GEO-SURFACE ENVIRONMENTAL APPLICATIONS BASED ON 3D SPATIAL IMAGES AND GIS IN KOREA

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ABSTRACT

Human beings have led their lives on the basis of Earth and been in pursuit of more success and quality of life. At this time it should be noted that spatial information technology such as aerospace technology, electronic technology and surveying technology have become an essential part of their lives. In particular, satellite images as the information infrastructure of ubiquitous society have established as important technology that improve human economic activities and the quality of life, ranging from making image maps of the nationwide, managing cities and transportation, monitoring disasters, detecting the changes in the environment in a scientific way, farming management, forest assessment, and fishery management, real estate marketing, tourism, medical care, welfare and so on, by improving the basic geographical information on land into more scientific real-time information. Especially, the successful utilization of KOMPSAT-2 announces the beginning of new spatial information era in Korea. This satellite image based on geographic information service, which delivers the accurate scientific information, will bring changes in industry and life style. This paper intends to provide knowledge about techniques, and description of geo-surface application based on 3D spatial images, aerial photo and GIS. We hope to deepen the understanding by showing how these technologies are used in the field of agriculture, forests, water resources, meteorological phenomena, identification and remediation of disaster and climate, and so on. With increased awareness of geospatial technologies and its role in society we must continue to embrace geospatial information technology to adapt to these changing circumstances.

Keywords: Geospatial Information, 3D Spatial Images, GIS, Geo-Surface, KOMPSAT

1. INTRODUCTION

In so-called a 'ubiquitous' age, there is great evolution in the existing 3D spatial images and GIS from a human-centered concept to a spatial-information concept in which things are recognized as an object. And with the universal use of geospatial information, there is revolutionary evolution in conceptual and technological terms. Geospatial intelligence, which enables our real space to recognize the situation for itself and to provide necessary service automatically, can be referred to as a high-leveled stage of ubiquitous computing, one of whose remarkable features is that intelligence comes into operation beyond an individual unit of things but at the whole spatial level.

The need of 3D geospatial information is rapidly increasing. Currently the most often quoted area of human activities can be summarized as 3D urban planning, environmental monitoring, telecommunications, public rescue operations, landscape planning, geological, mining activities, transportation monitoring, real estate market, hydrographical activities, utility management, and military applications. Practically, the area of interests grows significantly when the 3D GIS functionality is available on the market.

Among the geospatial data, the satellite images that have been most widely used in the world include Landsat-7 and 5, QuickBird, IKONOS, MODIS, SPOTS, ASTER and others. In Korea, KOMPSAT satellite image series are widely used by public institutions, related research institutes and companies. Other countries like USA, France, India, Japan, and Canada, Russia, and European nations have developed the private systems for remote earth explorations to use the data. And some countries like Israel, China, Brazil, and Pakistan including South Korea have endeavored to share these efforts and achievements with the advanced countries. The United States launched Landsat-1 in 1972; it has used Landsat-7 since July 1999. It has produced, circulated and applied commercial satellite images such as IKONOS, QUIKBIRD, GEOEYE that are matching satellite photographs.

In Korea it has a multitude of artificial satellites, and plans for launching artificial satellites, including Uribyeol-1, the first artificial satellite launched in 1992, Mugunghwa-1-5, broadcasting and communications satellites (1995~2006), KOMPSAT satellite image series for Earth observation, marine observation, and scientific experiment (KOMPSAT-1 launched in 1999; KOMPSAT-2 in 2006; KOMPSAT-3 scheduled to be launched in 2012; KOMPSAT -5 in 2012), COMS for marine and meteorological observation (in 2010). In the future, the country plans to launch KOMPSAT satellites: 5th Satellite, a multi-purpose practical satellite, equipped with a synthetic aperture radar (SAR), 3 th Satellite, a multi-purpose satellite, equipped with high-resolution satellite images (70cm-class), 3A Satellite equipped with a thermal infrared observation function.

This paper introduce the geospatial information technologies in Korea such as satellite images, photogrammetry technology, National Spatial Data Infrastructure, 3D GIS augmented reality, geo-sensor for real-time then shows the possibilities of applying these geospatial information technologies toward various fields.

