

# Study on Geographical Regression Analysis of Driving Factors of Land Spatial Planning for Urban Development

Luqun CHANG<sup>1,\*</sup>, Zhengfu BIAN<sup>2</sup>

<sup>1</sup> Ji'nan Research Institute of Geotechnical Investigation & Surveying, Ji'nan, Shandong Province, China;

<sup>2</sup> Engineering Research Center of Ministry of Education for Mine Ecological Restoration, China University of Mining and Technology, Xuzhou, Jiangsu Province, China.

**Abstract.** This paper integrates the factors of urban regulatory detailed planning, land use planning, whole life cycle of land resource management and project construction approval, unifies the spatial datum and constructs the Driving Factors System of the Land Spatial Planning (DFSLSP) through data fusion. Using the core idea of Spatial Information Multi-level Grid and according to the irregular grid architecture, the irregular multi-level grid level is associated with spatial control zoning and land use unit, and the Driving Factors Multi-level Grid of Land Spatial Planning (DFMGLSP) is simulated and established. On this basis, the concept, size and state of plot unit are redefined. Through the analysis results of Geographic Weighted Regression(GWR) examples, for the plots whose urban development status is seriously underestimated or overestimated, after superimposing the driving factors layers, analyze the spatial relationship between them and the plots with low reliability, so as to obtain the causes of errors, and screen out the land use planning permission and project planning permission as the driving factors affecting urban construction and development, and four factors, such as the "two regulations" conflict, approval but not supply, inefficiency and idle land, are the resistance factors affecting urban construction and development. All these provide new ideas and new methods for assisting the government in planning control and guiding urban development.

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## 1 Introduction

In recent years, the development speed of most domestic cities has increased rapidly, especially the new construction land dominated by residential land (R) around the city. However, in the early stage, in the process of carrying out the research on the mixed multivariate CA model of urban development constrained by spatial planning variables, the author found that there are some phenomena in the surrounding development areas of emerging cities such as Jinan High-tech East Zone: Although the development state of most cities in the region remains unchanged, there are also a small number of plots with backward development state.

The reason may be related to the notice on improving the "linkage mechanism of increasing and saving" of construction land issued by the Ministry of Natural Resources. The notice puts forward clear requirements for the treatment of "approved but not supplied" and "inefficient, idle land".

Shandong Province, Jinan City, especially the High-tech Zone, then combed the historical problem plots in detail and put forward a three-year action plan to improve land use efficiency. The introduction of the plan has played a negative role in the development of land plots with virtual high urban development status to a certain extent. This paper discusses how to combine the driving

factors of urban planning, land use and project management with the specific driving factors of urban planning and urban construction.

## 2 Research Status

When making development strategies and plans, urban planners usually establish dynamic urban models based on spatial decision support system (SDSS) [1] to evaluate the effectiveness of these strategies. The main method is to simulate the urban development process in the real geographical environment and try to predict the future urban development and evolution trend through historical data simulation. The shortcomings of these dynamic urban models mainly include two aspects:

One aspect is Constraints. The setting of planning control constraints is too simple, and there is little overall consideration of the comprehensive impact of land spatial planning constraints such as urban planning, land planning and ecological planning. In addition, the applicability of regional and development stages of constraints is ignored, and the time and spatial complexity of constraints are rarely considered [2].

The other aspect is Data Sources. At present, most of the data used in the research are Landsat satellites images [3] [4]. The advantage is that the data is easy to obtain and the structure is simple. Although it is suitable for large-

\* Corresponding author: [lqchangmx@126.com](mailto:lqchangmx@126.com)

scale regional research, it has low spatial resolution and can not truly, effectively and finely reflect all kinds of irregular land use units inside and outside the city.

These models are built using various software tools, such as geographic information system (GIS) or three-dimensional visualization software (3DMAX, BIM [5]).

### 3 Driving Factors of the Land Spatial Planning

The technical route of driving factor analysis is as follows:

Firstly, sort out the land management and approval business, urban planning management, planning approval business and the collaborative office and dynamic supervision process of various businesses. Then, analyze the main links of the process and the factors that play a driving role in land acquisition, supply, project planning and construction. Finally, screen out six factors: approved but not supplied, idle land, inefficient land, land use planning permit, project planning permit and conflict of the "two regulations".

