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Case study on Urban 3D-LUCC and its effects of secondary disasters based on GIS

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ABSTRACT

At present, rapidly changing landscape has become a typical feature in urbanization. we take Yuhua District in Shijiazhuang city as the study area, two different temporal RS data in 2010 and 2008 with a 0.6m resolution as base data, supplemented by field survey, GIS analysis,take a study on the rapidly changing in urban landscape structure by policy-driven in horizontal and vertical variations. And try to explore the effects and countermeasures of secondly disaster by rapidly changing urban landscape.

KEYWORDS

3D-LUCC;
Secondly disasters;
Policy-driven;
Urban landscape structure;

INTRODUCTION

Land use / cover change (LUCC) is a global change research hot field[1-3]. The regional land use / cover change (LUCC) and the drive mechanism is research focus in land use / cover change (LUCC)[4]. as a gathering of human civilization, City is the typical representative in land use / cover studying of regional scale. the change response of rapidly changing landscape and environment due to high utilization and rate of change of land use / cover is difficult and important part in LUCC research. As an artificial high intensity collection area of land use / cover change (LUCC), city ownership of land in China belonging to the State, government dominate the right to use land-use change under the theoretical framework. Therefore, the fundamental driving force of land use / cover change (LUCC) is the national policy of different levels of in different periods, so, urban landscape structure is a response to national and local policies in different periods.

Urbanization is a geographical space process[5], on the one hand, based on natural geography, urban land use/cover change (LUCC), including not only the surface of land use / cover change, but also land urban underground space utilization: horizontally, the city LUCC expresses as urban expansion and land cover change on surface; vertical direction, it expresses as changes in the volume of regional surface landscape, urban landscape height, size, characteristics and uses. Also it expresses as surface upward updates underground extension of urban landscape. As an artificial patch in regional natural ecosystem, the rapid change in urban landscape structure, size, density and other characteristics in the horizontal direction and the vertical direction makes urban area or local natural

environment changed dramatically, it will not be ignored about urban disasters and city emergency response.

LAND USE AND URBANIZATION

Present situation of urbanization in china

Since reform and opening especially in the last 20 years. Urbanization in China has improved continuously, urbanization rate is faster than the world average of 2.14%[6], especially the housing reform after the beginning of 1998, the rapid development of the real estate industry has a great development. At present, China is conducting the fastest expansion in urban areas in history, but the efficiency of the use of urban built-up area is declining[7]. GDP per unit area of the city in China during 2000-2010 is lower than that in 1990 to 2000. From 1990 to 2000, the urban built-up area in China grew up from 12 200 km2 to 21,800 km2; to 2010, reaching 40,500 km2 with an approximately 3.32 times in 1990. The suburban farmland is occupied at first in rapid expansion of the city, about 770 acres, nearly 53.4% of the urban expansion area is from arable land during the period of 1990-2000, about 1900 acres, nearly 68.7 percent of the city expansion area is from arable land during the period of 2000-2010[8]. At the same time, lots of arable land is changed into construction land, while makes the bad impact on food security.

Too fast and significant regional differences also urban-rural dual structure process of urbanization has not only made urban ecosystem structure, processes and functions affected degenerated[9], but also a negative response to a natural geographical environment, such as the urban heat island effect, water funnel, including haze, including air pollution. And there is also the loss of arable land resources, diminishes of GDP per unit area and other social environmental response[10]; also appears out some human environment response with a greater cost of other spatial and temporal characterization such as traffic congestion, education, health care which can show service functions of the urban.

Significance and value of research

Land use/cover (LUCC) is the essence of National development and human existence, as a high-intensity areas in land use/cover (LUCC), city is an artificial landscape collection. How to integrate urban ecosystems into the natural ecosystems, and output and maintaining of urban systems, also make it a virtuous circle, is the key point of city and social sustainable development. Therefore, it is very important for us to take a case study of typical urban LUCC and evaluate the response of urban ecosystems and natural geographic systems, socio-economic systems and human environment system, and based on different temporal and special scales urban land use change. It can verify the urban construction and urban planning of scientific rationality, but also especially an important reference value and guidance in the today when it takes an extraordinary scale and speed urbanization development in China.

North China Plain accommodate a population of over 440 million, over 20% of the land occupied by construction land in this region[8]. As the capital of Hebei Province, Shijiazhuang is a regional political economic and cultural center, also a development city relying on the Beijing-Guangzhou railway. it takes an advantages of expansion space and factors for its spatial location and its complete landforms such as mountains, hills, plains and so on. Policy of "great change after three years" has been launched in 2008 to make a regional central urban with an ecological and modernity feature in more than three years later, through mending the urban landscape structure and function, improving the layout and urban quality and features.