2. GEOSPATIAL INFORMATION TECHNOLOGY IN KOREA

2.1 Satellite images in Korea

Space programs in Korea has been persistently developed since 1990 with relatively short history and its various satellite resulted in various kinds of satellite images compared to simple image acquisition in the past and its application is also diversified. Application areas for satellite images are variably divided depending on classification and classifiers. Application areas for satellite images include map production, environments, maritime, geological features, forest, water resource, farming, climate and others. Other areas include researches on basic technologies required for processing technologies of satellite images, development of algorithm and evaluation of accuracy

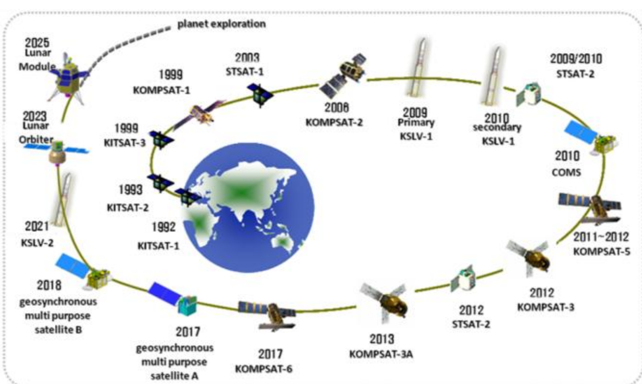


Figure 1. National Space programs in Korea(www.kari.re.kr)

2.1.1 KOMPSAT-1

Korea Multi-Purpose Satellite, KOMPSAT-1, which was developed by Korea Aerospace Research Institute, is equipped with high resolution electronic & optical camera, EOC (Electro-Optical Camera) is an electronic and optical camera to map nation, manage national lands and disaster and its major purpose to acquire image data to digitally map Han Peninsula and its specification is 510~730nm of single band with 6.6 m of resolution and approximately 17 km of observation width. OSMI (Ocean Scanning Multispectral Imager) equip with 800km of observation width, 850m of resolution and Cross Track Scan to observe maritime and especially changes in sea colors persistently. SPS (Space Physics Sensor) consists of high energy particle detector (HEPD) to detect high energy particle environments surrounding low earth orbit satellite and ionic layer measurement system (IMS) to measure thermion.

Table 2. Specifications of KOMPSAT-1(www.kari.re.kr)

Sensor	EOC(Electro-Optical Camera)		
Wavelength	510~730nm of single band		
Sensor	OSMI(Ocean Scanning Multispectral Imager)		
Band	Wavelength(nm)	Bandwidth(nm)	Applications
1	443	20	Density measurement for chlorophyll
2	490	20	Density measurement for vegetation
3	510	20	Turbidity measurement for chlorophyll
4	555	20	Turbidity measurement for vegetation
5	670	20	Atmosphere effect correction
6	865	40	Atmosphere effect correction

2.1.2 KOMPSAT-2

Korea Multi-Purpose Satellite, KOMPSAT- 2, which was launched in Plasektz of Russia on July 28, 2006, has its sun synchronous orbit of 685km above the Earth with 800kg of weight, 1.90m of diameter and 2.57m of height and 6.85m of length, resolution of 1m of black and 4m of color with high resolution camera (MSC, Multi-Spectral Camera) of 15km in observation width and its life expectancy for tasks is 3 years. This satellite is used for various applications such as monitoring various and huge natural disasters and surveying usage of natural resources, building geographical information system and map production. KOMPSAT-1 is equipped with electro & optical camera with 6.6m of resolution purchased oversea while KOMPSAT 2 is equipped with high resolution camera (MSC) of 1m of black & white and 4m of colors that is internationally co-developed.

Table 2. Specifications of KOMPSAT-2(www.kari.re.kr)

Imaging mode	Pan	Multispectral
Spatial Resolution	1m	4m
Swatch Width	15km	15km
Duty Cycle	>20% per Orbit	
Off-Nadir Imaging	Up to 45 degree	
Orbital Altitude	685km, Sun-synchronous orbit	
Operation Life	Minimum 5 years (Design Life :3years)	
Data Transmission	320 Mbps	
Revisit Time	Less than 3 days	
Data Storage	90 Gbits	
Dynamic Range	10 bits per pixel	

2.1.3 KOMPSAT-3 and 3A

A Korea Multi-Purpose Satellite, KOMPSAT- 3 will digitally take images on globe orbiting 14 times with 98 minutes of frequency a day, which is the first sub meter leveled globe observation satellite to carry out tasks for precision ground observation using high resolution electro and optical camera of 70cm in its resolution at altitude of 685km for next 4 years. Its speed is 7.4 km per second, which takes 10 minutes or so to pass through Han Peninsula carrying out its environmental observation tasks as ultra precision ground observation, maritime pollution, forest fire and others. KOMPSAT-3A is additionally equipped with Infrared Sensor based on the design of main body and optical system from KOMPSAT-3 and scheduled to be launched in 2012 for self-acquisition of infrared images for night observation on the ground. KOMPSAT-3A will be run with 530km of sun synchronous orbit, and provide infrared images required for GIS implementation for managing national lands and precise optical images for environment, agriculture and maritime and GIS applications and detecting forest fire and volcano.

