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Explore urban flood vulnerability based on spatial pattern in Taiwan ecological city viewpoint

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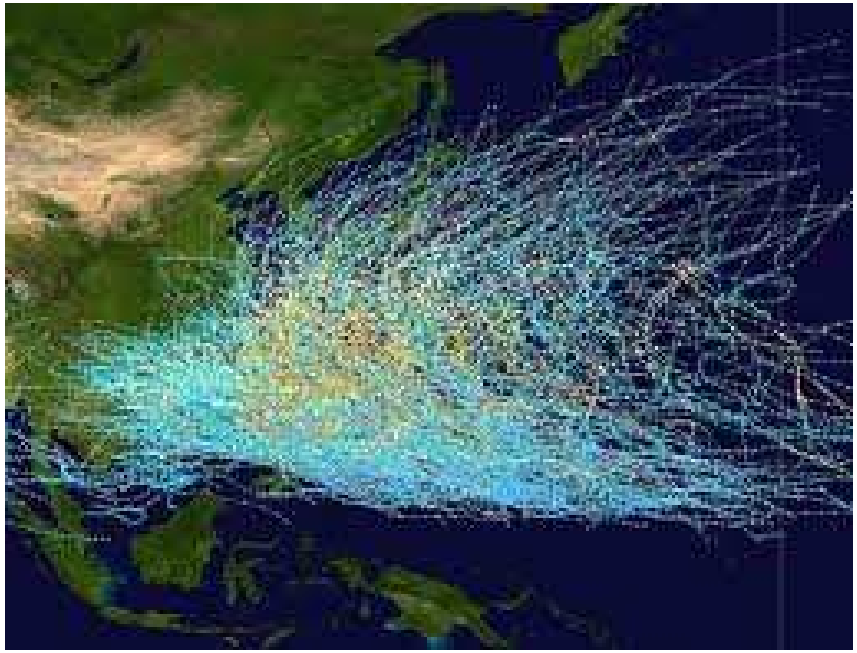
Outline

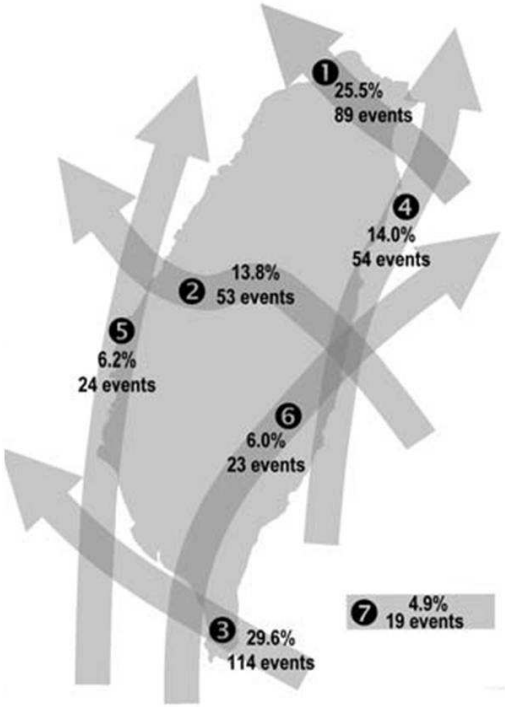
- **INTRODUCTION**
- **‘ECO-CITY’ VISION: THE DEVELOPMENT PERSPECTIVE**
- **METHODOLOGY**
- **ANALYSIS AND RESULT**
- **CONCLUSION**

INTRODUCTION

INTRODUCTION

- In 2005, the World Bank issued Natural Disaster Hotspots – A Global Risk Analysis, which indicted that Taiwan may be the place on Earth most vulnerable to natural hazards, with **73 percent** of its land and population exposed to three or more hazards.

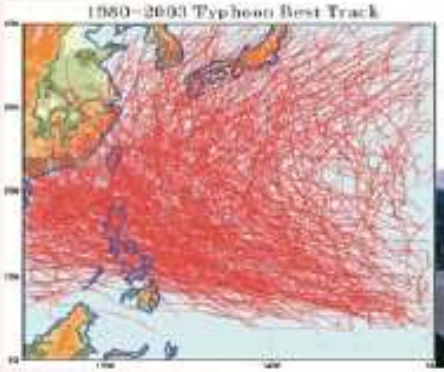




Location of Taiwan and the typhoon approach tracks based on typhoon data between August 1897 and September 2005.

