

Application of remote sensing methods to regional issues

- Promotion of regional environmental studies in Asia -

Akihiko Kondoh¹, Hiroaki Kuze¹, Chiharu Hongo¹

¹Center for Environmental Remote Sensing (CEReS), Chiba University
1-33 Yayoi-cho, Inage-ku, Chiba 263-8522 Japan, kondoh@faculty.chiba-u.jp

Abstract

In the context of the Project 4, a partial results on area studies and advanced databases were presented in this paper. As a connection to Project 1, results of global surface changes detection were explained first to find the local surface changes. Several important outcomes were selected and gave brief explanation. To find and organize the achievements of area studies, spatial database should be developed. Final part of the paper reported the example of databases on spatial information.

Keywords: area studies, Asia, advanced databases, collaboration for solution

1. Introduction

A lot of earth observation satellites have been operating during last decades, and new satellite programs are planned. In this circumstance, satellite data is expected to be useful for understanding the regional environment and for the solution of regional environmental issues. In project 4, we expect to generate synergetic effect with remote sensing and many other fields which deals with environmental issues by integrating spatial information and field experiences.

The majors of principle members are geography, atmospheric sciences, and agriculture sciences. So we set up the four main themes.

- Area studies in Asia
- Atmospheric environment
- Application to agriculture
- Advanced databases

Satellite remote sensing has been applied to various problems existing in Asian region. The problems to be solved in the project include water problems, food problems, air pollution, and many. New remote sensing techniques were developed for advanced agriculture, air pollution monitoring, and so on. Satellite imageries and their secondary data were open to public through world wide web to promote the utilization of satellite remote sensing.

The spectrum of our research target is too large. In this paper, we will introduce the outcomes from area studies, and advanced databases. Please refer to the papers included in the proceedings for remaining themes.

2. Selected Achievement

2.1 Detection of environmental changes by global remote sensing

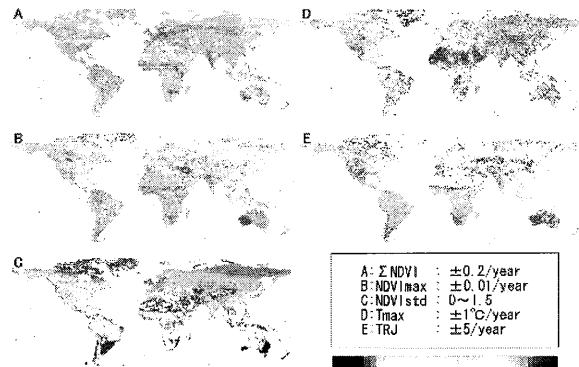


Fig.1 The results of global trend analyses between 1982 and 2000 by NOAA/AVHRR (Kondoh, 2004).

Global issues are appeared by the problem on the relationship between human and nature in a region. This is the reason why area studies should be promoted. However, there are vast amount of problems to be solved on the globe. Each problem may be small but deep, and essential problem in the local people. To find the problems, global change detection scheme is applied to global dataset derived from NOAA/AVHRR.

Fig.1 shows the result of trend analyses between 1982 and 2000 using indices derived from NDVI and Brightness Temperature (Kondoh, 2004). By combining these diagrams, important surface changes can be detected. One of important outcome is the detection of vegetation changes in the ecotone of tundra and boreal forest in Eastern Siberia shown in Fig. 2 (Sakai *et al.*, 2008).

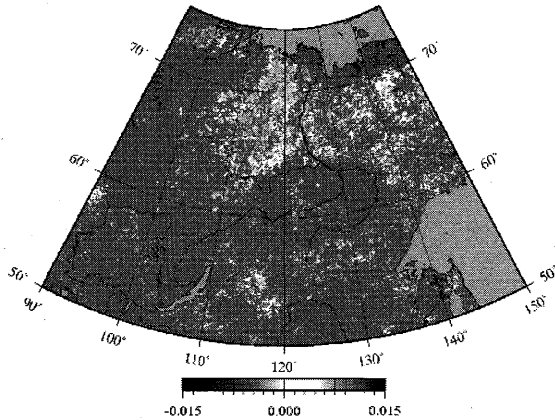


Fig.2 Increasing trend in annual maximum NDVI in red color, which suggests vegetation change possibly by global

The contents of this section is a part of *Project 1*. A great deal of the achievements of area studies can be located and interpreted on the framework of global change mapping.