2.1.4 KOMPSAT- 5

A Korea Multi-Purpose Satellite, KOMPSAT- 5 is equipped with Synthetic Aperture Radar (SAR) for the first time in Korea and with X-band(Spot mode : 1m, Strip mode : 3m, Scan mode : 20m) and it will be run at 550km of dawn-dusk orbit observing ground of Han Peninsula for next 5 years regardless of night time and daylight and weather conditions. This is expected to provide various radar images rapidly to complete golden missions such as GIS implementation for Han Peninsula, maritime surveillance, national land management, monitoring disasters and environments.

2.1.5 STSAT: Science and Technology Satellite-3

Science and Technology Satellite -3 has its purposes to observe atmosphere , environment, ground and sea level surrounding Korean peninsula as one of national space development long and medium term based plans and this satellite is equipped with MIRIS((Multi-Purpose Infrared Imaging System) and COMIS(Compact Imaging Spectrometer) MIRIS is near infrared observatory system to acquire infrared images for overall Korean peninsula consisting of near infrared camera observing space and another near infrared camera observing the Earth. COMIS is spectrometer for small images to spectrograph images of Korean peninsula and it is located 700km above the Earth with 30km of observation width and 37m of spatial resolution.

Table 3. Specifications of STSAT-3(www.kari.re.kr)

Near infrared space observatory camera	Near infrared globe observatory camera	Spectro-camera for small images
Wavelength: 0.9～2.0um (Viewing angle 3.67 degree x 3.67)	Wavelength: 3～5um Resolution: 42m Observatory altitude: 700km on the ground	Wavelength: 0.4～1.05um wavelength Degree 2～15nm Maximum number of bands: 64 channels Degree to recognize objects: 30m Observatory altitude : 700km on the ground

2.2 GIS technology in Korea

Recently, as necessity for GIS is appearing, Korea also began to introduce and implement GIS primarily for local government and government organizations from 1995 and also built GIS-based information system to most efficiently integrate and analyze spatial information and administrative information. This provides information based on GIS so that citizen lives under more convenient and comfortable environment with its goals to create new businesses which civil and public use GIS easily.

2.2.1 NSDI (National Spatial Data Infrastructure)

Recently advancement of wireless communication technologies and generalization of mobile devices resulted in advancement of ubiquitous computing technologies. Therefore, mobile GIS systems are actively researched to do query processes for spatial data effectively under ubiquitous environment. Ministry of Land, Transport and Maritime Affairs has ratified National Spatial Information Policies in 2012 and plans to invest on spatial information integration to implement national spatial information infra, cooperative governance, easy-to-approaching spatial information, intelligence of spatial information technologies and inter-operation for spatial information. In this map system is implemented with 1/1,000 for city area, 1/5,000 for rural area and 1/25,000 for forest maps.

Table 4. NSDI status in Korea (www.mltm.go.kr)

		Pilot project	2010 project	2011 project	2012 project
Integrated DB	Basic spatial information	41,004km²	56,605km²		
	Map for preserving cultural assets	1,171 EA	893 EA		
	Forest maps	8,780km²	13,195km²	18,303km²	18,512km²
	Coastal maps	1,323 maps	385 maps	405 maps	351 maps
System Development	Data management	Integrating center-city and province-city	Integrating central areas	Integration system and management	
	Information service framework	WMS,WFS,CSW, WPS	OpenAPI, MashUp	Public participation	
	System usage	DB utilization service	Smart phone service	Improving applications	Monitoring system
	Operating and supporting system	Operating and management system	Distribution system	Building security system	Spatial information management & updating