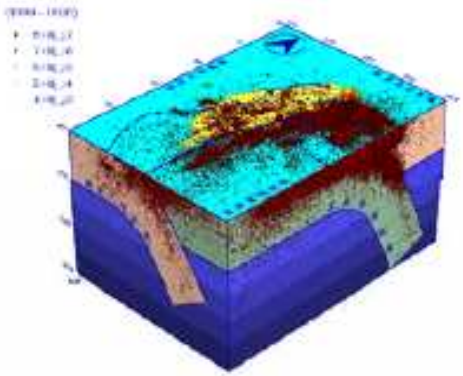
INTRODUCTION

- With the annual average of 3.6 typhoon, the loss is about USD $589 million/year



- Shortage and distribution of water worsen gradually.

- Large-scale earthquake make the serious impacts on society.



INTRODUCTION

Purpose

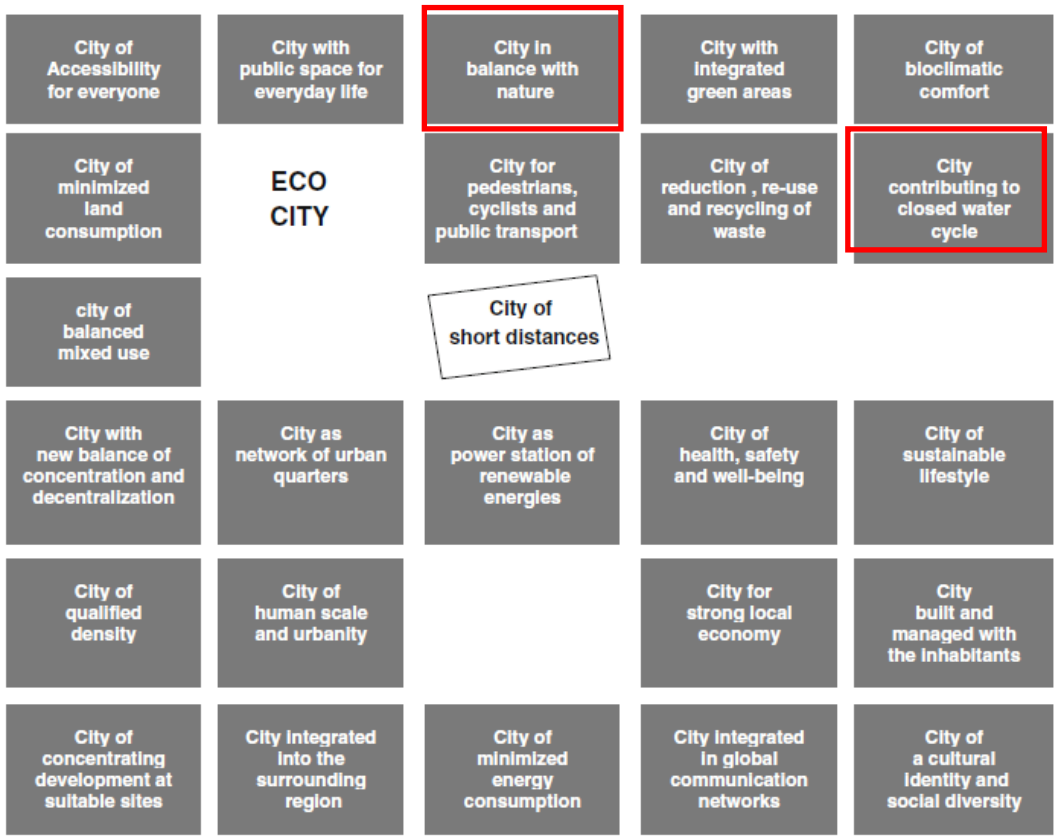
- Understanding urban flood situations and spatial pattern .
- Understanding the land use vulnerability area or levels from different situations.
- Rethinking ecological city viewpoint with land use plan.