Among them, land use planning permit is the legal certificate for the use of construction land and the connection stage between land supply and land use [6]. In the implementation scheme of new construction projects, it includes the pre-trial link of land use[7]; project planning permit is the precondition for the commencement of the project and an important link of land use[8]. When discussing the impact of the two, take whether the two types of permits have been handled as the index. See Table 1 for the specific driving conditions:

**Table 1.** Driving Factors System of the Land Spatial Planning

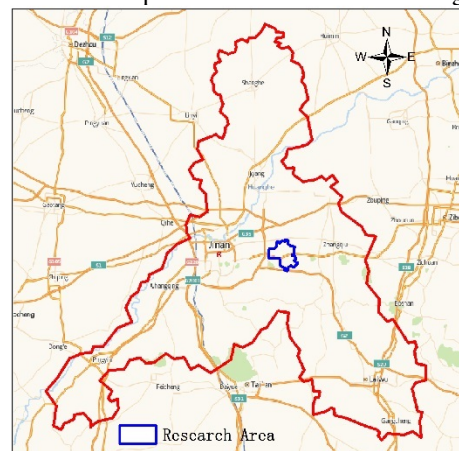
Code	Primary Factors	Secondary Factors	Driving Factors
100	Whole Life Cycle Of Natural Resource		
101		Land Survey	
102		Land Pre-Trial	
103		Land Acquisition	Approval But Not Supply(Ans)
104		Land Supply	
105		Land Storage	
106		Land Transaction	
107		Real Estate Registration	
108		Land Use Status	Inefficiency Land (Ie)
109		Land Supervision	Idle Land(II)
110		Land Use Planning	Conflict Of The "Two Regulations"(Ctr)
200	Urban Planning		
201		Regulatory Detailed Planning	
300	Engineering Construction Project Approval		

301		Land Use Planning Permit	Land Use Planning Permit(Lupp)
302		Project Planning Permit	Project Planning Permit(Ppp)
303		Project Construction Permit	
304		Project Planning Verification	

### 4 Simulation Implementation

#### 4.1 Selection of Research Area

This paper selects the East high-tech Zone of Jinan as the research area. The spatial location is shown in Figure 1:



**Fig. 1.** Research Area

The total area of the study area is about 110 square kilometers. As a new area of urban planning and construction, compared with selecting the whole urban area of Jinan as the research object, the advantage of high-tech east zone is that it can more truly reflect the process of urban natural development to high-speed development and the impact of policies in the process, better reflect the spatial control (restriction) role of urban planning achievements, and enrich the driving factors of spatial planning variables in the region, The weight of elements can be fully reflected.

#### 4.2 Definition of Plot Unit

The dynamic change based on irregular grid system can reflect the real development process of urban society, economy and nature, which is conducive to the simulation of space-time process [9]. In this paper, the core idea of spatial information multi-level grid [10] is adopted. Based on the irregular grid architecture, the irregular multi-level grid level is associated with spatial control zoning and land use units, and the Driving Factors Multi-level Grid of Land Spatial Planning—DFMGLSP (DFMGLSP) is simulated and established.

#### 4.2.1 Data Sources of Plot Unit

Considering that the research in this paper mainly serves the development of urban spatial planning, the plot units are divided into two categories, which are respectively given the geographical cells of irregular grid with the nature of construction land status and land use status. Current Status of construction land includes attributes such as residential land, public facilities land and industrial land, etc. Land use status includes attributes such as cultivated land, forest land, commercial land and residential land, etc.

#### 4.2.2 Size of Plot Units

The plot unit belongs to an irregular spatial grid, and its size is determined according to the geographical location of the plot and the existing construction land, land use and spatial control zoning data. Therefore, the plot units correspond to different scale spaces: Plots covering urban built-up areas (BA) and planning areas (PA) are extracted from the current Status of Construction Land datas. The plots covering the urban-rural fringe (URA) and other urban areas (OA) are extracted from the Current Status of Land-Use datas.

#### 4.2.3 Status of Plot Units

Considering the subtle changes in the developed areas covering urban built-up areas and planning areas, the plot unit status (development status) is divided into four categories: highly developed, medium developed, preliminary developed, undeveloped, and the quantitative expression of state set is (1, 0.67, 0.33, 0).