2.3.2 3D GIS Augmented Reality

Recently, domestic spatial information industry is a rapidly growing blue ocean business in the era of knowledge and information and its demands are sky-rocketing for spatial information based contents and fused service. Especially as 3D GIS is well recognized and its importance is increasing, cyber national land is implemented and this is extended into overall areas including administration, industries and defenses. 3D GIS, a core base for advancing industries, although it costs much at implementation phase, is able to create high added value when it is utilized after processing. Currently Korea will build realistic 3D cyber map with high resolution on numerical maps using spatial DB acquired by satellite images and aerial photography step-by-step basis and build spatial information infra structure and then produce and distribute 3D Cyber Map, advance public administrative services and activation of fused industries and provide app store services. This plan for building 3D spatial information portal has its goal to enter into world top 3 in spatial information area by 2015.

a) Seoul b) Yeosu Expo

Figure 2. Open Platform (www.vworld.kr)

2.3.3 Using Geo-sensor for real-time in/ out door 3D spatial information interface Technology

While conventional GIS has usually handled 2 or 3D static spatial data, GIS has begun to integrate GeoSensor for ubiquitous environment. GeoSensor can directly and indirectly acquire positional information such as RFID reader, mobile RFID reader, sensor nodes, telematics terminal and CCTV while it generates various types of data related to position as streams. These fused technologies are used for various location based services such as controlling logistics, taxi and mobile GIS by providing results of query for past and future location of moving objects via database in moving objects in a way that adds concept of time and queries history information and switched to outdoor measurement system from indoor-centric database building. In addition, by combining GeoSensor data collected by data mining technologies of u-GIS with conventional GIS data, it's possible to create useful information which couldn't be explored before and then use them for expert's decision making. Moreover, as situational information (temperature, humidity and brightness) collected by GeoSensor data and GIS data (surrounding spatial information) are integrated into a single entity, it becomes available to create more value added information.

a) Outdoor 3Dimension (www.esri.com) b) Indoor 3Dimension (www.vbuilders.co.kr)

Figure 3. 3D in/outdoor simulations

Korea has been implementing National Geographic Information System (NGIS) on step-by-step basis. The first phase is to build a basis for GIS focused on computerization of national basic maps for national spatial information such as making numerical maps for topographical map, map with common theme, underground facilities, cadastral map and implementing database from 1995 to 2000. The 2nd phase is focused on implementation of various application systems using spatial information from 1st phase and the utilization from 2001 to 2005. The 3rd phase is focused on integrating accumulated database and application systems for each area and institute and thus creating synergy effects from 2006 to 2010. The 4th phase is under process for national spatial information system to implement societies which all people in Korea can easily share and use regardless their location and time to pursue for quality of life and green competitiveness from 2011 to 2015. In addition to these, GIS businesses and its technologies, beyond generation of national maps, are extended and commercialized into various and high technologies such as dynamic navigation system using high precision positional information, object recognition technology based on actual image, positional correction technology and reality method based on augmented reality, and web-based user information.

