Remote Sensing Monitoring On Land Use Change In China

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Abstract

Since 1978,China land use mapping has been started ,the scale of the map is 1 : 1000000. The work lasted more than 10 years. From 1980, a national project of land use survey in China has been implemented by using aerial photography at large scale in the county and province level. So far this project has not been completedyet. In order to study the land use change in period of 2–3 years,a project concerning the land use study has been conducted since 1992 by using Landsat TM acquired around 1990 and the mapping scale in east China and in west China are 1 : 250,000 and 1 : 500,000 separatly. After digitizing the land use maps, a land use data base for the whole territory will be established in 1995. For the typical area with great land use change, remote sensing montoring with large mapping scale in the period 1–3 year has been included. Meanwhile,the land use frequently monitoring has been taken using NOAA AVHRR data at resolution of 16 km,4 km and 1 km in the whole country.

1. Introduction

In today's world, rapid population growth, accompanied by food and resource shortages,as well as environmental degradation is threatening social and economic development. China's population is over one–forth of the total world population but its arable land per capital is much lower even than most developing countries. The population of China was 1.05 billon and its total cultivated area was only 98 million ha in 1983. That is to say ,the land per capital is 0.09ha. When 2000 comes ,the population will reach 1.3 billion, meanwhile,with the development of national economy,urban and industrial land expanding,the arable land has reduced year by year . The area of nonagricultural land will reach 10 million ha,and the area of badly degraded land will take 10% in whole territory of the conditions , such as the desertiffication land caused by unreasonable use, has increased by more than 1000km^2 each year . It is clear

that changes in land conditions and food supply have a significant influence on sustainable development .Recently, as the progress of China's opening and reforming, the structure and area of cropping has greatly affect the national ecorcomic development of our country.So the land use moitoring is very important in China.and the ability to obtain the information about the land dynamic timely and provide scientific decision–making.

1. Study on land use / land cover

The first national project on land use mapping was carried out in 1978 in China. The scale of the map is 1 : 1000,000.

The preparatory work started since 1978,and by 1981 sampling studies in all provines were launched,the compliling and mapping completed in 1988,the whole process lasted nearly 10 years.

The compiling of 1 : 1000,000 land use map of China was based on multiple informations,including sampling studies and route survey in each provine, interpretation of landsat images and air–photos,and facts gathered from large scale thematic maps.

From 1980, a national project of land use survey in China has been implemented by using aerial photography at large scale (1 : 100,000 in agriculture area) in the county and provine level. so for this project has not been completed yet.

In order to study the land use change in the period of 2–3 years, a project concerning the land use has been conducted since 1992.Main remote sensing data source is Landsat TM acquired around 1990. The interpretation mapping scale in east China and in west China are 1 : 250,000 and 1 : 500,000 separatly.After digitizing the land use maps ,a land use data base for the whole territory will be established in 1995.

To counter the demands of macro–investigation for results data and remote sensing characteristics, landuse and cover types was classified two classes including 6 first class types and 22 second types . In order to create environment classification system and further understand the relationship between land resource and geographical environment background,type boundary of basic geographical units will be drawn while remote sensing image is interpreted for land resource.Multi–attribute judgments of one unit are realized through matching remote sensing date with non–remote sensing data.The classification system is consisted of 43 types and two classes.(Tab.1and Tab.2)

Table.1 Macro–classofication system of land use / land cover

1. Farmland
   - 1.1 irrigated field
   - 1.2 non–irrigated field
2. Forest
   - 2.1 forest coverland
   - 2.2 shrub land
   - 2.3 other
3. Grassland
   - 3.1 high coverage grassland
   - 3.2 middle coverage grassland
   - 3.3 low coverage grassland
4. Water body
   - 4.1 river channel
   - 4.2 lake
   - 4.3 reservoir
   - 4.4 glacier and firn
   - 4.5 beach
5. Resident and Industrial Site land
   - 5.1 township
   - 5.2 industrial Land
   - 5.3 other
6. Others
   - 6.1 sandy land
   - 6.2 desert
   - 6.3 salinized alkaline
   - 6.4 marshland
   - 6.5 bareland
   - 6.6 bare rock gravel land

Table 2.China geographical environment basic unit classification system

A. Temperature

Classified 9 classes according to accumulated temperature index(> ° C)

B. Moisture Coefficient

Classified 5 classes based aridity

C. Geomorphological features

Four type is differentiated from geomorpholoical forms

1.Mountainous land

Four sub–types area divided according to relative elevation differcnces

2. Hilly land

Four sub–types according to elevation

3. Plat form

Four sub–types according to plat form altitudc

4. Plain

Seven sub–types according to relative elevation differcnces

D. Soil texturc

Sandy,loam,and fine soil are divided

The project was based on fully studying practicable technique routines. Landsat TM will be used as main information sources. Image interpreting work will be carried out according to the divided map sheets of international standard. Area measurement,graphic data input and creating information system will be finished at same time under the support of computer software and hardware environment.The main procedures is shown as Fig.1.

