Ice Breakup Dates on 18 Eurasian Lakes Estimated by MODIS Data from 2001 to 2005

Takashi Nonaka (PASCO Corporation), Tsuneo Matsunaga (National Institute for Environmental Studies), Akira Hoyano (Tokyo Institute of Technology)

Background
- Snow and ice is widely taken as one of the important indices showing climate change.
  "Ice breakup date" of the lake and river has become early about fewer weeks over the past century. (IPCC, Intergovernmental Panel on Climate Change, 2001)
- However, few in-situ data of the ice breakup date exists on Eurasian continent.
  (For example, Lake Baikal)
- Remote sensing is especially useful to estimate the ice breakup dates for the lakes with no available in-situ data.

We developed the method to estimate the ice breakup dates in previous studies.
In this study, the ice breakup dates on 18 Eurasian lakes from 2001 to 2005 are estimated and the relationships between ice breakup dates and local climate will be discussed.

Requirement of satellite sensor for estimating ice breakup date
- Observing everyday (short revisiting time)
- Having near infrared band as well as thermal infrared band
  → MODIS AVHRR etc. is suitable

Data accuracy is very good, and various products are prepared.
  → MODIS is especially suitable

Results
- Ice breakup dates of the center of each lake were estimated using MODIS Level 3 SST data.
- Breakup temperature of all lakes was set to 2.0 °C of freshwater.

Ice breakup dates in 2002 and 2004 are relatively earlier for some of the lakes (especially area 1 and 2).
- Clear trend of the time series of the ice breakup date is not observed for lakes at high elevation (area 3).
- Ice breakup dates in 2005 is earlier than in 2004 for some of the lakes in area 3 and 4.

Ice breakup dates have become early, and mean air temperature in spring has become an increase.

Ice Breakup Date:
- First day when a specific area of lake surface is completely free of ice

Relationships between ice breakup dates and local climate
- Ice breakup date were estimated by the suggested method.
- Air temperature data at the center of each lake were derivate from NCEP/NCAR data set, and averaged from March to May.

Ice breakup dates are strongly related with air temperature, and 1 day change represents 0.2 °C changes.

Summary
- Ice breakup dates on 18 Eurasian lakes from 2001 to 2005 were estimated using MODIS data.
- The annual changes of the ice breakup date are different by the location, elevation, and local climate.
- Ice breakup dates are strongly related with air temperature, and 1 day change represents 0.2 °C changes.

Future study
- Long term of the ice breakup dates will be discussed, and the trend of the climate changes will be derived.

Applications
- Environmental study
- Fisheries management
- Tourism
- Recreation
- Etc.

Ice breakup dates are related with the trend of mean air temperature.

Relationships between ice breakup dates and local climate

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Applications
- Environmental study
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Effects of the 2004 Indian Ocean tsunami in Thailand based on ASTER images

Fumio YAMAZAKI¹, Ken’ichi KOUCHI², Masashi MATSUOKA³


Introduction

High-resolution satellite (QuickBird, IKONOS) images were employed and GPS-synchronized photos/videos were taken in the damage survey after the 26 December 2004 Indian Ocean Tsunami in the south Thailand. Terra-ASTER images were also used to identify tsunami inundation areas comparing the pre-event and post-event images.

Tsunami Damage Survey in Thailand with GPS and Satellite Images

A reconnaissance survey was carried out by a team consisting of researchers from Thailand, Japan and USA. The objective of the survey is to gather geo-referenced tsunami inundation and damage information with the enhanced use of satellite images and GPS. Spectral reflectance of various surface materials were also obtained as ground truth data.

Tsunami Inundation Mapping Using ASTER Images and SRTM

ASTER images were used to identify tsunami inundation areas using the changes in the normalized difference vegetation index (NDVI), soil index (NDSI), and water index (NDWI). It is found that tsunami caused the decrease of NDVI and the increase of NDSI and NDWI.

References


Vegetation and Water Analyses of Industrial Waste Using Remote Sensing

Hachinohe Institute of Technology

Wenhui Zhao, Takanori Sasaki and Shigetaka Fujita
After an illegal dumping site was found on the border between Iwate and Aomori Prefectures, an environmental monitoring system using artificial satellites and ground observation apparatus was established to constantly monitor and analyze environmental changes. In this study, the data collected using this system, including satellite data, on-site, infrared camera images, and water quality data, was analyzed to establish the level of on-site contamination and state of recovery. Some SPOT images were compared to establish the on-site vegetation changes using the NDVI (Normalized Difference Vegetation Index). The relationship between changes in water quality and rainfall was established. It was confirmed that the removal of fluid waste and extensive work carried out on the site reduced the alkalinity of the water.

**Key Words:** Industrial waste, Remote sensing, Vegetation analysis, Water quality
One of the biggest illegal dumping sites in Japan was found on the border between Iwate and Aomori Prefectures. Its area is 27 hectares, and the total amount of waste is about 820,000 m$^3$. It caused major social problems such as environmental contamination. An environmental monitoring system was established to collect and analyze the environmental data on-site. This system is very useful for establishing the level of contamination and state of recovery on and around the site.

The satellite data such as multispectral SPOT image was analyzed for environmental analyses in the wide area, and the data from on-site sensors including water quality data and weather data was analyzed in detail.

The waste is taken away in trucks, but this will take several years to complete. In the meantime, the waste has been covered with tarpaulins to avoid pollution spreading before disposal. Waterproof walls will be set up around the site.
Artificial satellites and ground observation apparatus were used in this environmental monitoring system. Data from NASA’s Terra-1 and Aqua EOS satellites was received directly by an antenna installed on the roof of a building on our campus. Moreover, SPOT images, DEM data, and Quickbird images were analyzed by the ENVI software.