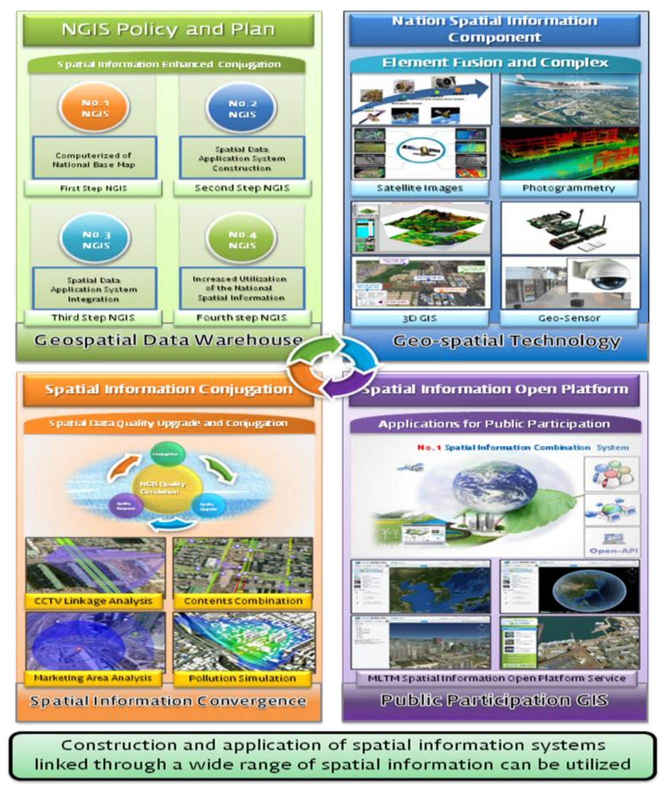


Figure 4. National Geographic Information (NGIS) Plan

3. GEO-SURFACE ENVIRONMENTAL APPLICATION BASED ON 3D SPATIAL IMAGES AND GIS

Currently variety of software is already capable of handling a wide range of spatial problems, beginning with approaches for describing spatial objects to quite complex analysis and 3D visualization. However, increasing number of applications need more advanced tools for representing and analyzing the 3D real world. Among all types of systems dealing with spatial information GIS has proven to be the most sophisticated system that operates with the largest scope of objects (spatial and semantic), relationships and provide means to analyze them. The most significant achievements in the 3D research area concerning key issues of 3D. 3D visualization within 3D GIS requires appropriate means to visualize 3D spatial analysis, tools to effortlessly explore and navigate through large models in real time. The development of data integration solutions thanks to global imaging data acquired by way of satellite images,3D GIS and aerial photographs, multi-dimensional spatial data and dynamic data streams, cannot only monitor unusual weather but also can analyze all spatial phenomena that happen on the ground so as to make predictions about the future, which makes it possible for it to be used in different fields, such as agriculture, forests, monitoring the environment, cities, water resources, atmospheric circulation management, natural disasters, etc.

3.1 3D Topographic Mapping in River area using LiDAR and SONAR Data

The topographic establishment of interior and exterior floodplains located mainly along the embankment line of the area next to a river is important in regard to the protection of the river environment and the related ecosystem, the development and management of the area next to a river, and the simulation related to flooding. In particular, the underwater topographic monitoring process which causes changes to a river bed is significant for the construction of an embankment and the estimation of a dredging amount for interior and exterior floodplains.

In the past, a number of ground measuring technologies were used to extract such topographic information of a river. However, such tools as LiDAR, SONAR, a single beam and a multi-beam have recently been used in such countries as the US. This case study focuses on the topographic establishment of a precise river structure including interior and exterior floodplains in order to obtain the information of major infrastructure and construct a database for the 4 Major River Project which is currently being executed by the government. For such a purpose, the LiDAR data has been used for the interior floodplain of an embankment, while the SONAR data has been utilized for the exterior floodplain. For the continuous indication of such data, the mosaic tool of EDARS Imagine has been used. By executing a continuous monitoring process for the topography of a river, it will be possible to extract topographic data for the cross section of a river bed and check the current state regarding changes to a river bed in the future. Also, while executing the continuous monitoring process for chances to a river bed, which could possibly lead to a flood, it will be possible to establish a dredging plan, organize a river channel for the maintenance of a river bed, and manage a riverside and a crossing structure (Myung Hee Jo).

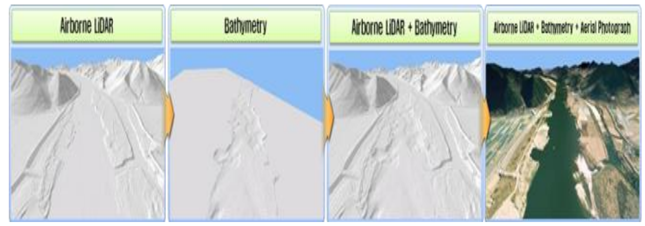


Figure 5. Generation of the topography by combining data for land areas and water areas

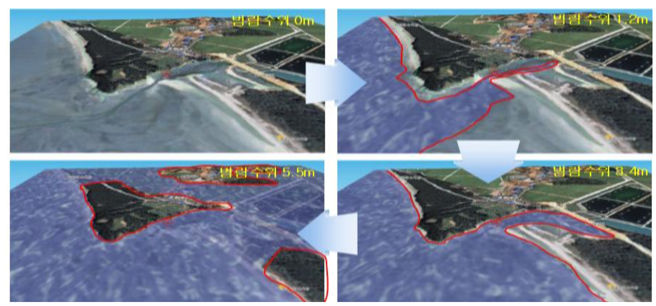
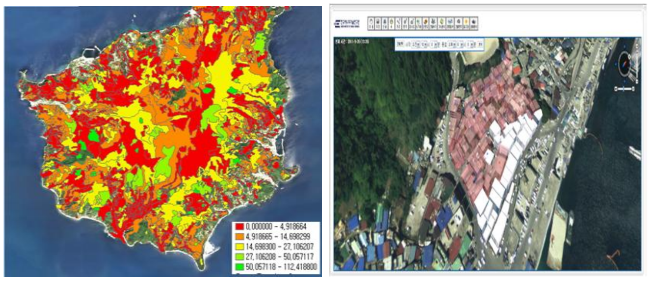