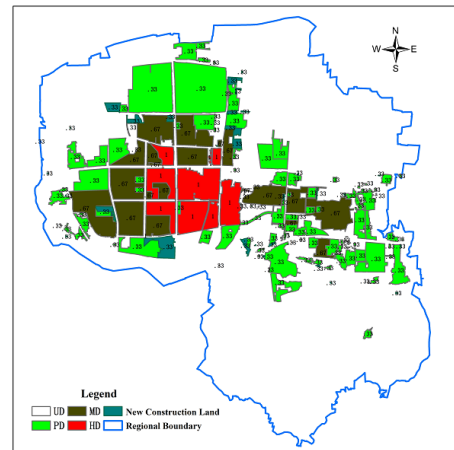
### 4.3 Geographically Weighted Regression

Geographically Weighted Regression (GWR) is a method to study the quantitative relationship between two or more variables with spatial (or regional) distribution characteristics by using the regression principle. It is a local form of linear regression. In the calculation, the spatial characteristics of the data are included in the linear regression model by assuming that the regression coefficient (weight) is the geographic location function of the variable [11]. The application field of modeling focuses on the analysis of spatial differences of land use and driving mechanism [12].

#### 4.3.1 Inputting Datas

Based on the calculation of ArcGIS GWR tool, the parameters are as follows:

(1) The input element is the surface layer of urban development status in 2018, as shown in Figure 2;



**Fig. 2.** State of Urban Development (2018)

(2) The dependent field is the state of urban development (State);

(3) The explanatory variables are Ans, Il, e, Ctr, Lupp, Ppp respectively. The values of these six types of attributes are the area of various driving factors closest to the study plot (\*\_Area).

(4) Kernel type selects ADAPTIVE method. The Kernel surface is created according to the density of the feature sample distribution.

(5) The kernel bandwidth is determined by AIC and minimum information criterion.

#### 4.3.2 Regression Results

The regression result indicators are shown in Table 2:

**Table 2.** Table of GWR Analysis Results

OID	VARNAME	VARIABLE	DEFINITION
0	Bandwidth	1449.06	
1	ResidualSquares	2.69	
2	EffectiveNumber	45.99	
3	Sigma	0.14	
4	AICc	-173.41	
5	R2	0.74	
6	R2Adjusted	0.60	

The main parameters in the above table are described as follows:

(1)Bandwidth: locally estimated bandwidth, 1449.06 meters, which controls the smoothness in the model, that is, the optimal bandwidth estimated by AICC model;

(2)Residual squares: the sum of squares of residuals in the model is 2.69, the measured value is small, and the GWR model fits the observed data better.

(3)Sigma: the root of squares of the normalized residual sum of squares, which is the estimated standard deviation of the residual. It is mainly used for AICC calculation.

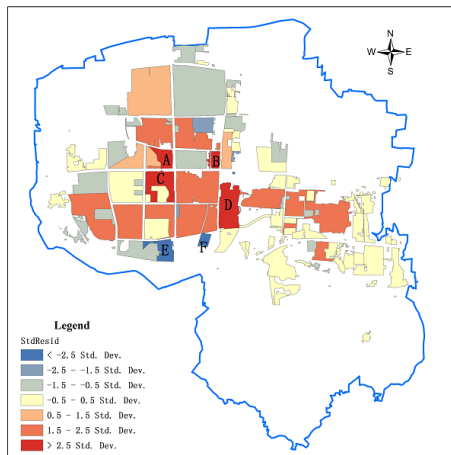
(4)AICC is a measure of model performance. For different regression models, the model with lower AICC value will better fit the observed data.

(5)R2: R square is a measure of fitting degree. Its value varies from 0.0 to 1.0.

(6)R2adjusted: the corrected R2 value is calculated and normalized according to the degrees of freedom of

numerator and denominator. It is to compensate the number of variables in the model. Compared with R2, it has more reference value.