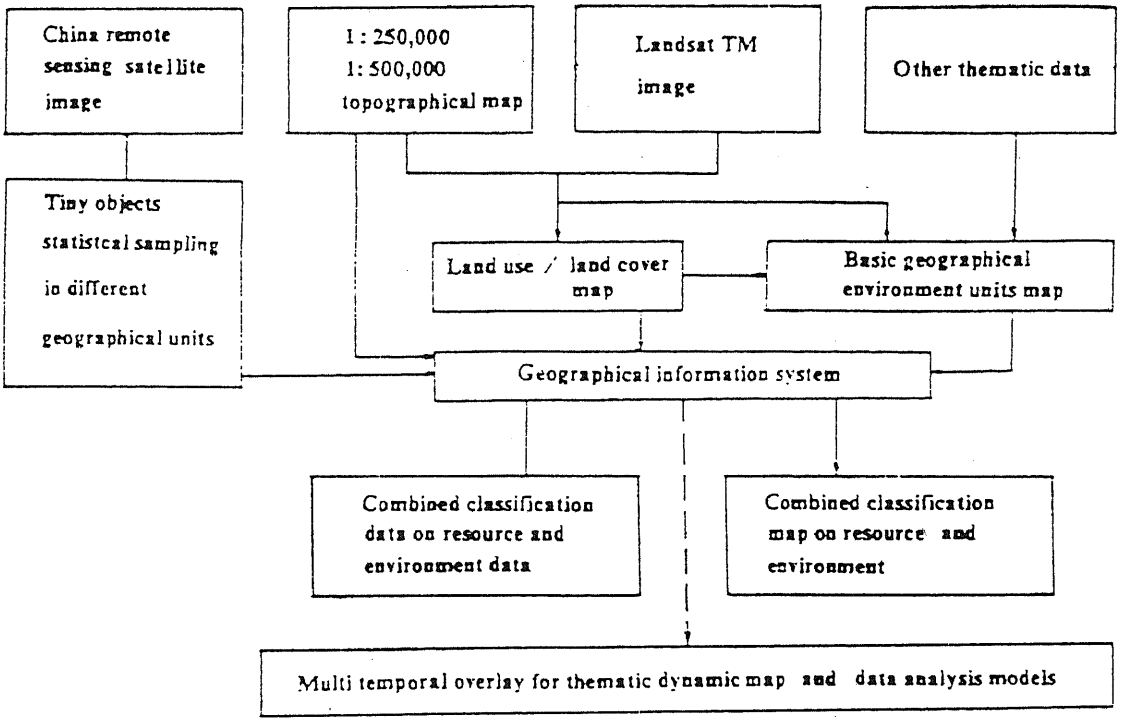

Fig. 1 The procedure of land use data base establishment

So far there are three levels of this data base in China. The first level of data base was established based on a series map at scale of 1 : 4,000,000.The layers included in data base are soil,vegetation,desert,desertification,drainage system,lake,railway,road,political boundary,etc., The development of second layer data base is on the way which is made based on a series map at scale of 1 : 1,000,000.The layer of the data base include landuse, land evaluation,drainage system,communication etc.The DEM data base is generated by the topographic map at scale of 1 : 1,000,000.

2. Study on land use change

The"Three Norths"protective forest system covers 13 privinces with a total area of 4.067 millon square kilometers. In order to evaluate the practical economic and ecologic benefits resulted from the huge investment in afforestation,the

prject of "Comprehensive Inventory and Moniroring of "Three Norths "Shelter Forest Region by Remote Sening Data"was put on the list of national key scientific and technical projects since 1986.

All the resource data needed were obtained and 1747 sheets of serial thematic maps were compiled on the scale of 1 : 100000, 1 : 2000000 and 1 : 5000000, including forest maps, forest site maps, grassland resource maps, land use maps, and land resource evaluation maps. Data analysis shows that forest coverage in the invesigated region raised significantly from 6.3% in 1977 to 8.43% in 1988, and the ecological environment in priority afforestation region has obviously improved. The construction of the "Three Norths" protective forest system really made tremendous achievements. At the same time, some problems were discovered, such as mono-speies afforestation, low survival rate of arbor forest in some of arid and semi-arid regions, insect and disease development in some regions. Especially, desertification is very seriously in the fragile zone. For instance, the desertification area increased by 9.36% from 1960 to 1987 in Yulin county.

The North China Plain along the Bohao Bay was selected as the study area on coastal changes and the project was performed by the Chinese Academy of Sciences. Nine Paleo-coastal lines since the Holocene Epoch have been determined throug processing and analyses of multi-temporal Landsat MSS, TM image data, and integrated analysis of remote sensing data, archaeological data, and lithosphere data.