Now three years passed, it takes a rapidly changing and turnover along the horizontal and vertical directions on landscape and structure in its city space. It is a typically rapid urbanization representative in Hebei Province and even national microcosm of urban construction by policy driven. So, typical case study, which conclusions are more strong practical significance.

DATA SELECTION AND PROCESSING

Overview of Natural geography in study area

Shijiazhuang is located in south-central of Hebei Province and economic zone around Bohai Bay. Located at latitude 37 ° 27 '~ 38 ° 47', longitude 113 ° 30 '~ 115 ° 20', Hengshui city is in its East, the longest strengths from north to south is of approximately 148.018 kilometers, and the widest widths from east

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to west is about 175.383 kilometers. Perimeter of Shijiazhuang city border is about 760km, with its total area of 15,848 square kilometers and urban area of 307 square kilometers (including Jingxing mining region). Shijiazhuang city located at the eastern margin of Eurasia in Mid-latitude, is temperate continental monsoon climate, With a four distinct seasons and significant summer and winter, concentrated rainfall, significantly wet and dry period. Yuhua District is located in the southeast of Shijiazhuang City, is one of Shijiazhuang five administrative districts with an area of about 104 square kilometers.

Division of landscape types

Taking into account the urban landscape heterogeneity and social functions, and Shijiazhuang city is located in plain in front of Taihang Mountains, with a relatively simple urban landscape affected deeply by human activities, we divided its landscape along horizontal direction into the following five classes: 1. Urban construction landscape 2. Cities Landscape (including parks, playgrounds, green spaces, green belts and other outdoor activities in leisure venues) 3.urban tranffic land (mainly for highway and railway land) 4. water body (including parks, residential landscape water, urban landscape river waters) 5. cultivated land (including general field, vegetable, greenhouse space) 6. unutilize land (including flood, undeveloped land within the city, as well as a variety of wasteland, wasteland).

Then, we reference the classification standard in Building Industry, five classes is divided into according to the height of urban landscape in vertical direction.

1. Low-rise building: Number of floors are between 1 to 3 floors.
2. Multi-storey building: Number of floors are between 4 to 6 floors.
3. Second high-rise building: Number of floors are between 7 to 15 floors.
4. High-rise building: Number of floors are between 16 to 25 floors.
5. Super High-rise Building: Number of floors are above 26 floors.

Data and processing

We select two temporal (early 2008 and late 2010) sharing data on Google earth in Yuhua District, and the highest resolution of data is to 0.6m, through using the geographic information system tools (ArcGis9.x) and image processing software (Erdas professional 9.x)released by ERSI in U.S., we get the transferring matrix in landscape structure during study period in the horizontal, and changing height, density and scale in vertical landscape after the image stitched, raster images Regis rated, study area cropped, landscape interpretation and vector layered extraction, overlay analysis, property calculations and so on.

We make a field survey based on interpret to the image from early 2008 to late 2010, and do the geo-processing on landscape (all kind of artificial building) in vertical direction

See TABLE 1 for landscape height changes and TABLE 2 for landscape area changes from 2008 to 2010.

TABLE 1 : Landscape in vertical direction from 2008to 2010

Year	Classes for Vertical building landscape(unit: km2)		
	Super High-rise	High-rise	Second high-ris
2008	1.1583	0.3733	1.6784
2010	1.9132	1.9125	1.8224
Rate of change	65.17%	412.27%	8.58%
Year	Multi-storey	Low-rise	
2008	13.5793	29.5789	
2010	13.9320	27.2671	
Rate of change	2.60%	-7.82%	

TABLE 2 : Landscape change frome 2008 to 2010

Year	Index	Land use/cover Class(unit: km2)		
		construction land	cultivated land	Green land
2008	Area	46.22	30.84	8.72
	Percent	44.22%	29.51%	8.35%
2010	Area	47.41	24.69	10.90
	Percent	45.36%	23.62%	10.43%
08-10	Rate of change	2.57%	-19.93%	24.92%
08-10	Change	1.19	-6.15	2.17
Year	**Index**	**unutilized land**	**Water bady**	**Traffic land**
2008	Area	9.37	0.56	8.80
	Percent	8.97%	0.54%	8.42%
2010	Area	11.99	0.52	8.96
	Percent	11.47%	0.50%	8.57%
08-10	Rate of change	27.91%	-7.06%	1.80%
08-10	Change	2.62	-0.04	0.16

CHARACTERISTICS ANALYSIS OF URBAN LANDSCAPE STRUCTURE CHANGES IN THE STUDY AREA

Landscape in horisonal direction

There are shown in TABLE 2, in early 2008, landscape area in study area shows as: construction land> Agricultural Land> unused land> Transportation land> green land> water body; and in the end of 2010, landscape area in study area shows as: construction land> Farm land> unused land> green land> Transportation land> water body, which the green area of land is more than transportation land, other landscape types of the total size of the relationship has not changed. The common characteristics of two temporal data is that urban construction land and agricultural land take a vast majority of the total area, water body area occupy smallest.