‘ECO-CITY’ VISION: THE DEVELOPMENT PERSPECTIVE

‘ECO-CITY’ VISION: THE DEVELOPMENT PERSPECTIVE

In the ECOCITY project, the structure adopted for analysis and evaluation was based on the following elements:

- **Urban structure**
- **Land use**
- **Transport**
- **Energy**
- **Material flows**
- **Socio-economy.**



Developed countries’ aspirations for an eco-city (source: http://www.ecocityprojects.net/index_public.php)

‘ECO-CITY’ VISION: THE DEVELOPMENT PERSPECTIVE

The urban flood issues between ecological city and compact city discuss complicated dialectical perspective from channelizing spatial plan and dike spatial plan.

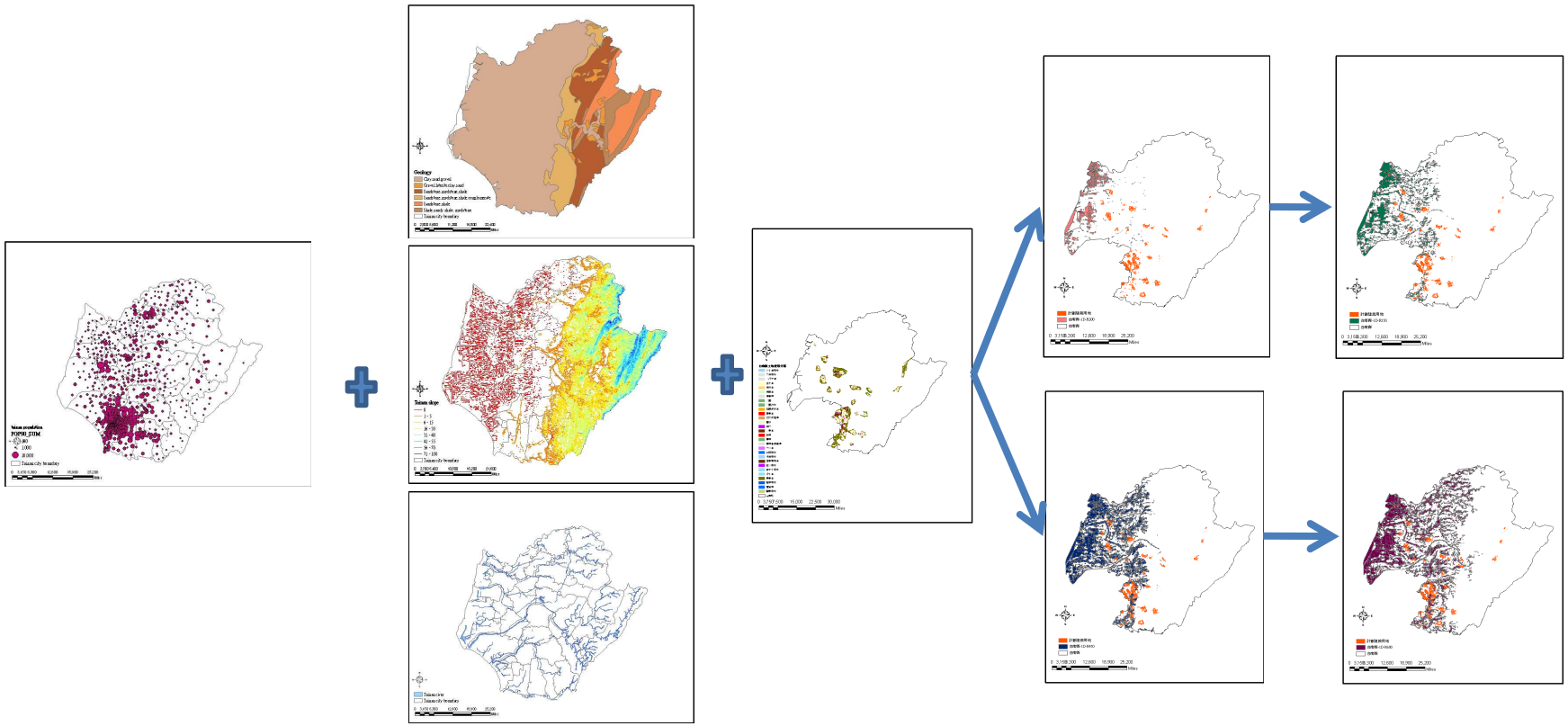
VS

METHODOLOGY

METHODOLOGY

- Study area

These study area Tainan is the forth-grade city in Taiwan, but it's the oldest city which has abundant cultural heritage, as the cultural style presented. The methodology will now be described in greater detail, taking as an example its pilot application for Tainan in Taiwan, which is a town in which there is present risk from flood hazard.



