

MODELLING AND UNDERSTANDING MULTI-TEMPORAL LAND USE CHANGES

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ABSTRACT:

Understanding temporal urban growth is very crucial to the interpretation of urban morphology and a key challenge for the study of rapid urbanization in contemporary China. Previous land use change modelling approaches only consider the spatial complexity that may be indicated by spatial dependence and landscape fragmentation, ignoring the temporal complexity inherent in the process of urban growth. Multi-temporality is a typical characteristic of urban growth and multi-temporal data availability has been much improved due to great advance in geospatial technology particularly remotely sensed imagery. This paper proposes an innovative application of a machine learning method – Maxent for analysing the urban morphology of a fast growing city –Wuhan, China. Multi-temporal data sets for 1955, 1965, 1993 and 2000 were processed from remotely sensed imagery. The results demonstrate that Maxent is an effective exploratory method and tool for understanding urban morphology.

1. INTRODUCTION

Rapid urbanisation has stimulated fast urban growth occurring in Chinese cities and other developing countries. Wuhan, a mega city in Central China, has seen its urban built-up areas grow tenfold between 1955 and 2000 (Cheng and Masser, 2003). Understanding temporal dynamics of urban form and urban land cover/land use is a prerequisite to making appropriate sustainable urban development policies and strategies. Stimulated by rapid advances in geospatial technologies, high-resolution remotely sensed imagery has become widely available and at low cost. Such factors have made monitoring urban growth possible and more successful in developing countries. Moreover, various models have been developed and explored for interpreting, predicting and simulating urban development pattern and processes and assisting the decision support of urban growth management and planning. Among these models, logistic regression, cellular automata and multi agent system methods have received a lot of attention. However, most models are only focused on the spatial complexity of urban growth system, not on temporal complexity. Urban growth is a continuous process, which means that new buildings, roads, and commercial centres emerge temporally accidentally. Multi-temporality is a typical characteristic of urban morphology. Three classic theories of urban morphology were developed in the 1970s: the concentric zone theory, the sector theory and the multiple nuclei theory. These theories have defined morphological factors (e.g. distance to city centre(s), distance to main corridors) which affect urban development patterns. Morphology analysis makes it possible to summarise the changes and trends of the urban spatial structure. For example, we need to establish the dominant morphological factors (e.g. proximity and development density) driving urban growth in multi-temporal periods. Such findings can make a useful contribution to the local knowledge of urban development planning.

The availability of multi-temporal data sets offers great opportunity for measuring and understanding urban

morphology. However, previous studies in urban morphology were focused on the measurement of urban morphology using methods such as fractals, density gradient and landscape matrix. These methods only provide single or multiple indicators for spatially measuring urban morphology, instead of, temporally modelling urban morphology. Multi-temporal spatial modelling is still not well developed in geospatial areas. In this paper, we propose an innovative application of a machine learning method – Maxent, for analysing urban morphology of a fast growing city (Wuhan, China). Multi-temporal data sets are available for 1955, 1965, 1993 and 2000, which were processed from remotely sensed imagery. This research has demonstrated that Maxent is an effective exploratory method and tool in helping understand urban morphology.

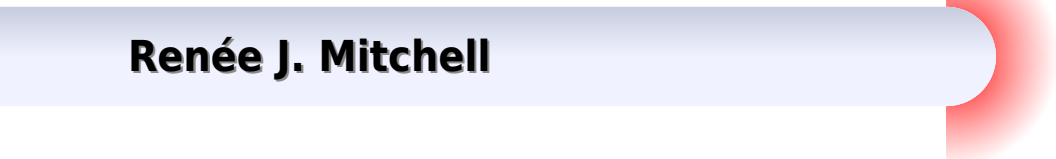
2. DATA & METHODOLOGY

2.1 Data sources and processing

Wuhan is located in Central China on the middle reaches of the Yangtze River. Wuhan municipality, the capital of Hubei province, has a total population of about 8 million over an area of 2000 km² in 2007. Wuhan is known as ‘Water City’ (*Liáng chéng*) due to the two rivers (Yangtze and Han rivers) that intersect here, and the surrounding lakes. In previous research (Cheng, 2003), temporal urban growth of Wuhan from 1955 to 2000 has been mapped (see figure 1) based on primary data sources composed of aerial photographs from 1955 (scale 1:25000) and 1965 (scale 1:80000), SPOT Pan/CS images taken in 1986 and 2000, and secondary data sources (e.g. land use map of 1993, topographic maps of 1993, traffic and tourism maps and master plan schemes). Land conversion was detected and classified using the maximum likelihood method (SPOTs) and visual interpretation (photographs).