On some view of each class, all of construction land, green land, unused land, transportation land has increased, which unused land increases the most amount in area from 9,374,665.203 square kilometers in 2008 to 11,991,459.33 square kilometers in 2010. with an area increment of 2,616,794.127 square kilometers and increased rate by 27.91%. Changes of green area is more violent, with an area of 2,174,091 square kilometers and 24.92% of percent increment. The third is construction land, with an area of 1,189,300.2 square kilometers and 2.57% of percent. Transportation land area changes are relatively small. The area reduction of landscape types include agricultural land and water body, with an 30,841,867 square kilometers in 2008 to 24,693,748 square kilometers in 2010, and with a 6,148,119 square kilometers 19.93% reduction of agricultural land from 2008 to 2010. While reduced area of water body is smaller from 2008 to 2010, with a 39836.72254 square kilometers and 7.06% reduction of area

Landscape in vertical direction

Studies have shown that high-rise building in study area landscape area grows from 0.3733 square kilometers in early 2008 to 1.9125 square kilometers in late 2010. it grows up to 412.27% from 2008 to 2010, area of Super high-rise Building landscape grows from 1.1583 square kilometers in early 2008 to 1.91322 square kilometers in 2010, with a 65.17% growth rate from 2008 to 2010. Two types of architectural landscape above are the biggest change of all landscape types. Area changes of high-rise spread along Urban Expressway. Second high-rise and multi-storey buildings landscape increase with 8.58% and 2.60% growth rate for each one. while only the area of low-rise landscape decreases with a 7.82% reduction rate. The trend of high-rise building landscape in the study area is toward the vertical direction.

URBAN LANDSCAPE CHANGE AND ANALYSIS OF SECONDARY DISASTERS

As a collection of human civilization, the urban is also the largest area in land use/cover change, besides the negative impact on the natural ecological considerations, the secondary disasters brought by urban landscape change are also worthy of attention, mainly as follows:

Hurricane exited among high-rise and above building

Because of the impact to heat and wind flow, super and high-rise buildings in urban will hinder the flow of the wind, and make the wind flow through the left and right sides of the building, which makes the leeward side of the building into negative pressure area, and forms vortex. Furthermore, velocity of wind flow increases up in the gap between the building, and cyclone appeared around the corner. The higher and the more intensive of the building, the more obvious and the more difficult to control to this phenomenon, the impact is also more complex, and hurricane between super and high-rise building will be formed.

Urban HEAT ISLAND

As model that human changes natural ecosystems, changes in urban land use/cover in the horizontal direction makes the underlying surface characteristics changed; Meanwhile, urban landscape extends vertically, makes the urban social function more density, urban factories and vehicle's exhausting heat, population density, more building, dry ground, and less water evaporated, that cause local temperature, humidity, precipitation and other local climate index changing,

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urban temperature is higher than the surrounding suburbs, it is the urban heat island effect. Urban heat island effect is not conducive to the spread of pollutants, and also to form a "muddy island" phenomenon.

Ground subsidence

Research to Yuhua District in Shijiazhuang city suggests that changes in the urban landscape by policy-driven in addition to the horizontal expansion, the variation of velocity in the vertical direction is also worth attention. Nearly 10 years, because of the national housing policy, city develop and expands very quickly in horizontal and vertical direction. At the same time, Demanding to more building materials in urbanization also makes natural mountain surrounding the city is a large excavation, or even disappeared, while in the urban expansion area, artificial mountain: city multi-level to high and super high-rise buildings appeared in large numbers, physical geography surface balance is artificially changed, the stability of regional geology became worse. while in urban development, urban surface space increasingly tense, that leads to accelerated land use space underground, such as the urban underground rail transportation, underground drainage ditches, building underground parking lots. Especially in the North China Plain, overexploitation of groundwater has become a huge funnel, the possibility of land subsidence caused by high-rise building is very large.

CONCLUSIONS AND SUGGESTIONS

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We conclude through the case study that, different from conventional urban LUCC. In the study area during the "great changes after three years" period, Agricultural land area decreased by 19.93%, while construction land area increased by only 2.57%, urban green area r increase 24.92%. Landscape in study area extends vertically significant. And vertical building landscape increases with a growth rate of 412.27% for high-rise building and the 65.17% for super high-rise building landscape. It shows that the trend of urban land use/cover change is in the direction of the development of three-dimensional in today and future, also expresses an actively driven effect for government policy in the urban landscape structure and development.

Mean while. The expansion of the city in three-dimensional space, the increased city capacity and density of life and productivity, that makes the city an increased risk of sudden disasters. And high-rise building also often becomes objects of social terror attacks. Therefore, it is extremely important to comply with the natural sciences urban development decision-making.

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