Five water quality analyzers, weather measuring equipment and two infrared cameras were set up at the dumping site. Data was then transmitted to the monitoring PC every three minutes. The items measured were pH, electric conductivity, flow rate, air temperature, and precipitation.
Vegetation Analysis using NDVI

The NDVI was used to transform multispectral data into a single image band representing vegetation distribution. The NDVI values indicate the amount of green vegetation present in the pixel — near-infrared radiation minus visible red radiation divided by near-infrared radiation plus visible red radiation. Written mathematically, the formula is: \( \text{NDVI} = \frac{(\text{NIR} - \text{RED})}{(\text{NIR} + \text{RED})} \).

Very low NDVI values (0.1 and below) correspond to barren areas of rock, sand, or water. Moderate values (0.2 to 0.4) represent shrub and grassland, while high values (0.6 to 0.8) indicate forest. The on-site NDVI value was lower, meaning that there was less on-site vegetation than in the surrounding area. There are signs of human activity such as narrow paths in Figure (b), in contrast to the natural montane vegetation shown in Figure (a). Furthermore, these figures show a reduction in vegetation, and we can determine those areas that had changed in that period.

Changes in NDVI data on the dumping site

(a) Jul.20, 1992  
(b) Jun.17, 2004
The DEM data of 15 m spatial resolution was combined with a Quickbird image of 2.4 m spatial resolution to obtain high spatial resolution. The output image is three-dimensional visualization of the illegal dumping site and its surrounding areas.
Water Quality Analysis

Five water quality analyzers have been installed at the former water supply source (Point 1), the new water supply source (Point 2), in the vicinity of the Kumahara River (Point 3), at the intake (Point 4) and the outlet (Point 5) of the water purifying plant. The pH and electric conductivity of on-site water (Point 4 and 5) were higher than normal water (Point 1, 2, and 3), and the pH at Point 4 reduced on rainy days (September 2, 7, 14, and 22).

Table 1 Changes in water quality (pH)

<table>
<thead>
<tr>
<th></th>
<th>2004.9</th>
<th>2004.10</th>
<th>2005.9</th>
<th>2005.10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point 3 (Kumahara River)</td>
<td>7.34</td>
<td>7.15</td>
<td>6.93</td>
<td>6.48</td>
</tr>
<tr>
<td>Point 4 (entrance of the water purifying plant)</td>
<td>7.92</td>
<td>7.97</td>
<td>7.34</td>
<td>7.58</td>
</tr>
<tr>
<td>Point 5 (exit of the water purifying plant)</td>
<td>7.41</td>
<td>7.27</td>
<td>7.18</td>
<td>6.85</td>
</tr>
</tbody>
</table>

34,428 tons of waste (26,668 tons of solid waste and 7,760 tons of fluid waste) was removed. Although only 4% of the total waste in Aomori Prefecture has been removed, almost all the fluid waste has been removed. Furthermore, the extensive work carried out as mentioned above has improved the water quality. We found that the alkalinity of the water was reduced by the water purifying plant — the mean pH in September 2004 fell from 7.92 (Point 4) to 7.41 (Point 5), and in September 2005 fell from 7.34 to 7.18. The mean pH at Point 4 also fell from 7.945 (September and October 2004) to 7.46 (September and October 2005).
A remote sensing system was established to monitor and analyze the environmental data at the illegal dumping site on the border between Iwate and Aomori Prefectures. In this paper, the data collected using this system, including satellite data, images from on-site infrared cameras, and water quality data, was analyzed to establish the level of on-site contamination and state of recovery.

Multispectral SPOT images of high spatial resolution were analyzed using the NDVI to establish changes in vegetation at the dumping site. We found signs of human activity such as narrow paths and a substantial reduction in on-site vegetation when the waste was dumped. This system will help identify and confirm other illegal dumping sites.

Changes in water quality are important in assessing contamination and were analyzed, along with rainfall, as the waste was removed. The removal of waste and other on-site work reduced the alkalinity of the water. In the future, new satellite data and ground data will be sequentially collected by this system. This will be compared with current data to understand and forecast environmental changes.
Introduction

Interpretation of subsurface condition from Radar image is of great interest, covering surface as well as subsurface features with resolution much higher than resolution offered by radar technique. Lithological as well as geological informations extracted from the image could be of higher value. Conventionally, geological features are derived visually from Radar images. Patterns associated with geological structures/seismic could be detected. Attempts to interpret lithological as well as structural geological features deeper than 1-10 meters are of course challenging. We are now in the early stage of our attempts to obtain techniques that make deeper interpretation possible. In this research, we tried to derived geological structures and other features visually from JERS-1 SAR data from Cepu Area, Central Java Province, Indonesia, in which huge oil reservoir located. Figure 1 and figure 2 show the study area and its geological structures. The use of geological map is intended to get better understanding of geological features and structures that could be recognized in the Radar image. We applied conventional image processing flows on the data to improve data quality that lead to more interpretablety of the data.

Data and Data Processing

JERS-1 as well as ASTER images for this research were available from Remote Sensing Research Center – Panditho Panji Foundation and ERSDAC. Combining with data from field observation, we processed the JERS-1 image using following data processing flows: radiometric correction (speckle reduction) with low-pass filtering, geometric correction (image rectification) with least-square polynomial regression, image focusing with linear contrasting and high-pass filtering. All processing steps were conducted using ER Mapper 6.4 software. Figure 3 shows raw image of study area. Rectangle in red denotes area used for comparison in processing steps were conducted using ER Mapper 6.4 software. Figure 3 shows raw image of study area. Rectangle in red denotes area used for comparison in processing steps were conducted using ER Mapper 6.4 software. Figure 3 shows raw image of study area. Rectangle in red denotes area used for comparison in processing steps were conducted using ER Mapper 6.4 software. 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Comprehensive evaluation of Leaf Area Index estimated by several method — LAI-2000, SunScan, Fish-eye, and littertrap —

Midori Kurata¹, G.A.Sanchez-Azofeloa², Wang Quan³, Yoshitaka Kakubari¹
1 Faculty of Agriculture, Shizuoka University, 2 Earth & Atmospheric Sciences University of Alberta,Canada

1) Introduction
Leaf Area Index (LAI) is a key biophysical variable influencing land surface processes such as photosynthesis, transpiration, and energy balance and is a required input for various ecological models. It is necessary to rely first on ground-based LAI estimates if remotely sensed vegetation indices need cross-calibration. At present, there are several techniques for estimating LAI. The aim of this study is to establish a practical technique for LAI estimation suitable to mountainous beech forest stands.