METHODOLOGY

- **Flood governing equations**

(O'Brian, et. al. 1993).

(1)The two-dimensional constitutive equations include the continuity equation:

$$\frac{\partial h}{\partial t}+\frac{\partial hV_x}{\partial x}+\frac{\partial hV_y}{\partial y}=i \quad (1)$$

(2) The two-dimensional equations of motion:

$$S_{fx}=S_{ox}-\frac{\partial h}{\partial x}-\frac{V_x}{g}\frac{\partial hV_x}{\partial x}-\frac{V_y}{g}\frac{\partial hV_y}{\partial y}-\frac{I}{g}\frac{\partial V_x}{\partial t} \quad (2)$$

$$S_{fy}=S_{oy}-\frac{\partial h}{\partial y}-\frac{V_y}{g}\frac{\partial hV_y}{\partial y}-\frac{V_x}{g}\frac{\partial hV_y}{\partial y}-\frac{I}{g}\frac{\partial V_y}{\partial t} \quad (3)$$

Category	Code	Classification	Unit	Illustration
Date	D	1、2	Date	Explain rainfall duration
Return period	I	1、2、5、25、50、100、200	Year	Known as a recurrence interval is an estimate of the interval of time between events certain intensity or size.
Rainfall intensity	R	150、300、450、600	mm	Explain rainfall duration rainfall amount.

METHODOLOGY

Anselin L (1995)

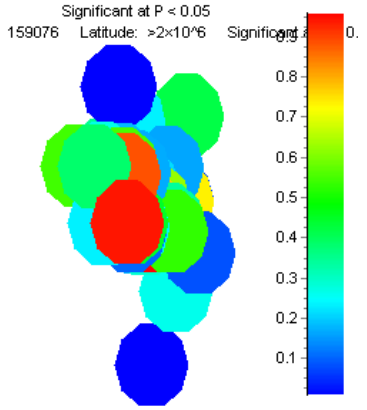
- **Utilizing explore spatial data analysis**
- **Spatial autocorrelation analysis**

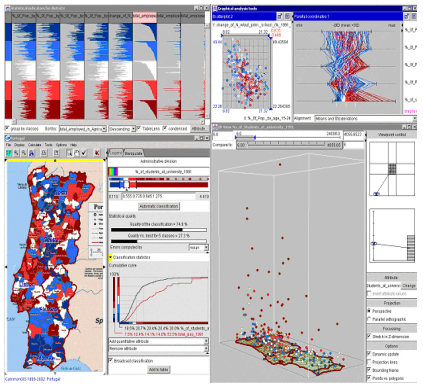
$$I(d) = \sum_i \sum_l w_{il} z_i z_l / S_0 m_2 \qquad (1)$$

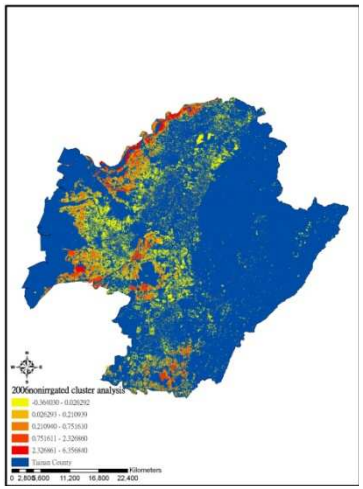
$$S_0 = \sum_i \sum_l w_{il} \qquad (2)$$