2-2 Selected area studies in Asia

(1) Water problems in North China Plain, China

We started the discussion of the project in 1997 with Chinese colleagues, and fields research was started in 1998. This project is concerning hydrological cycle and its implications to water problems in North China Plain (NCP). The field work include groundwater survey, flux measurement, hill slope study, and of course remote sensing.

NOAA/AVHRR and GMS data received in CEReS are used to monitor surface wetness. Combined method with NDVI and Brightness temperature by NOAA/AVHRR, and thermal inertia monitoring by GMS showed good performance to detect surface wetness (Kondoh and Oyamada, 2000).

Decadal collaboration with Chinese colleagues achieved proper recognition of current situation and future perspective of water resources in semi-arid NCP.

(2) China's Great flood in 1998

China suffered great flood in Changjiang, Songhua and Nenjiang in 1998. Because 1998 was the warmest year after global warming got a position of primary global concern, the floods were tend to be considered as the effect of global warming, and got worldwide news coverage.

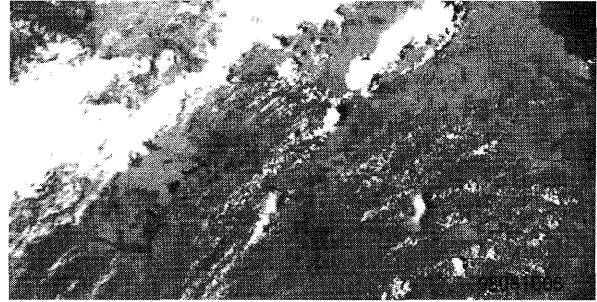


Fig.3 The NOAA/AVHRR image in August 10, 1998 received in CEReS. At this date, bank was collapsed in one place, and retarding basins was filled by water.

Detailed monitoring of flood by satellite and field research with Chinese colleagues revealed the flood was a normal big one, and the effect of climatic changes was hard to be recognized (Li *et al.*, 1999).

NOAA/AVHRR images received in CEReS could send imageries of changing inundation area in the middle reach of Changjiang River through WWW. Fig.3 shows the image in August 10 when water level in Changjiang was the highest.

(3) Grassland monitoring in semi-arid environments

Herbaceous plant that supports environment and life in semi-arid region was vulnerable to climatic change. The response of herbaceous plant to weather conditions was examined in Mongolia and Inner-Mongolian Plateau. The outcomes gave an implication on the response of grassland ecosystem to the global warming.

In the grassland ecosystem, vegetation activity is strongly depended on water availability. If global warming may cause desiccation, herbaceous plant got the serious damage (e.g. Kondoh *et al.*, 2005).

(4) Groundwater degradation in arid region

Groundwater as a primary water resource in arid region was investigated in United Arab Emirates, Turpan basin in western China, and the Dead Sea Basin, Jordan, and many sites in Asia. Synthetic research including remote sensing revealed the occurrence of groundwater, changes in groundwater cycle, geochemical characteristics, accompanied water problems, and so on. The outcomes offered valuable knowledge for integrated water management in arid regions.

(5) Hydrological changes in Xinjiang, China

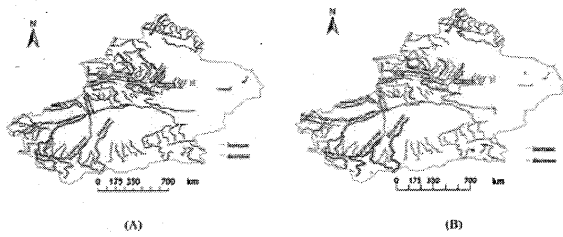


Fig.4 Changes in annual discharge. Red and blue denote increase and decrease, respectively. (A) 1956-1986, (B) 1987-2000. Recent increase in Northern Xinjiang is apparent.

The response of regional water resources to the climatic changes was investigated in Xinjiang, China. Water resources were changing under the influences of both human and climatic factors. The outcome presented the holistic perspective of future water resources in Xinjiang.

Fig.4 shows the detected hydrological change in the rivers in Xinjiang. Increase in discharge may implicate the effect of global warming (Aji *et al.*, 2008).

(5) Heat island studies in Tokyo Metropolitan Area

Heat islands in Tokyo Metropolitan Area were researched by using remote sensing and GIS. The results showed the decadal changes in heat islands and its effect to local weather conditions (e.g. Harada and Kondoh, 2005; Shiraki *et al.*, 2008).

