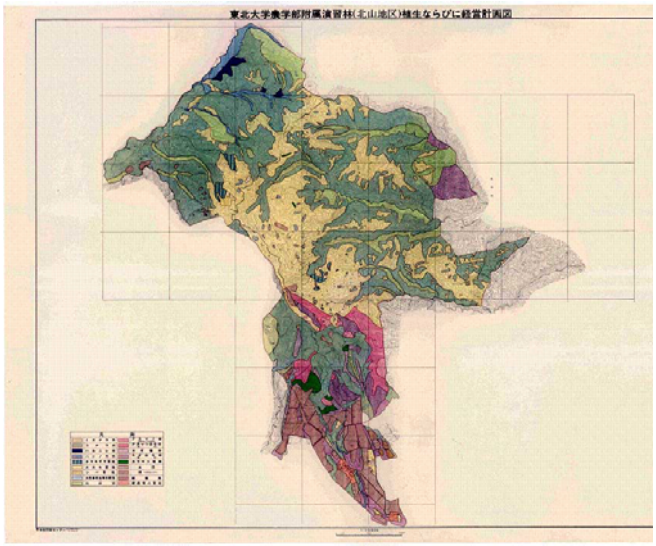

Figure 2. The paper map of Field Science Center

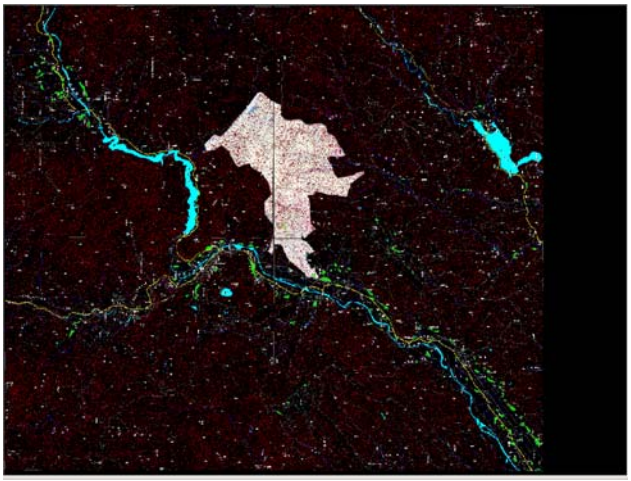

Figure 3. The map of Field Science Center on the digital map of 1/25,000 of Geographical Survey Institute in Japan

3.3 Aerial Photos

Newly aerial photos were taken at October 2002 by Japan

Forest Technology Association, and we use the photos. This image are 4 lines acquisition, and each line has 6 or 7 photos. First, scanning the photos by large size scanner. Next, we orthonized the photos at each line using Leica Photogrammetry Suite. At last, we mosaic the photos using same software, and highlighted field Center area. Fig. 6 is the mosaic image of aerial photos at Field Science Center and Fig. 7 is 3D images of the center area using aerial photos and DEM.

3.4 Aerial Hyper Spectral Imaging Data

Aerial hyper spectral imaging data of 190 bands were taken at late in July, middle August and late in September in 2007. The operation were performed using Aisa System and organized by Earth Remote Sensing Data Analysis Center. Airplane flied form north to south at 3000m altitude. The resolution is 3m and swath width is 900m. Fig. 8 is aerial hyper spectral images of Field Science Center on 21 September 2007. Selected band are almost Landsat TM as R: short wave infra red, G: near infra red, and B: green.

3.5 Field Survey

We checked vegetation type of forest and grassland area, and condition of agricultural field in the field center for these tree or four years. Every observation time of aerial hyper spectral imaging, we performed ground survey at same time. Now, we are making the map of Field Science Center using these field surveys, existing map and remote sensing data on our remote sensing system and GIS. Fig. 9 is the photo data of Field Science Center on aerial hyper spectral image.