$$m_2 = \sum_i z_i^2 / I$$

$$z_i = x_i - \bar{x}$$



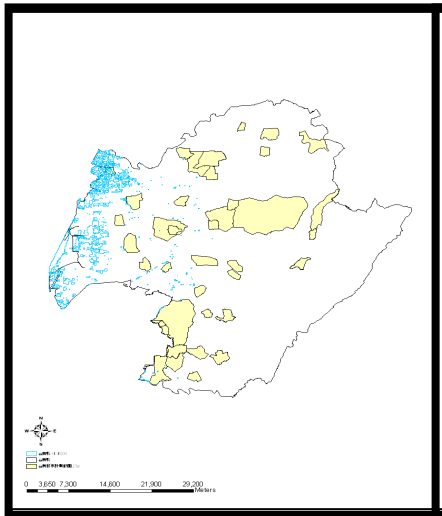
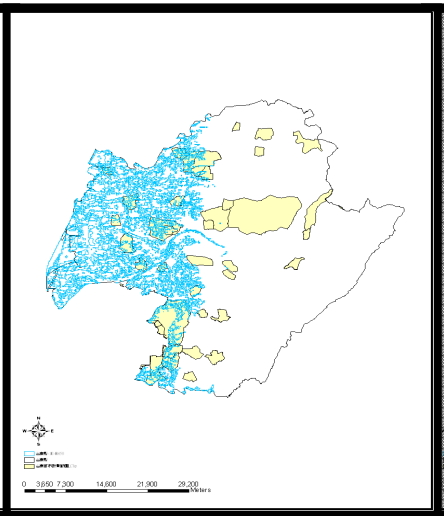
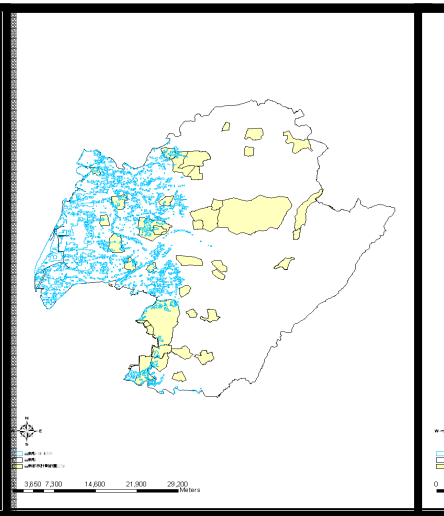
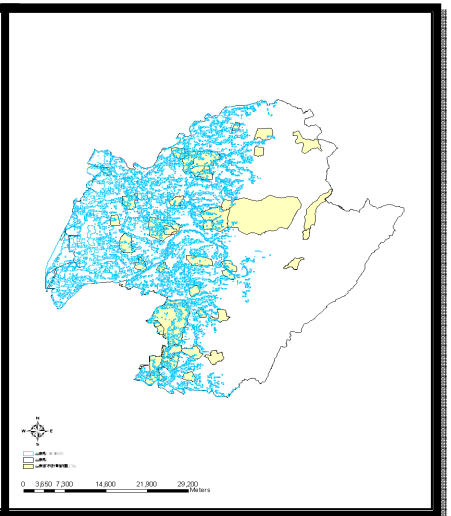
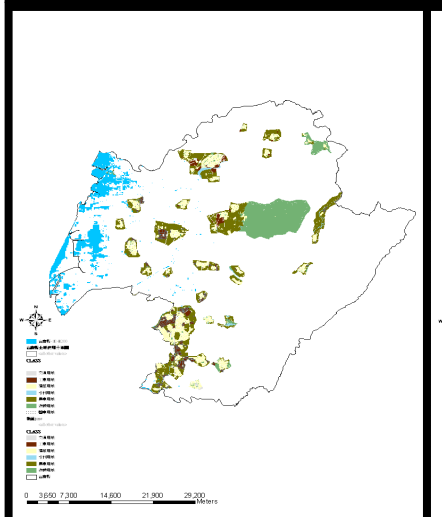
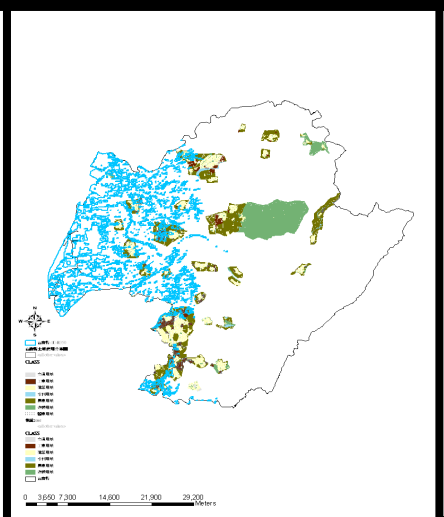
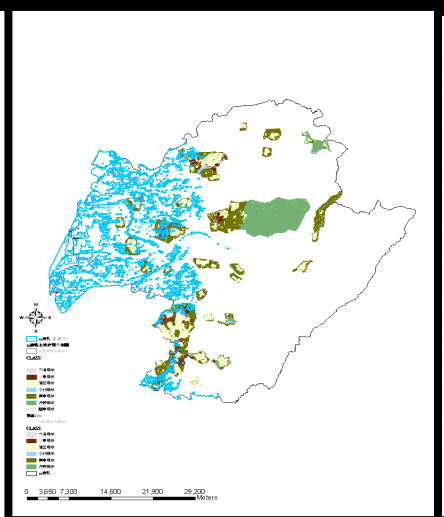
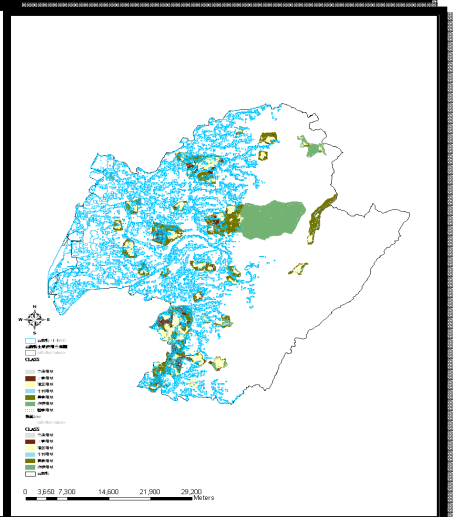