Figure 6. Inundation simulation using 3D image based river areas

3.2 Suitability Analysis for Renewable Energy using DSM and Satellite Image

It has recently become important to draw up an inventory of the resources available with a view to conducting an in-advance computer simulation of the selection and effect of new renewable energy beds based on high-resolution satellite images, GIS spatial analysis and 3D information technology. Especially when selecting a suitable location for energy facilities is it necessary to use satellite image information about a region in question and information from thematic maps to take into account the natural environment (insulation/sunshine, rainfall/snow/snowfall, wind speed/wind quantity/wind direction, air pressure/airstream, cloud shape/cloud quantity, land heat, humidity), the topographic environment (DEM/DSM, aspect, water system, soil, geological features, forest type), and the social environment (administrative maps, population distribution maps, industrial distribution maps, land-use maps, land-cover maps, traffic maps, cadastral maps). In the following, in order to construct wind-power energy facilities, this study performs a land-cover classification and spatial analysis of ground temperature and topography, on the basis of which it does 3D modeling of an expected suitable region for renewable resources map and performs a computer simulation of it to evaluate their efficiency (Myung Hee Jo).



a) Forest biomass mapping b) Solar energy mapping

Figure 7. Renewable energy mapping

3.3 Mapping potential landslide area and vulnerable area using GIS data and Satellite Image

The world including our country has been frequently faced with natural disasters such as flood, drought, earthquake, tsunami and forest fire, which caused by meteorological calamity. Korea has nationally controlled natural disasters such as inundation from flood, forest fire from drought and landslide. And in particular, the spatial information is to systemize a series of process ranging from site information comprehension to prediction and the information is shared by the related department of the central government and between those local governments in order to minimize damage from those natural disasters. For this purpose, a diversity of site sensor information as well as satellite images and aerial photographs are integrated and controlled, real-time, especially in relation to a disaster site.

Recently the large scale of forest disaster such as landslide and forest fire gives a very bad impact on not only forest ecosystem but also farm business so that it has became the main issue of environmental problems in Korea. In this study, the landslide hazard area forecast method was developed by considering not only the topographic thematic maps based on GIS and satellite images but also amount of rainfall data, which are very important factors of landslide. GIS weight score and overlay analysis were applied to topographical map and meteorological observation map. Finally the landslide area distribution map was constructed by considering the evaluation criteria. Also, the accuracy could be acquired by comparing the landslide hazard area forecast map and real damaged area extracted from satellite image (Myung Hee Jo).

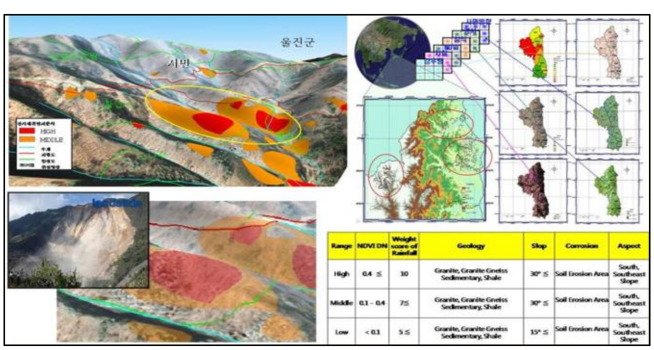


Figure 7. Mapping potential landslide hazard area

3.4 Identifying Crop Cultivation Land (paddy and field) using Satellite images and GIS data

Recently many developed countries have used satellite images for classifying the size of cropland area. Korea also has used satellite images for the same purpose since KOMPSAT-2 was successfully launched and operated in 2006. In this study various satellite images (ASTER, Spot-5, Rapideye, Quickbird-2, Geoeye) were used to calculate the size of cultivated area using objected classification method. Also their usability and effectiveness for the cultivated land survey are verified by comparing with field survey data. Finally, Geoeye and Rapideye have higher accuracy to calculate the rice yield area while Geoeye and Quickbird-2 have higher accuracy to calculate the field area (Myung Hee Jo).