Modelling Changes In Understanding

Renée J. Mitchell



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Exploring Maternal-Fetal Pharmacology Through PBPK Modeling Approaches André Dallmann, Johannes Nicolaas Van Den Anker, 2022-06-06 **Modelling the Impact of Climate Change on Water Resources** C. Fai Fung, Ana Lopez, Mark New, 2011-07-05 The quantitative assessment of the impact of climate change on water availability and water resources management requires knowledge of climate hydro geo logical and water resources models and particularly the relationships between each of them This book brings together world experts on each of these aspects distilling each complex topic into concise and easy to understand chapters in which both the uses and limitations of modelling are explored The book concludes with a set of case studies using real life examples to illustrate the steps required and the problems that can be faced in assessing the potential impacts of climate change on water resource systems For students scientists engineers and decision makers alike this book provides an invaluable and critical look at the information that is provided by climate models and the ways it is used in modelling water systems A key focus is the exploration of how uncertainties may accrue at each stage of an impacts assessment and the reliability of the resulting information The book is a practical guide to understanding the opportunities and pitfalls in the quantitative assessment of climate change impacts and adaptation in the water resource sector *A Review and Assessment of Land-use Change Models*, 2002 Principles of Financial Modelling Michael

Rees,2018-07-10 The comprehensive broadly applicable real world guide to financial modelling Principles of Financial Modelling Model Design and Best Practices Using Excel and VBA covers the full spectrum of financial modelling tools and techniques in order to provide practical skills that are grounded in real world applications Based on rigorously tested materials created for consulting projects and for training courses this book demonstrates how to plan design and build financial models that are flexible robust transparent and highly applicable to a wide range of planning forecasting and decision support contexts This book integrates theory and practice to provide a high value resource for anyone wanting to gain a practical understanding of this complex and nuanced topic Highlights of its content include extensive coverage of Model design and best practices including the optimisation of data structures and layout maximising transparency balancing complexity with flexibility dealing with circularity model audit and error checking Sensitivity and scenario analysis simulation and optimisation Data manipulation and analysis The use and choice of Excel functions and functionality including advanced functions and those from all categories as well as of VBA and its key areas of application within financial modelling The companion website provides approximately 235 Excel files screen clips of most of which are shown in the text which demonstrate key principles in modelling as well as providing many examples of the use of Excel functions and VBA macros These facilitate learning and have a strong emphasis on practical solutions and direct real world application For practical instruction robust technique and clear presentation Principles of Financial Modelling is the premier guide to real world financial modelling from the ground up It provides clear instruction applicable across sectors settings and countries and is presented in a well structured and highly developed format that is accessible to people with different backgrounds *Effect of Digital and Climate Changes in the Business Models of Companies* Adam Jabłoński,Marek Jabłoński,2025-08-12 The aim of the monograph is to present a modern and original approach towards designing and implementation of effective solutions that ensure an induction towards positive climate change The monograph presents the application of digital business models and strategies combining solutions of digital and climate transformation The monograph presents a set of digital solutions that change the functioning of technical organizations in a multiple crisis environment Applied technological management supported by elements of automation and robotics will shape the emergence of new climate services The described mechanisms for implementing cybersecurity and safety principles will serve to reduce climate threats **Business Models and Firm Internationalisation** Christian Nielsen,Svetla T. Marinova,Marin A. Marinov,2021-12-21 Internationalisation has been a binding request for firms dealing with the challenges of the present day realities Extant international business publications have recently begun to point out the relationship between the notions of business model and internationalisation yet the field needs considerably more attention The core aim of this book is to provide a comprehensive analysis of the ways in which business models and internationalisation impact one another in the process of initiating and expanding international business activities The analysis makes it feasible to detect the core issues of the interdependences between business models

and internationalisation to facilitate management decision making and implementation of pertinent firm internationalisation incorporating the application of appropriate business models In this book the business model is applied to explore the specifics and aspects of firm internationalisation processes Innovating the business model is analysed as a persuasive means for augmenting the propensities of firms to internationalise The book enriches the comprehension of the significance of business model innovation as an enabler of firm internationalisation in view that it shows in what manners business model innovation facilitates firm internationalisation The book chapters address a broad range of issues encompassing the general roles of business model in firm internationalisation the relationships between digital business models and platforms on one side and firm internationalisation on another how business models determine the internationalisation of services firms the interplay between business models and firm internationalisation in specific contexts It will therefore be of interest to researchers academics and advanced students in the fields of international business and management

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