2) Material & Method

Study site - The northern slope of the Naeba Mountain (36°51’N, 138°41’N), located in southern Niigata Prefecture in Japan

- dominant species is beech (Fagus Crenata)


<table>
<thead>
<tr>
<th>site name</th>
<th>altitude (m)</th>
<th>stand density (trees ha⁻¹)</th>
<th>mean tree height (m)</th>
<th>DBH (cm)</th>
<th>age of stands (yr)</th>
<th>altitude (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>old-beech</td>
<td>1500</td>
<td>550</td>
<td>22</td>
<td>17.6</td>
<td>300</td>
<td>1500</td>
</tr>
<tr>
<td>mix-wood</td>
<td>1500</td>
<td>229</td>
<td>22</td>
<td>13.8</td>
<td>229</td>
<td>1500</td>
</tr>
<tr>
<td>young-beech</td>
<td>1500</td>
<td>250</td>
<td>25</td>
<td>11.5</td>
<td>250</td>
<td>1500</td>
</tr>
</tbody>
</table>

3) Estimating LAI by direct methods

litter collection
5-10 litter traps were set randomly at 8 sites respectively

allometric equation
In seven sites, destructive samplings were made for parameterising allometric at each altitude (IBP, 1970)

F = 0.006 × (D π) + 0.4656 (D π)

F: total leaf area of each tree, D: diameter at breast height, h: tree height, K: fitted coefficients of the equation at different altitudes

4) Estimating LAI by indirect methods

- LAI-2000: The Plant Canopy Analyser (LI-COR Inc., USA) measure the diffuse radiation below 490nm
- SunScan: Canopy Analysis System (Delta-T Devices Ltd, UK) measure the PAR above canopy (with BFS) and below canopy (with probe)
- Fish-eye: Hemispherical photographs taken by using digital cameras with a specific software Hemiview (Delta-T Devices Ltd)

4) Conclusion
LAI-2000 was suitable for LAI estimation in mountain beech forests. And broad view angle is required for measuring. In addition, it usually understimates LAI and thus needs correction before it can be used.

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1. INTRODUCTION

1. One of the most significant challenges for improved the national food security program is availability of timely, up-to-date, and accurate data for planners and decision makers. Such information needs to be available to concerned government officials, regulators, donors, NGO and other interested organizations in a comprehensive, consistent, regular, and easy to understand format.

2. In Indonesia, there are many institutions concerned in food security data, which each institution has own analytical tools and methods for determining the food security parameters; therefore, we often find a dissimilar published data for a same physic variable such as the paddy field area of a certain province. In addition, it takes time for collecting the historical data from local until national levels, consequently, it is awfully difficult to access the real time food security information.

3. This research attempts to (1) develop a food security database system included an analytics instrument to improve the quality of paddy field data using remote sensing and GIS technologies, (2) calculate the food balance of each region using DSS model, and (3) design the food security information system.

4. All kind of spatial data either image or vector as well tabular data have been integrated in a database system, and then transformed into food security information to enhance the knowledge based as a basis for decision making are discussed in this paper.

2. HOW TO ACHIEVE THE GOAL AND SATELLITE IMAGE USED IN THIS STUDY (CASE STUDY: MIDDLE OJAJA PROVINCE)

3. ANALYTICS INSTRUMENT TO DETERMINE PADDY FIELD AREA ON FOUR CLASSES OF SLOPE

4. REGRESSION ANALYSIS OF (A) RS VS THEODOLITE AND (B) RS VS GPS BASED ON FOUR CLASSES OF SLOPE

5. ESTIMATION OF PADDY YIELD (KG) USING PADDY FIELD AREA (HA) AND PRODUCTIVITY (KG/HA)

6. FOOD BALANCE USING DSS MODEL

7. DEVELOPMENT OF WEB-BASED FOOD SECURITY INFORMATION SYSTEM

8. CONCLUSIONS

Food security has to be achieved at national, local and household levels by securing the access to food by the population and to information by policy makers. The decision support system (DSS) for food security that has been developed for Central Java province was carried out in three main phases: i.e.

(a) identify and develop required variable in the food security database such as demographic, statistical, satellite data, etc;
(b) estimate paddy production of each district using high resolution images and compute food balance based on the supply and demand, and
(c) design and operate the information delivery system to multiple users.

With the DSS the different variables and criteria commonly used by various institutions dealing with food security can be standardized. The utilization of multi-spectral and multi-temporal satellite imagery integrated in geographic information system as components of the DSS will facilitate the efforts of all the institution as well as minimizing the cost.
Experimental study on the effect of Cheong-gye stream restoration on urban environment
(Long-path measurement of atmospheric pollutant species with an obstruction flashlight)
Yohei Shiraki, Ippei Harada, Hiroaki Kuze(CEReS, Chiba University)
Toshiaki Ichinose(Center for Global Environmental Research,National Institute for Environmental Studies)
Yingjiu Bai(Tohoku University of Community Service and Science)

Purpose
The expressway was dismantled in Seoul in July, 2003, and the municipal river (Cheong-gye stream) was restored in October, 2005.