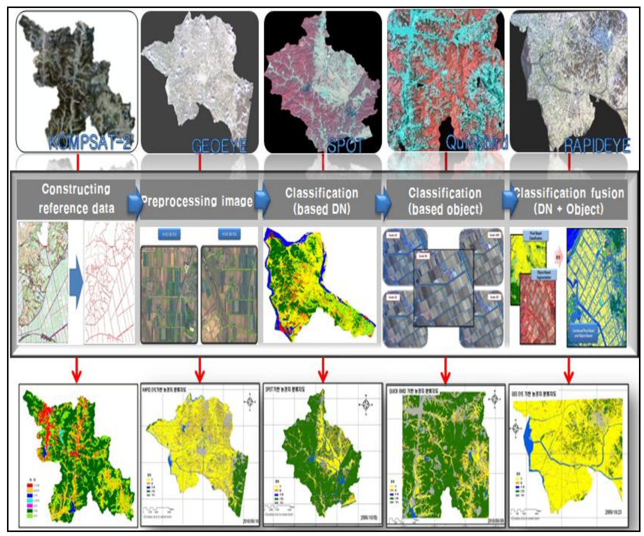
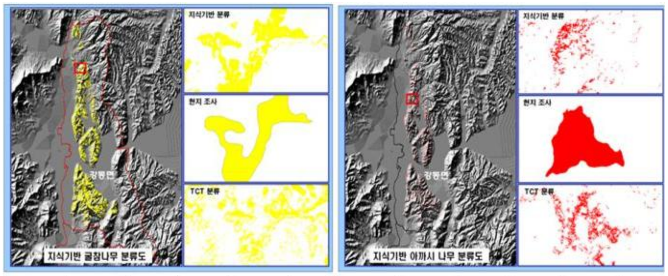


Figure 8. Cropland area mapping based on satellite images

3.5 Mapping Forest Type Classification using KOMPSAT-2 Image

The image processing and analysis technologies especially classification methods have been developed for the long time for these various applications of satellite image data. This study developed the advanced classification method for indefinite class especially specific tree species using remote sensing technologies and GIS. Various data sets for knowledge based classification (each band spectral characteristic of KOMPSAT-2, slope, aspect, elevation and MSAVI) was first constructed and knowledge based classification algorithm of decision making model was performed. The efficiency of knowledge based tree species classification method was clarified after comparing with 1:1,000 scaled forest type map. Finally, the development of knowledge based tree species classification method using KOMPSAT-2 image data can be applied to collect and analyze domestic forest resources (Myung Hee Jo).



Division	DGPD site surveying	knowledge based	Accuracy	TCT based classification	Accuracy	Division	DGPD site surveying	knowledge based	Accuracy	TCT based classification	Accuracy
oriental oak	9.13 (51%)	8.77(49%)	96%	7.20(40%)	78%	Black locust	1.07 (6%)	0.36(2%)	34%	0.89(5%)	83%

Figure 9. Mapping forest type classification using KOMPSAT-MSC image

3.6 Surface Temperature Change Analysis Using ASTER TIR Satellite Image

The most important task in the field of meteorological phenomena and climate is to conduct the modeling and prediction of ozone-layer formation. Furthermore, satellite images are used for the measurement of earth radiant energy and reflected energy and the modeling of the earth climate. Low-resolution meteorological satellite images are widely used; and the thermal band of mid-resolution satellite images like Landsat TM is used in some regions. This is a plan to achieve spatial information such as heat island and wind roads, which have become global, hot issues. In this study, the surface temperature environment change between before and after Cheonggye Stream Restoration Project was mapped and analyzed by using ASTER (Advanced Spaceborne Thermal Emission Reflection Radiometer) TIR (Thermal Infrared) satellite imagery, the correlation analysis was conducted through comparing the difference between atmosphere temperature of AWS (Automatic Weather System) and surface temperature of ASTER. Furthermore, this study will be the infrastructure of urban meteorology model development by understanding surface temperature pattern change and executing quantitative analysis of heat island (Myung Hee Jo).