The standard variance visualization is shown in Figure 3:



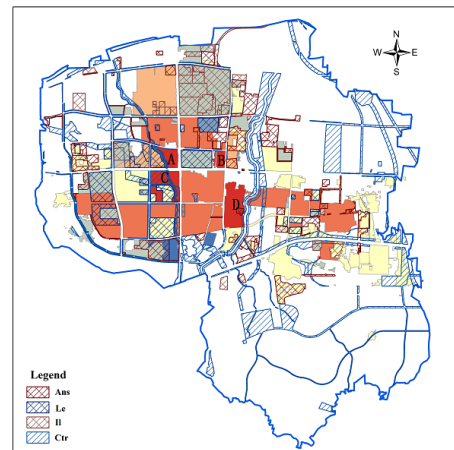
**Fig. 3.** Map of Standard deviation of GWR

The values and colors in the figure above are the standard errors of coefficients (weights), which are mainly used to measure the reliability of the estimated values of each coefficient. Therefore, when the standard error is smaller than the actual coefficient value, the reliability of the estimated value is higher; When it is relatively large, that is, the area where the absolute value is greater than 2.5 times the standard deviation, such as plots A, B, C, D, E and F in the above figure, it indicates that there is a problem with local multi-collinearity.

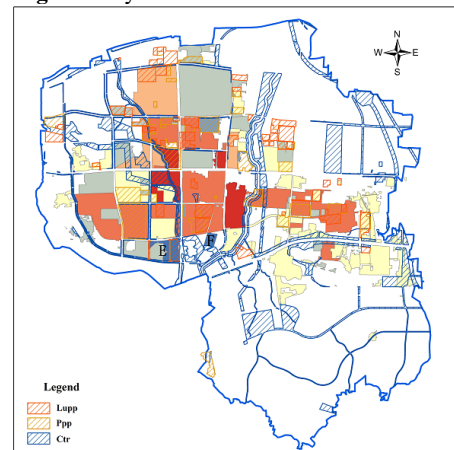
#### 4.3.3 Result Analysis

The urban development status of plots A, B, C and D with low reliability in the geographically weighted regression map is seriously overestimated, while plots E and F are seriously underestimated. After overlapping the layers of approved but not supplied, idle land, inefficient land, land use planning permit, project planning permit and conflict of the "two regulations", the causes of errors are analyzed by analyzing their spatial relationship with six plots with low reliability:

(1) The overestimated plots A, B, C and D are distributed on both sides of the strip of conflict between the "two regulations", which are closely surrounded or contain plots of resistance factors affecting urban construction and development, such as approved but not supplied, inefficient and idle land, as shown in Figure 4. These resistance factors are amplified due to their proximity to the assessed plot and the influence of weight. At the same time, the above resistance factors are ignored when evaluating the state of urban development, so the observed value (evaluation value) of the plot is overestimated.



**Fig.4.** Analysis of Resistance Factors of GWR



**Fig.5.** Analysis of Dynamic Factors of GWR

(2) The underestimated plots E and F are distributed on both sides of the strip of conflict between the "two plans". The plots contain dynamic factors affecting urban construction and development, such as land use planning permit and engineering planning permit, as shown in Figure 5. The influence of the above dynamic factors is ignored when evaluating the state of urban development, so the observed value (evaluation value) of the plot is underestimated.

## 5 Conclusion

### 5.1 Summary

This paper strengthens the "integration of two plans" and "integration of two maps", integrates the elements of urban regulatory detailed planning, overall land use planning, the whole life cycle of natural resource management and approval of projects construction, unifies the spatial datum, and constructs the Driving Factor System of Land Spatial Planning for Urban Development (DFSLSPP) with 3 first-class factors, 15 secondary factors and 6 driving factors through data fusion.

Using the core idea of spatial information multi-level grid and according to the irregular grid architecture, the irregular multi-level grid level is associated with spatial control zoning and land use units, and the Driving Factors Multi-level Grid of Land Spatial Planning (DFMGLSP) is

simulated and established. On this basis, the concept, size and state of land unit are redefined.

Through the analysis results of geographical regression examples, for the plots whose urban development status is seriously underestimated or overestimated, after spatial superposition of the driving factors layer, analyze the spatial relationship between them and the plots with low or high reliability, so as to obtain the causes of errors, and screen out the two factors of land use planning permit and planning permit as the driving factors affecting urban construction and development. There are four factors that affect urban development, such as approved but not supplied, idle land, inefficient land, conflict of the "two regulations".

## 5.2 Issues to be Solved

Under different spatial scales, the effect of regression analysis and the action degree of various factors affecting the analysis are different. Therefore, how to determine the appropriate spatial resolution and how to divide the spatial grid is also a problem to be considered in the next step.

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