ANALYSIS AND RESULT

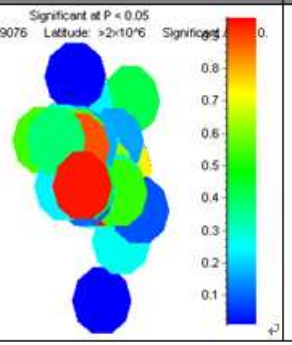
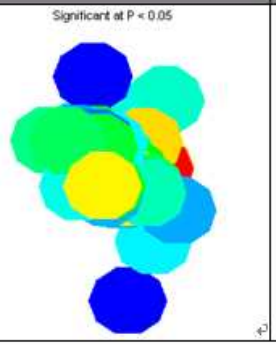
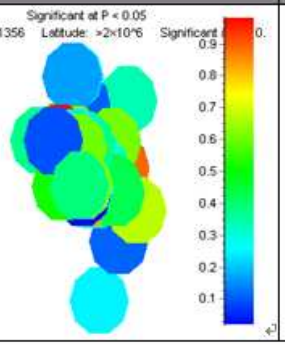
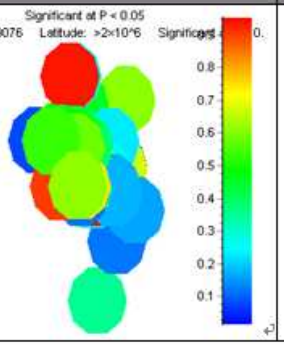
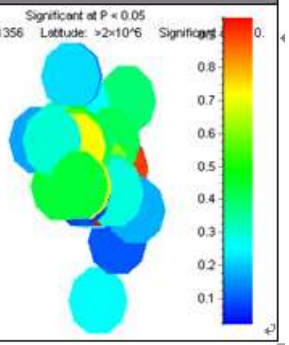
ANALYSIS AND RESULT

- **Urban flood situations and spatial pattern .**

1d-r200	1d-r350	1d-r450	1d-r600
			
			