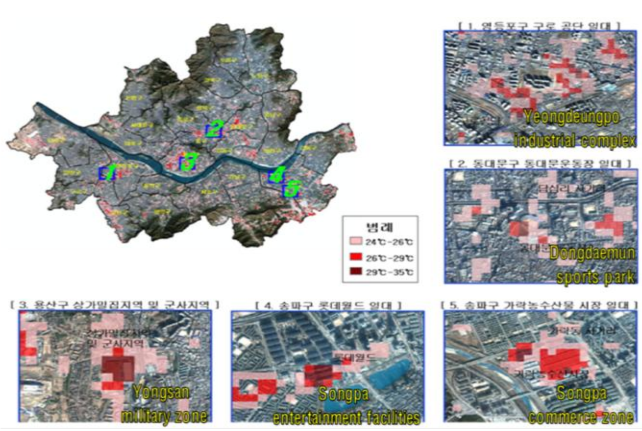


Figure 10. Surface temperature change analysis using ASTER TIR satellite image

3.7 Detecting Aquaculture Facilities for Seaweed, Ear Shells and Fish by using Aerial Images

Korea is surrounded by sea on three sides. This country has been supplied with a variety of aquaculture products cultivated on shore. There have recently been a lot of studies to have better understanding of the correct location and quantity of aquaculture farms for seaweed, ear shells and fish that cover a wide area of sea. This study uses higher resolution aerial images (25 centimeters) than satellite images of 2~2.5-meter resolution that have been ever used, to conduct an accuracy detection of the facilities of aquaculture farms. It chooses as the object of research Wando-gun that has aquaculture farms for seaweed, ear shells and fish. It obtains aerial pictures of the island, conducts an image correction of them, constructs spatial DB and thereupon performs a detection of the aquaculture facilities. An analysis of facilities inside and outside the permitted areas reveals that there has been an increase in the facilities of seaweed and ear shell aquaculture farms outside the permitted areas (Myung Hee Jo).

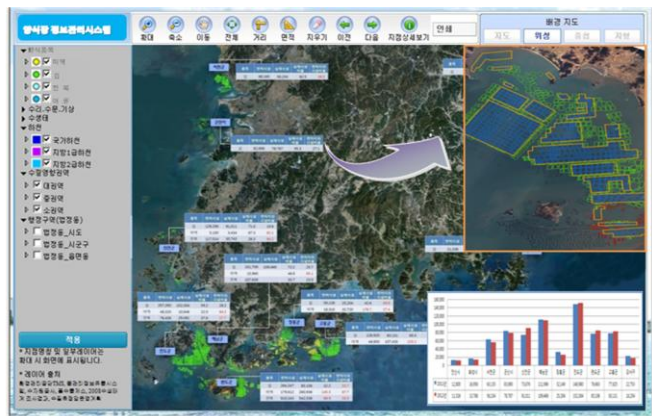


Figure 11. Detecting aquaculture facilities for seaweed, ear shells and fish

4. CONCLUSION

Geospatial information technology has recently gone in the direction of unifying various kinds of technology, such as earth-observing satellites and weather satellite image information that objectively deliver new information on the earth space and unusual weather, high-spectral sensor images and LiDAR that can sensor unidentified information on the ground surface of the earth, and 3D GIS, which makes it possible to conduct in-advance computer simulations.

This study intends to provide knowledge about techniques and was design to show the practical potential utilization of satellite imagery, KOMPSAT, aerial photo, LiDAR, and 3D GIS for technical analysis in time and space to extract the surface characteristics and integrate these with system. It then focuses on the management and integration to specific fields such as monitoring the environment, water resources, river management, agriculture, forests, rivers and streams, disaster and calamities, marine, atmospheric circulation management and so on.

This study shows reliable and satisfactory results to carry out multidimensional terrain analysis of earth surface using the 3D spatial images and GIS. With the result we can get reliable spatial information with high resolution, and more than 3D spatial analysis techniques and time-spatial analysis. Through this we can expect to make good use of much more realistic perspective image map in real life. Our 3 dimensional images is the result of combining the GIS and 3D spatial images efficiently. Finally, we could monitor, manage and approach to analysis of changes of the surface characteristics in a more systematic and efficient way by using geo-surface environmental application based on 3D spatial images and GIS.

Furthermore, if spatial information technology can be used at the national level, this spatial information technology can further the U-Eco City, an eco-friendly information management system that links ecological technology with the space for human lives, and enhance the global competitive edge in response to international environmental regulations. Once Korea develops space products by using its unique advantages to converge highly developed and component technologies and by securing independence in the field of commercially viable satellite technology, it will become one of the world’s satellite powerhouses and space powers in the years to come.

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