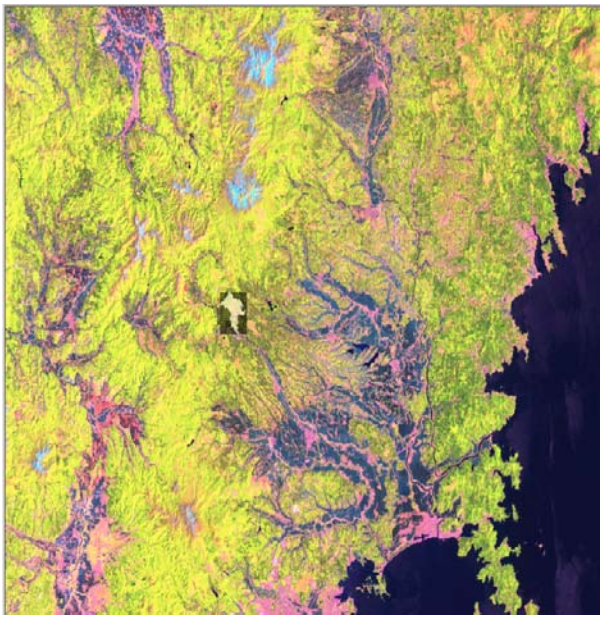

Figure 4. The map of Field Science Center on Landsat/TM images

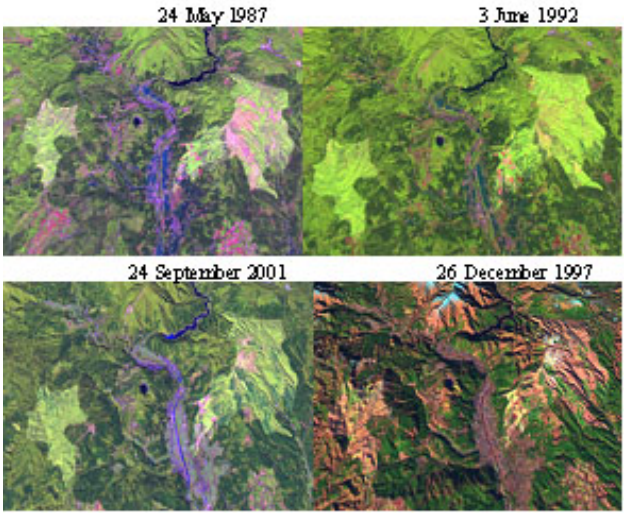

Figure 5. 3D images of the center area using Landsat/TM image and DEM

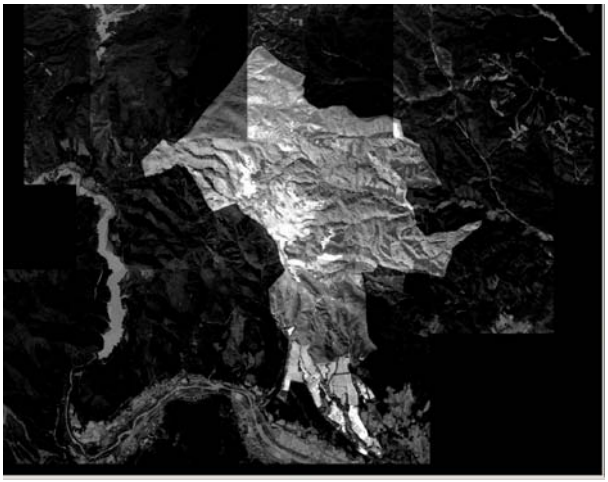

Figure 6. The mosaic image of aerial photos at Field Science Center

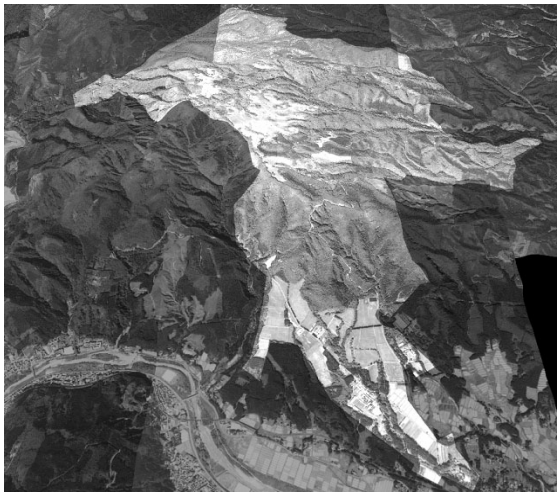

Figure 7. 3D images of the center area using aerial photos and DEM

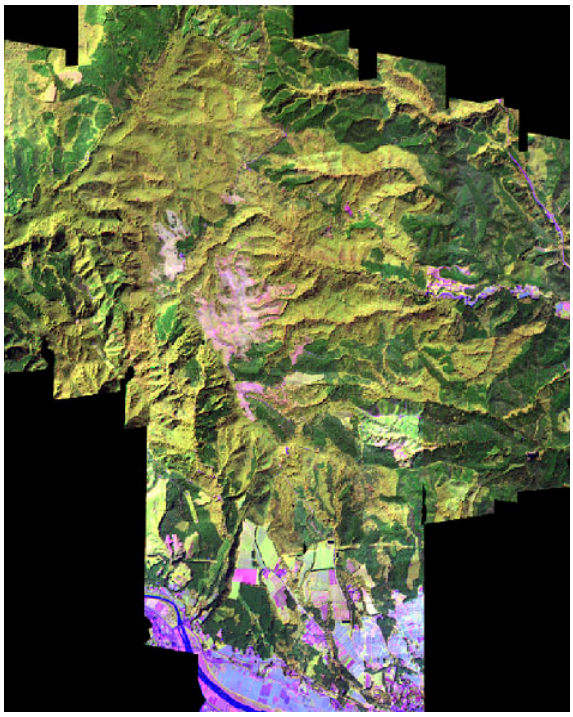

Figure 8. Aerial hyper spectral images of Field Science Center on 21. September 21.

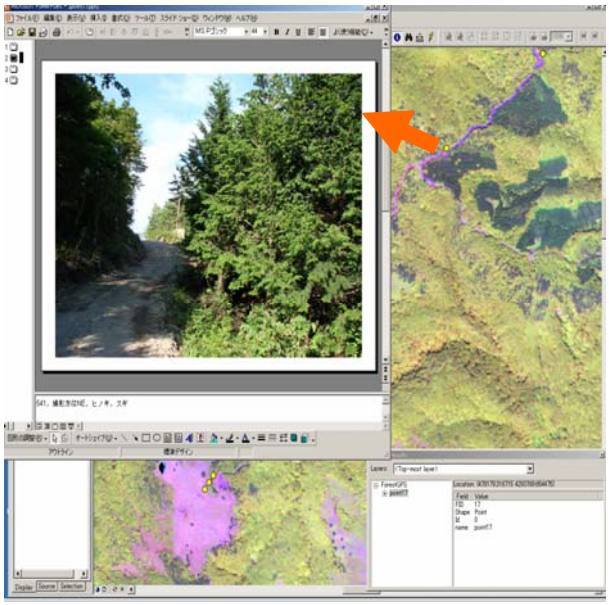

Figure 9. The photo data of Field Science Center on hyper spectral image

4. LECTURES OF REMOTE SENSING

The lectures of remote sensing at undergraduate and graduate university course were started at 2004. The both lectures almost same contents, because both students are not familiar with remote sensing. Those lectures are at 3rd grade at undergraduate and 1st graduate students and for the lectures, we made the textbook named “Hand Book of Agricultural Remote Sensing”(T. Akiyama, N. Ishitsuka, S. Ogawa, G. Saito and S. Uchida, 2007). Recently, almost students have their own note PCs, and the students practice remote sensing using Multi-Spec software, ASTER data and the PCs in the lectures.

CONCLUSIONS

Educational Framework of Remote Sensing for Field Science Center, Tohoku University is almost establish and it is necessary for developing every times.

REFERENCES

OECD, 2004. Remote Sensing for Agriculture and the Environment, pp285, Greece, ISDN960-88000-8-0.

Remote Sensing Society of Japan, 2003. Special Issue for Agriculture, Journal of the Remote Sensing Society of Japan, 23(5), 449-587, Japan.

T. Akiyama, N. Ishitsuka, S. Ogawa, G. Saito and S. Uchida, 2007. Hand Book of Agricultural Remote Sensing, pp518, The Japanese Agricultural Systems Socitety, Tsukuba Japan, ISBN 4-921201-22-7.