In this study, it is intended that the atmospheric pollutant data and the air temperature data are accumulated in the proof of the relaxation effect of the heat island phenomenon in Cheong-gyecheon.

Research method
1) Long-path measurement of atmospheric pollutant species with an obstruction flashlight
2) Observation of air temperature

Observation technique of atmospheric pollutant species
1) The background from the sky radiation is easily subtracted because the spectra of strobe flash are distinguished straightforwardly from the difference of the observed intensity.
2) Simultaneous observation of several trace gas species is feasible if the relevant spectral features fall within the considered wavelength interval of the lamp and the CCD.
3) When the spectral intensity of the flashlight is known at the strobe site, the transmitted spectra give an information on the aerosol extinction along the optical path.

Result of observation
Air temperature

Future work
The atmospheric pollutant species observation and the meteorological observation in Seoul will be studied, and the relaxation effect of the heat island phenomenon of the municipal river will be clarified.

Thus, it is possible to contribute to the creation of the municipal river and the promotion of maintenance in Asian cities.

As for the rise of NO₂ in Chongae 4ga, 2004. The influence of construction is stronger than the influence of the autoexhaust.

It is worth observing atmospheric pollutant species.
Study the effect of green covering on the land value of Tokyo Metropolis using geographic information system (GIS)
Ippei Harada (Graduate school of Science and Technology, Chiba University)
Akihiko Kondoh (Center for Environmental Remote Sensing, Chiba University)

Background
The urbanization around the center of Tokyo was expanded due to the increasing population of the Tokyo region (Tokyo, Chiba prefecture, Saitama prefecture, Kanagawa prefecture). The housing establishment and city traffic have developed the suburbs which were before an agricultural land and mountain area. The rapid expansion of Tokyo region from the end of 1980s till the beginning of 1990s was due to the impact of the economic bubble, which consequence, increased the land and stock values, thus increased the problem of urban environment.

Land value is a quantified economic parameter which shows the utility value of land. It is a comprehensive value which reflects the environmental condition and many other functions of the city.

Study Area
The extent of Tokyo metropolis is about 100 km and there are many cities existed also on the fringe of Tokyo. Tokyo is the center of major activities and developments of Japan. The impacts of the urbanization was not limited in Tokyo area but it was extended also outside Tokyo region to include the nearby prefectures, which then increased their land prices.

Data
1. 10m Grid Land Use:Metropolitan Area (in 1984 and 1994).
4. Land classification map at 1:500000 scale (Chiba, Saitama, Tokyo and Kanagawa prefecture → Tokyo region).

Research method
1) The city environmental element was extracted using Geographical Information System (GIS).
2) The influence of the city environmental element was correlated with the formation of land values and analyzed using multiple linear regression analysis.

Land use/cover change during the bubble economic term

Table 1. The percentage of changes of land use from 1984 to 1994.

<table>
<thead>
<tr>
<th>Land use</th>
<th>Change in 1984</th>
<th>Change in 1994</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial land</td>
<td>-2.85</td>
<td>-2.31</td>
</tr>
<tr>
<td>Industrial land</td>
<td>0.46</td>
<td>0.30</td>
</tr>
<tr>
<td>Residential land</td>
<td>1.35</td>
<td>0.98</td>
</tr>
<tr>
<td>Artificial land use was increased in Tokyo region. Natural land use was decreased in Tokyo region. However, park and green space were increased. The center of Tokyo → Land use change is small. The suburbs → Land use change is large.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Multiple linear regression analysis

Table 2. Determining factors of land values by regression analysis of the meso-scale

<table>
<thead>
<tr>
<th>Year</th>
<th>Linear regression (Land value in 1985 and 1994)</th>
<th>( p(z) = f(Z_1+Z_2+...+Z_n) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>Building coverage ratio</td>
<td>Building coverage ratio</td>
</tr>
<tr>
<td>1994</td>
<td>Building coverage ratio</td>
<td>Building coverage ratio</td>
</tr>
</tbody>
</table>

Table 3. Determining factors of land values by regression analysis of the local-scale

<table>
<thead>
<tr>
<th>Year</th>
<th>Linear regression (Land value)</th>
<th>( p(z) = f(Z_1+Z_2+...+Z_n) )</th>
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<td>Building coverage ratio</td>
<td>Building coverage ratio</td>
</tr>
<tr>
<td>1994</td>
<td>Building coverage ratio</td>
<td>Building coverage ratio</td>
</tr>
</tbody>
</table>

Conclusions
Multiple linear regression analysis was used to analyze the effect of the green environmental impact on the formation of land value. It was not able to explain the influence of the vegetation impact on the land value of the area through the meso-scale in 70km range from the center of Tokyo, but this influence was clarified through the area of local scale in 4.4km range from the city of Tokyo metropolis as considered one of the elements that the vegetation could influence the formation of land value.
The relationship between PAL NDVI and land use changes in semi-arid regions, China

Hajime OSADA (Graduate School of Science and Technology, Chiba University)
Akihiko KONDOH (Center for Environmental Remote Sensing, Chiba University)

Objective
• To discuss the relationship between remote sensing data and land use/cover changes.
• To evaluate whether it is suitable for which indicator expressing the kind of environmental change in semi-arid regions.

Study area
• 110°~125°E, 40°~55°N.
• It was mainly located in the semi-arid regions, northeast part of China.
• The Grassland occupies the greatest portion of land cover in this area.
• The grassland of the semi-arid regions tend to be influenced by the human-driven factor and the climate-driven factor.

Data
Pathfinder Advanced Very High Resolution Radiometer Land Data Set (PAL)
• Instrument: NOAA/AVHRR
• Temporal resolution: 10-day
• Spatial resolution: 0.1°
• Period covered: 1982-1999

Land use map
The source of land use information is Land use map of China, 1:1000000 and 1km mesh Land-use map of China. Both maps were made by Chinese Academy of Science, and they have different period covered into six types which unified both (table 2). Since the names of the types in the two maps were different, they were classified into six types which unified both (table 2).