2-3 Environmental Information Base Projects

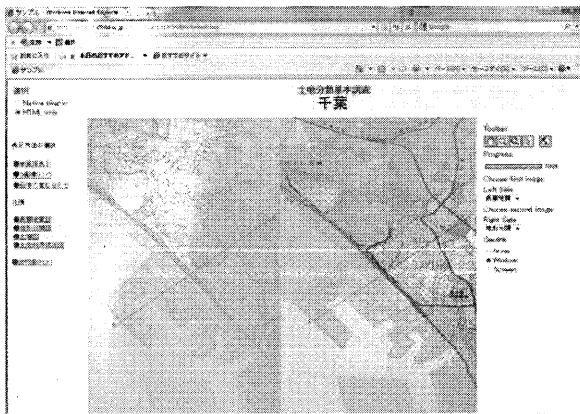


Fig.5 An example of land information systems. Characteristics of land can be interpreted by inspecting the browse maps. This system can be used substitute of Hazard Maps.

| ITEM ZONE / LATITUDE | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 |
|----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| N-50 | | | | | | | | | | | | | | |
| N-45 | | | | | | | | | | | | | | |
| N-40 | | | | | | | | | | | | | | |
| N-35 | | | | | | | | | | | | | | |
| N-30 | | | | | | | | | | | | | | |
| N-25 | | | | | | | | | | | | | | |
| N-20 | | | | | | | | | | | | | | |
| N-15 | | | | | | | | | | | | | | |
| N-10 | | | | | | | | | | | | | | |
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Fig.6 Portal site of satellite image browsing system.

(1) Land Information Browsing System

Homepages that publish digital thematic maps was constructed on WWW and open to public through Internet. The datasets include secondary products of satellite data and thematic maps on land characteristics. Fig.5 shows an example of such a homepage.

(2) Satellite Image Browsing System

Homepages that show past satellite images were constructed on WWW and open to public through Internet. Accumulation of past imageries after 1972 could produce new information through synergy with clients who are the specialist of many fields and sectors.

By inspecting images through this page, we can find many environmental changes that may be serious issue to be solved in the region. Fig.6 shows the portal site of such a image browsing system. When you click the tile (48, N-28), the



Fig.7 Landsat images in 1990 and 2000. Original images are NASA Geocover TM Mosaics.

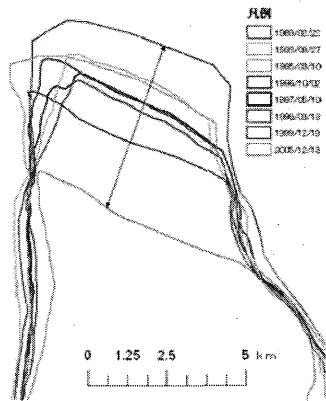


Fig. 8 Time changes in northern coast of Hatiya Island, Bangladesh (Original diagram by Ohtani, 2009).

pop-up appears (Fig.7) and find the changes in coastal lines in Bangladesh between 1990 and 2000.

The recognition of the fact may urged us to study the time changes of the coast in the mouth of Ganges. Fig. 8 shows the changes in the coast line at the north part of Hatiya Island. The coast lines are delineated by JERS1 SAR data because SAR is all-weather type sensor. Image analyses reveals the coast had been recessed about 5 kilometers during past 15 years. The recession rate show the correlation to precipitation amount that means the erosion is a working of nature.

3. Final remarks

Global issues are appeared as a problem in a region. We have to keep close observation of the any places in the world, especially in Asia. Satellite remote sensing is a powerful tool to detect surface changes due to its temporal and spatial nature.

However, outcomes of area studies often consider as case studies. We do emphasize the importance of area studies because the world consists of many regions. There is no universal means to solve all the regional issues. We should accumulate the outcomes and experiences from the region.

To organize the many achievements from the region, databases should be constructed to share the outcome from the regions. Solution should be based on the collaboration among different fields

and different sectors.

Remote sensing is a effective tools in the collaboration work because accumulation of Earth Observation Data during past 30 years is vast. Change detected include the effects of climatic and human factors. The problem is the one concerning the relationship between nature and human in a region. We have to share the solution between science and local sectors based on the real understanding of the problem. It is the goal of the Project 4.

We have to find the signals of environmental changes, and locate it to global spatial framework toward satellite environmental change science. Solution should based on collaboration.

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