Study shows that coastal change is a reflection of change in sea-level and global climate. The rate of shore line forward movement is uneven, for example, during the sea invasion of the Holocene Epoch(700 yrs. B.P.) the horizontal speed of sea water invasion was about 70-75km / 100yrs, the extent of invasion towards west was up to 150-160km. During the dry-cool time of paleo-climate(e.g.7800yrs. B.P., 5300yrs. B.P.,3800yrs. B.P.,200yrs. B.P.), sea levels dropped down, river brought a great amount of silt and sand which deposited in the plain and river mouth area and coastal lines moved towards the sea. In the map made in this study, it can be seen that the delta of the Huanghe River has moved 412km^{2}seaward from 1975-1985. The sea level change is very sensitive to climate change and will influence greatly human activities, especially in distribution of industry and agriculture in the coastal region.

As for land cover change we have used the IDRISI GIS software system(Eastman, 1992b) to run a series of 36 monthly AVHRR-derived NDVI images for China for the time period of January, 1986 to December, 1988. The data was extracted from the NOAA-EPA Monthly Generalized Global Vegetation Index data set which is part of the NOAA-EPA Global Ecosystem Data

Set (NOAA–EPA,1992).The images were in raster format and had a 10–minute resolution.

Using the standardized PCA, the first component created represented the mean annual vegetation pattern for China regardless of temporal change. Component 1 shows the characteristic vegetation cover found in China. Vegetation is most sparse in the west ,especially in the Tarim Basin, and then the Gobi Desert and Ordos Plateau to the north. Vegetation as depicted by NDVI is more dense in East China, though areas of low NDVI in the East are areas of population centers as well as open water. Of interest in the low NDVI over the Sichuan basin, and area of intensive agriculture. Although this area has a high population density, the low NDVI may be from the high humidity and frequent fog–cover over the region , lowering the NDVI recorded by the NOAA satellite. The greatest NDVI comes from the tropical regions of southern Yunnan and Hainan island. Because component 1 explains the greatest variation in the temporal data set, and the resulting component depicts the typical vegetation pattern for China, this indicates that the major element of element of variability in NDVI is that which occurs spatially.

Concerning the component loadings, figure graphs the component loadins for component 1 and shows that the original 36 images all correlate very highly with Component 1. Briefly, the loading chart illustrates the correlation betweeneach of the 36 monthly images and the cmmponent being diagramed. For example, the pixels of the component image with a positive correlation

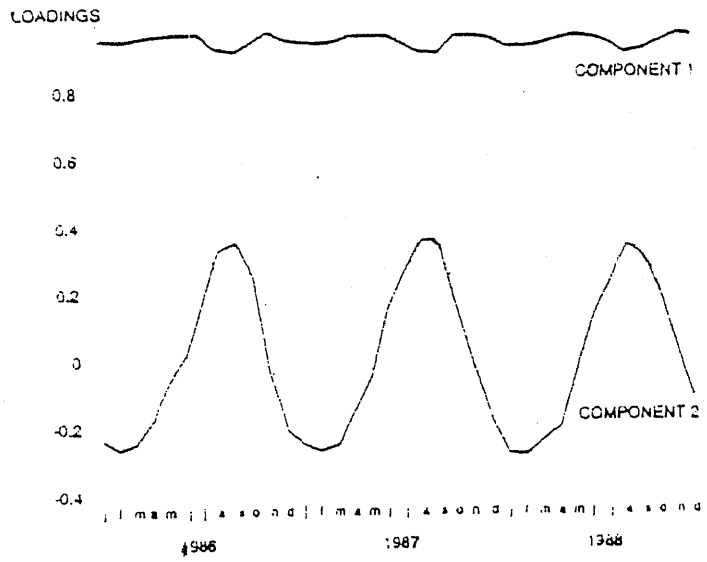

Fig 2. Loading cart of component 1 and 2

have a similar monthly variation (more overt in earlier components than in later ones) as indicated by the component loadings. Pixels which are negatively correlated tend to have anopposite motly variation as indicated by the component's loadings. Another way of explaining the loading is ,according to Eastman and Fulk(1993), if a month shows a strong positive correlation with a specific component, it indicates that that month contains a latent (to some extent a hidden or unapparent)spatial pattern that has a strong similarity to the one depicted in the component image. Similarly, a strong negative correlation indicates that the monthly image has a latent pattern that is the inverse of that shown.

To demonstrate this concept component 2 shows a strong positive correlation in the northeast of China, and a strong negative correlation in the Southwest, with much of the country in between the positive and negative correlations, though statistically most of the country is more positively correlated. The loadings for component 2 show a high correlation in the summer months and a low correlation in the winter months. What this indicates is that the next greatest change after component 1 is the temporal change caused by the changes in seasons from summer to winter.

3. Conclusion

As part of the world ,China also confronts with the seriousness of resources and environment problems caused by human activities and the change of natural conditions. It is important for China, to pay more attention to the study of global change and to enhance international cooperation in the field, so as to adjust the policy of economic development in the process of modernization in the country.

4. Reference

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