Table 1. Property of land use maps

<table>
<thead>
<tr>
<th>Land use types</th>
<th>Period covered</th>
<th>Number of land use types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land-use map of China, 1:1000000, (1980s)</td>
<td>1978-1987</td>
<td>52 layers</td>
</tr>
<tr>
<td>1km mesh Land-use map of China(Later 1990s)</td>
<td>1996-2000</td>
<td>25 layers</td>
</tr>
</tbody>
</table>

Table 2. Fusion of land use types of different two maps

<table>
<thead>
<tr>
<th>Land use types</th>
<th>Land-use map of China, 1:1000000, (1980s)</th>
<th>Land-use map of China, 1km mesh Land-use map of China (Later 1990s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivated land</td>
<td>Paddy, Irrigated field, Non-Irrigated field, Garden</td>
<td>Paddy, Field</td>
</tr>
<tr>
<td>Forest</td>
<td>Forestal forest, Economic forest</td>
<td>Forestal forest, Shrub, Sparse forest, other forest</td>
</tr>
<tr>
<td>Grassland</td>
<td>Pastureland, Moorland, Steppe</td>
<td>High, middle, and low coverage grassland</td>
</tr>
<tr>
<td>Unused land</td>
<td>Sandy land, Sandy desert, Gobs, Saline-arid land</td>
<td>Sandy land, Sandy desert, Gobs, Saline-arid land, Bare land</td>
</tr>
<tr>
<td>City, Industrial area, Habitat</td>
<td>City, Town, Industrial and mining area</td>
<td>City, Tuben, Shu, Other building site</td>
</tr>
<tr>
<td>Water</td>
<td>River, Lake</td>
<td>River, Lake, Dan, Sandy, Shu, Forest</td>
</tr>
</tbody>
</table>

Comparison of PAL NDVI and land use/cover change

• NDVImax is sensitive to land use changes in the 3 point.
• NDVI is less sensitive to land use in point A (Unused land → grassland) and point B (grassland → cultivated land).
• Tmax shows similar trend of temporal change, so it may react to annual climatic variation.
• TRJ is sensitive to land use change in point A and B.

The temporal change pattern which was alike at 3 different points was shown. This was considered to be influenced of a climate change.

Long term change analysis (Large scale)

Indicators for environmental change detection
• NDVImax: Annual max value of NDV (Normalized Difference Vegetation Index). It means annual max production of vegetation.
• NDVI: Annual integrated value of NDVI. It means annual biomass of plants.
• Tmax: Annual surface temperature. Surface temperature was calculated by using split window method from channel 4 and channel 5.
• TRJ: Annual slope of trajectory on (T(surface temperature)-NDVI) space. This shows the reaction which changes with land cover types change. It shows small value on forest and high value on grassland.

The trend maps of NDVImax and NDVI may show that annual production of vegetation in most areas tend to increase.
• The distribution of negative trend of TRJ is correspond with positively indicating trend of NDVImax and NDVI.

The extracted are showing characteristic trend which was compared with PAL NDVI and land use/cover change on local scale.

Extract the area showing characteristic trend

Conclusion
• In this study, the changes of the land use/cover in the local scale were detected using PAL NDVI data.
• It was strongly found that the human-driven factor has more effect than the climate-driven factor.
The characteristics of water resources in Xinjiang Uyghur Autonomous Region, China, using GIS and remote sensing

Dilnur Aji 1, Akihiko Kondoh 2

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2Center for Environmental Remote Sensing, Chiba University

Introduction

Lakes and rivers are the most important water resources in Xinjiang, since there are little precipitation and melted-snow water from high mountains, which are limited in summer season. The characteristics of water resources and the cause of these changes was analyzed in this research.

Objectives

- To detect the water area fluctuation of main lakes
- To explore the rivers outflow change in the last 50 years
- To analyze the main factors that governing water resources

Study area

Results: Water area of lakes

There were 65% of decreased rivers and 35% of increased rivers between the period of 1956~1986. Most of the decreasing processes were happened in north Xinjiang, and most of the increasing processes were happened in south Xinjiang in that period. On the contrary, there was a significant change, which has occurred during the period of 1987~2000 when the outflow of the 77% rivers have doubled, and the slight of outflow of the 23% rivers have decline. Remarkable increase was in north Xinjiang and a slight decrease was in south Xinjiang during this period.

Used Data and Methodology

Landsat MSS Data
Landsat TM Data
Landsat ETM+ Data

GCP Selection of MSS, TM and ETM+, TM (For Ebnur Lake)

Geometric correction (For Ebnur Lake)

Mosaicking operation (For Bostan Lake)

Classification of land cover condition
Meteorological Observations

Change detection of water area

Comparison among changes of water area and Meteorological data

Consideration of influence of Human impact
- Statistical data
- Chronology of China

Consideration of influence of Climatic change
- CRU TS2.0 data set
- World Climate Data

Rivers outflow
1956~1986
1987~2000

Precipitation differencing

Temperature differencing

Climatic factors
Socio-economic factors
In the western equatorial Pacific Ocean high sea surface temperature area is well known for the warm pool. This makes the area highly convective, which in turn influences the visible and infrared wavelength sensor signal through clouds and water vapor. In situ spectral radiometry for sea surface is inevitable for calibrating and validating physical and biological parameters such as sea surface reflectance and chlorophyll-a concentration without atmospheric corrections of remotely sensed data. The purpose of the research is to not only validate sea surface reflectance and chlorophyll-a concentration derived from MODIS but also investigate the parameters affecting sea surface reflectance by using a radiative transfer code known as 6S (version 5.2B).

Summary

(1) The maximum spectral reflectances are observed between 370~380nm and the minimum spectral reflectances are observed over 700nm.