ANALYSIS AND RESULT

- **Explore spatial data analysis of flood area**

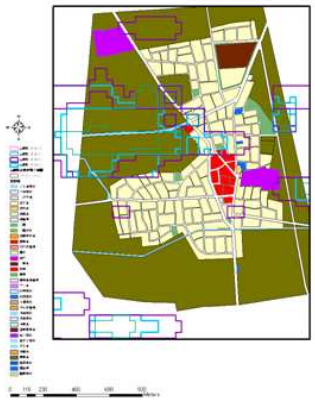
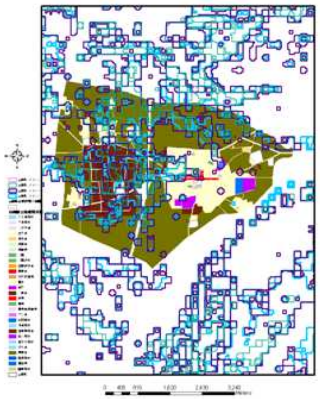
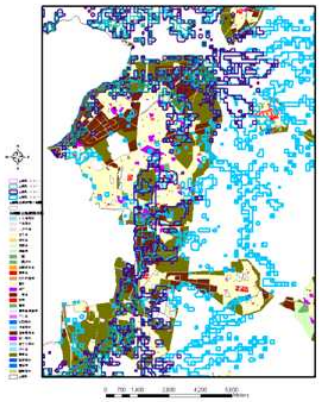
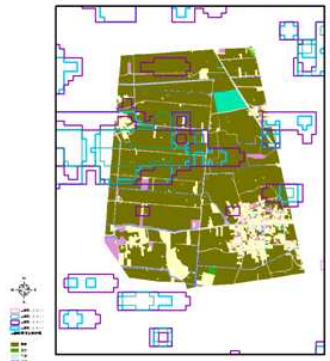
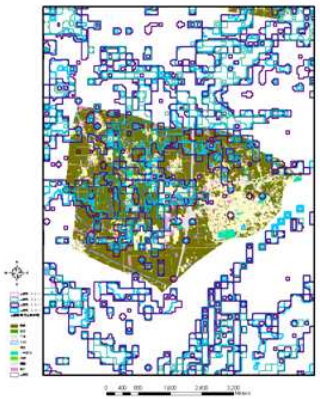
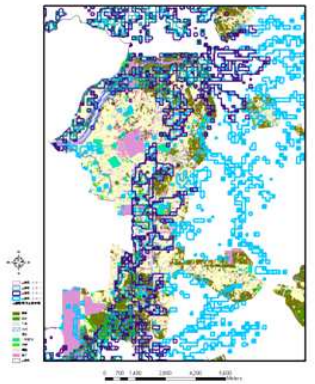
Flood Area	A	B	C	D	E
Explore spatial data analysis					

- The result of the SAA analysis on Tainan the value of Moran's I is positive 0.52, and refers to the gather and independent distribution in region.

- In the future, the land use planning suggests strengthening prevention such as Yong Kang district, Sinying district and Madou district.

ANALYSIS AND RESULT

- **Land use vulnerability assessment of flood area**

Jiangjyun land use vulnerability area	Yanshuei land use vulnerability area	Yong Kang land use vulnerability area
		
Jiangjyun current status of land use vulnerability area	**Yanshuei current status of land use vulnerability area**	**Yong Kang current status of land use vulnerability area**
		

ANALYSIS AND RESULT

Results indicate that Tainan area will be vulnerability by flooding at minimum and maximum inundation 4 to 13 levels, respectively. The most severely impacted sectors are expected to be the residential areas, agricultural land. The urban flood issues were discussing water retention by land use from ecological city.

		The simlation of flood				Vvulnerability level
		I	II	III	IV	
Land use planning type	Residential	27(2)	21(3)	17.3(3)	6.1(2)	10
	Agriculture	88(4)	71(4)	77.2(4)	6(1)	13
	Open space	59(3)	2.8(1)	2.2(1)	25(4)	9
	Wetland	13(1)	4(2)	2.6(2)	8.2(3)	8
Current Status of Land Use type	Residential	77(4)	82(4)	3.7(3)	11.4(2)	13
	Agriculture	33(2)	21(3)	13.6(4)	23.6(4)	14
	Open space	20(1)	0.7(1)	0.02(1)	2(1)	4
	Wetland	46(3)	2(2)	0.4(2)	23(3)	10

CONCLUSION

CONCLUSION

•First, urban flood might have different spatial distribution. How to declare and categorize a factor based on its identity and effectiveness is a quite important and skillful work.

•Second, this paper use FLO-2D, SAA and vulnerability analysis provide adjustment of urban flood and land use.

•Finally, it is important to involve the to balance the impact of water retention by land use include: wetland preservation; open space build storm water planter; and the afforestation of dunes.

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- Central Weather Bureau (http://www.cwb.gov.tw/V4e/, CWB)
- fig3. source: http://www.flickr.com/photos/kyo4890x115/3807860280
- fig2. source: http://www.ecocityprojects.net/ index_public.php

The eco-city will include both high and low-density developments that shoot off from a central transportation spine connecting main sites.

Thanks your attention

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