(2) MODIS-derived chlorophyll-a concentration was underestimated comparing with in situ chlorophyll-a concentration.
Urban Change Monitoring using Former Japanese Army Maps and Remote Sensing

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2) Department of Architecture, Institute of Technology Bandung

Abstract

In this research, urban change area of Jakarta city, Indonesia is derived by employing old maps of VOC, former Japanese Army and Indonesian Army – US Army Joint Mapping maps, and satellite imageries as KH-7/Gambit, Landsat MSS and Landsat TM. The result of this research can enrich the lack of urban area spreading of Jakarta city before 1980s. The result shows the Jakarta area (681 km\(^2\)) became urban area completely in 1990s with population about 8.5 millions.

Method

![Research flow-chart](image1)

Study site

![Study site](image2)

Sources

Maps
1. VOC 1887 [1]

Satellite images
1. KH-7 / Gambit 19670526
2. Landsat MSS 19760621 [3]
3. Landsat TM 19890503 [3]

References
1. Pandhito Panji Foundation Archive
2. Former Japanese Army maps : Possession of the Museum of Natural History, Faculty of Science, Tohoku University, Japan
3. Global Land Cover Facility, University of Maryland, United States
4. BPS : Statistics Indonesia
Cloud heights and cloud types are characterized from the lidar data observed by two continuously operated portable automated lidar (PAL) systems and images from the visible and thermal infrared channels of NOAA16-AVHRR. The PAL systems are located in Chiba and Ichihara city areas, separated by approximately 10 km from each other. Measurements from October 2003 to March 2004 reveal that similar cloud structures are observed especially when the wind is along the path connecting the two sites. Slight time lags are frequently observed in the cloud occurrence, and they can be explained from the wind velocity data in the region. Monthly average of cloud base height (CBH) and cloud cover ratio show good correlation between the two sites. Cloud-type classification using a threshold technique in split window data of NOAA16-AVHRR gives results that are found to be consistent with the PAL cloud observations.

**Table 1: Portable Automated Lidar System Specification**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>10°</th>
<th>20°</th>
<th>30°</th>
<th>Vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser</td>
<td>Co-axial</td>
<td>Co-axial</td>
<td>Co-axial</td>
<td>56-kW Co-axial</td>
</tr>
<tr>
<td>Wavelength</td>
<td>532 nm</td>
<td>1064 nm</td>
<td>532 nm</td>
<td>1064 nm</td>
</tr>
<tr>
<td>Repetition rate</td>
<td>1.4 kHz</td>
<td>1.4 kHz</td>
<td>1.4 kHz</td>
<td>1.4 kHz</td>
</tr>
<tr>
<td>Repeatability</td>
<td>95%</td>
<td>95%</td>
<td>95%</td>
<td>95%</td>
</tr>
<tr>
<td>Receiver</td>
<td>Hamamatsu</td>
<td>Hamamatsu</td>
<td>Hamamatsu</td>
<td>Hamamatsu</td>
</tr>
<tr>
<td>Diameter</td>
<td>3.5 cm</td>
<td>3.5 cm</td>
<td>3.5 cm</td>
<td>3.5 cm</td>
</tr>
<tr>
<td>Type</td>
<td>Nd:YAG</td>
<td>Nd:YAG</td>
<td>Nd:YAG</td>
<td>Nd:YAG</td>
</tr>
<tr>
<td>F/number</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Baseline error</td>
<td>0.2 mm</td>
<td>0.2 mm</td>
<td>0.2 mm</td>
<td>0.2 mm</td>
</tr>
</tbody>
</table>

**Table 2: NOAA-16 Specification Orbital characteristics**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equator crossing time</td>
<td>Northbound 13:54A, Southbound 1:54D</td>
</tr>
<tr>
<td>Period (min.)</td>
<td>102.1</td>
</tr>
<tr>
<td>Mean altitude (km)</td>
<td>98.8°</td>
</tr>
<tr>
<td>Swath width (km)</td>
<td>3000</td>
</tr>
<tr>
<td>Resolution (µm)</td>
<td>1.1</td>
</tr>
<tr>
<td>Resolution (mm)</td>
<td>1.1</td>
</tr>
<tr>
<td>Resolution (m)</td>
<td>102.1</td>
</tr>
</tbody>
</table>

**Legend**

- Cirrus (Ci)
- Dense cirrus (Ci+d)
- Cumulus (Cu)
- Cumulonimbus (Cb)
- Clear area
- Unclassified

**Abstract**

Cloud information such as the cloud type, structure, and altitude is of importance for a variety of meteorological and climatological applications. By intercepting the solar radiation, clouds have a cooling effect on the earth’s surface. Knowledge of cloud properties can give us the thermodynamic and hydrodynamic structure of the atmosphere. The height of an inversion layer can often be related to the cloud appearance. In this study, we compare the ground-based lidar observations with the satellite-derived cloud information over the Chiba area, continuously unaided operation of PAL allowed for long term cloud monitoring without sacrificing the high temporal and spatial resolution, also, this study validates the usefulness of the split-window technique in the cloud classification.

**Introduction**

Lidar data are obtained from two identical portable automated lidar (PAL) systems. One of the PAL systems is located in Ichihara, at the Chiba Prefectural Environmental Research Center (CEReS) (33.52N, 140.07E), while the CEReS PAL system is on the main campus of Chiba University (35.62N, 140.12E). These two sites are about 10 km apart from each other (refer to figure above). Both are Mid scattering lidar systems capable of measuring backscattered radiation of up to 15 km in altitude. Specifications of the two PAL systems are given in Table 1. Both systems are equipped with automatic realignment systems that adjust laser beam directions every 15 min to ensure proper lidar alignment.

**Results - 5 November 2003**

- Satellite data on 5 November 2003 at 0100H JST
- Mostly cirrus (blue) with patches of cumulus (white)
- Consistent with PAL data

**Results - 26 August 2004**

- Data on 26 August 2004 from 0000H to 0500H
- Clouds seen at around 2 km for both sites
- Data indicative of mid-altitude cirrus clouds

**Results - 8 March 2004**

- Data on 2 March 2004 at 1200H JST
- Clouds seen at 6 to 8 km for both site
- Satellite data on 8 March 2004 at 1200H JST
- Predominantly dense cirrus (green) and cumulonimbus (yellow)
- Consistent with PAL data

**Results - 3 June 2004**

- Data from 2100H of 2 June to 0300H of 3 June 2004
- Clouds seen at 6 to 8 km for both site
- Satellite data on 3 June 2004 at 0100H JST
- Predominantly dense cirrus (green) and cumulonimbus (yellow)
- Consistent with PAL data

**Conclusion**

Cloud classification using NOAA16-AVHRR using split-window technique

2 PAL systems located 10 km from each other validate satellite data

Local vertical temperature profile needed for better cloud top height estimation

When satellite data has both cumulus and cirrus clouds, lidar data show only the low lying cumulus

**Legend**

- Cirrus (Ci)
- Dense cirrus (Ci+d)
- Cumulus (Cu)
- Cumulonimbus (Cb)
- Clear area
- Unclassified
Sandstorm mapping in Bodele depression, North Africa, with MODIS natural color images

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Introduction

Sahara desert is the world largest Aeolian soil (fine sediments of desert sands and dust) concentration. It supplies about 50% of the Aeolian materials to oceans through sandstorms. Many studies have carried out to identify sources of these Sahara sandstorms using field investigations and remote sensing data. TOMS (Total Ozone Mapping Spectrometer) satellite data clearly detected the origin of large-scale airborne aerosols in Sahara. This figure shows a map produced by NASA using TOMS data to analyze aerosol activites (2004). This high aerosol activites are concentrated over the area from Bodele depression to the direction of Lake Chad. Recent droughts and sand storms from Bodele depression reduced Lake Chad greatly to 50% of its original size within last four decades.

Monitoring with MODIS data

MODIS sensor data are providing an extensive amount of semi-real-time information for sandstorm observation. The approach of this study is to isolate sandstorm mass (area covered by the storm). By the conventional minimum likelihood classification method. The main advantage for this approach is the availability of sandstorm-free image data set to be used as ground truth information.

Training sites and Classification

Training sites were selected through a visual comparison of 2 images, overlaying one over the other, 20050110.aqua.250m - Sandstorm image (Start variability from the space) and 20050224.terra.250m - Non-sandstorm image. Training site identification and classification conducted by knowledge based approach, using digital data files. Study area covers about 59,000 sq km (4400 x 3600 pixel).

Based on above assumption, different subclasses in sandstorm-covered area were combined into three classes in the final map as, A) Sandstorm with 0 visibility. B) Sandstorm with poor visibility (compare to non-storm image) and C) Sandstorm with moderate visibility (compare to non-storm image). Following 2 images are showing sandstorm and after sandstorm image.

In page 4, classified image is presented. Resulted maps gave a clear discrimination along the sandstorm thickness boundaries as well as different colors within the sandstorm. In future studies, same method can be applied to map in Bodele depression sandstorms to compare with 2005 January map (this study).
Comparison of monitoring applicability between Crop Production Index and conventional methods using satellites

1. Background
The demand for crop production will rise as a result of population growth in China and India.

1.1) Rice is an excellent grain food, which supports the gigantic population in China and India.

1.2) The amount of rice export is small compared with the corn and the wheat.

1.3) Problems with the rice production could therefore have a catastrophic effect on countries that import rice and other crops.

1.4) Global warming makes both heavy rains and drought more likely, increasing fluctuations in the pattern of precipitation.

2. Objectives
This paper compares the applicability of the Crop Production Index CPI with conventional methods and proves the ability of the CPI to predict crop production using rice yield statistics, contrasting it against conventional methods such as cumulative growing degree day GDD, integrated NDVI, and photosynthesis rate PSN.

3. Modeling

\[ \text{CPI} = \int \text{PSN} \cdot dt \]  

where PSN is the photosynthesis rate, and \( \Delta T \) is the absorbed photosynthetically active radiation. CPI is the cumulative yield from planting to harvesting.

4. Data used in the modeling

4.1) Meteorological Data

The ground air temperature data, which are supplied by the JMA (Japan Meteorological Agency) at the AMeDAS (Agro Meteorological Data Acquisition System) sites, distributed in the Japanese agricultural plains, have large acreages suitable for satellite monitoring of the paddy fields.

4.2) Crop statistics

The Japanese Ministry of Agriculture, Forestry, and Fisheries provides grain statistical information, which includes a crop situation index for the paddy rice at ten sites for monitoring and validation districts.

4.3) NDVI

The satellite NDVI data used in the CPI index is the 4-minute mash set of vegetation index data derived from NOAA Advance Very High Resolution Radiometer (AVHRR) by Tanaka (2001).

Fig. 1 Sudden rise and fall in trade price of rice compared to cheaper prices of other grains in main trading countries.

Fig. 2 Flowchart of research on crop production monitoring and development of photosynthesis type of crop production index using satellite remote sensing and world weather data.

Fig. 3 Main causes of bad harvest and relating factors for monitoring rice production in the era of water resources restriction.

Fig. 5 Distribution of NDVI and monitoring sites in Japan for validation of Crop Production Index CPI.
Figure 8 shows the performance of the integrated photosynthesis rate IPSN used as a crop yield index. The crop situation index decreases linearly with IPSN but shows no ability to predict low temperature sterility, because sterility is not dependent on photosynthesis but is related to flowering and pollination. The IPSN produces much better than the GDD or iNDVI since it is linear with respect to crop yield; however, the IPSN values show considerable scater arising from dependence on regional conditions.

5. Results of crop production indices

5.1 Growing index GDD

Figure 6 shows relations between the crop situation index CSI and the cumulative growing degree day (GDD), and between the yield and cumulative GDD. The cumulative GDD has a linear relationship to the yield but shows no ability to integrate bad production due to low temperature sterility on normal rice yields in other years. The air temperature has two effects on growth and flowering by photosynthesis and on pollination from leading to flowering of the grain. This sterility effect on the pollination is not linear in temperature, but can be rapidly below a threshold of about 16 degrees centigrade.

5.2 Integrated NDVI (iNDVI)

Figure 7 shows relations between the integrated NDVI and Crop situation index and between yield and NDVI. The integrated NDVI is not able to predict either the crop situation index or the yield, and in particular is unable to predict a bad harvest due to low temperature sterility. The iNDVI values depend strongly on regional characteristics such as soils, type of rice and mixed effects, involving other plants (vegetables, trees, etc.).

5.3 Integrated PSN (IPSN)

Figure 8 shows the performances of the integrated PSN IPSN used as a crop yield index. These figures show relations between crop situation index and integrated PSN and crop yield between IPSN.

6. Conclusions

1. Consequently, only CPIu is able to predict a bad harvest due to sterility effects, by making the CPIu values decrease sharply to zero based on the cause-functional relationship between CPIu and the crop situation index CSI, as well as the yield.

2. The validation exercise clearly proves the improved ability of the present index to predict poor production due to low temperature sterility from normal rice production due to low temperature sterility from normal rice production. The results are controlled using rice yield statistics in comparison to conventional methods such as cumulative growing degree day GDD, integrated NDVI, and photosynthesis rate IPSN.

3. The method is based on routine observation data, allowing automated monitoring of crop production at arbitrary sites without any special observations.
Krakatau was well known and became famous in the world because of the paroxymal eruption on August 27, 1883 and it was considered to be a great event of the eruptive history, which has erupted more than 16 cubic km of ash column of about 80 km high, and rose tsunami as high as 30 m along the west coast of Banten and south coast of Lampung. Although at that time the big cities have not developed as such today, but 295 small towns were swept by tsunami and killed 36,417 people (Verbeek, 1884), and the explosion could be heard at Africa, Australia, Philippines etc or 4800 km far away. Krakatau began to be known in the eruptive history with the gigantic eruption occurred in 416 BC, which caused a tsunami and formed a caldera (Judd, 1889). Furthermore De Nieve (1981) noted some information that before the second paroxymal occurred in 1883, several large eruptions of Krakatau arose in the centuries of 3,9,10,11,12,14,16 and 17 which were followed by growing up of Rakata, Danan and Perbuwatan volcanoes on August 27, 1883.

Second major period of Krakatau began in February 1884 to December 1892, when the first phase of eruption on December 29, 1882 occurred as a submarine explosion in the center of Krakatau Volcanic Complex. The visible phenomena of the eruption comprised buildings and fountains of seawater (Stehn, 1929a). It was observed on January 20, 1929 the crater rim appeared east of the eruption point, consisting of ashes, lapilli, loose block. It formed an island above the water and was named “Anak Krakatau” (Child of Krakatau). The eruptions continued until February 15, 1929 where the explosion column reached a height of 800 m. Observations on February 18, indicated that the eruption was no longer visible and the Anak Krakatau island was shaped like a sickle, opening to the south-west, and which had reached a height of 38m above sea level. This event was declared by Stehn as a birth of Anak Krakatau. (Article source: Directorate of Volcanology and Geological Hazard Mitigation, ESDM, Indonesia and Krakatau by Simon Winchester)

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Satellite Observation and Analysis of Terrestrial Environmental Changes

Development and Publication of Land Cover and Vegetation Datasets at Regional and Global Scales

H. Sasaki\(^a\), H. Nakajima\(^a\), T. Okatani\(^a\), Y. Numata\(^a\), Y. Yamada\(^a\) and R. Tateishi\(^b\)

\(^a\): Geographical Survey Institute, \(^b\): Chiba University

Summary: With the participation of 155 National Mapping Organizations of all over the world, ISCGM (International Steering Committee for Global Mapping), whose secretariat is hosted by Geographical Survey Institute of Japan, has been developing “Global Map.” Global Map is global digital geographic framework data for sustainable development which describes global environmental status and its changes.

ISCGM places a special emphasis on raster formatted global land cover data and percent tree cover data development, in the second phase of Global Mapping to be completed by 2007. As one of central activities of ISCGM, this joint study aims to explore effective acquisition methodology of these raster data by fully utilizing satellite remote sensing technology. Followings are the outline of Global Map and expected outcomes of this study.

What is Global Map?

- Digital geographic information in 1 km resolution (at app. 1: 1 million scale)
- To cover the whole land of the globe in consistent specifications under international cooperation
- Includes 8 data layers

![Global Map Data Layers](image)

Status of Global Mapping Project

- 155 countries/areas participating
- 21 countries released

![Global Map](image)

As of December 2005

Expected Outcomes of This Study

Tree Canopy Cover

Land Cover (Example: Kenya)

![Ground Truth data](image)

Legend

- Closed Forest
- Open or Fragmented Forest
- Other Wooded Land
- Other Land Cover
- Water

- Evergreen Needleleaf Forest
- Evergreen Broadleaf Forest
- Deciduous Needleleaf Forest
- Deciduous Broadleaf Forest
- Mixed Forest
- Closed Shrublands
- Open Shrublands
- Woody Savannas
- Savannas
- Grasslands
- Permanent Wetlands
- Croplands
- Urban and Built-up
- Snow and Ice
- Barren or Sparsely Vegetated
- Water Bodies