



Center for Earth Observation and Digital Earth  
Chinese Academy of Sciences

# Land surface variables change analysis of urban agglomeration using TM/ETM data

Xinwu LI, Qingni Huang and Zhongchang Sun

Center for Earth Observation and Digital Earth,  
Chinese Academy of Sciences

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# Outline



- Introduction
- Study area and datasets
- Research contents
- The analysis of LSVs of JJTang urban agglomeration
- Comparison analysis of LSVs between Tianjing and Toronto
- Future work

**1.** Rapid urbanization all over the world especially in developing countries raises increasing concerns about its impacts on the earth system, in particular, megacity and urban agglomeration is the most significant system to affect the environment.

**Megacity:** the population is more than ten millions.

**Urban agglomeration:**

- ◆ Population size and population density (Jean Gottman, 1957);
- ◆ within specific territory, a large number of cities with different characteristics, types and scale economically centered with one or two megacity and formed as an integrated system with aid of the modern transportation and highly developed information network etc. (Shimou Yao, 2006)

**2.** How to drive or response of Megacity or urban agglomeration to regional or global environment change is one of key topics for global environment change study at current times.

**3.** The **Land Surface Variables(LSVs)** which characterize the urban area of megacity or urban agglomeration are directly or indirectly drive or response factors to regional or global environment change.

Typical urban LSVs:

Impervious Surface Percent(ISP), Land cover, NDVI, Land Surface Temperature(LST),water body, emissivity etc. [www.ceode.ac.cn](http://www.ceode.ac.cn)

## 4. Scientific objectives

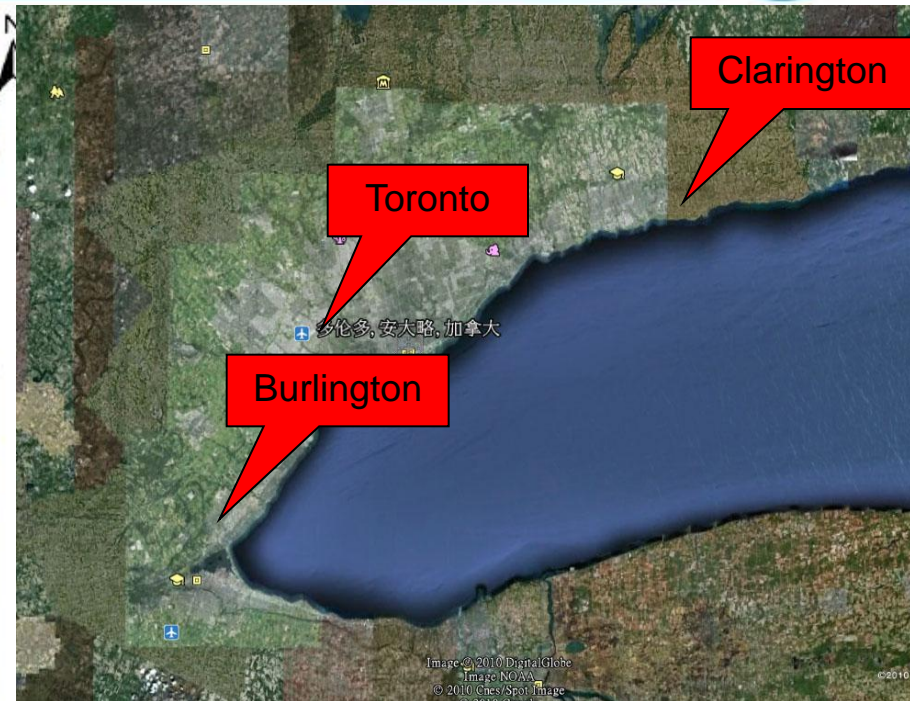
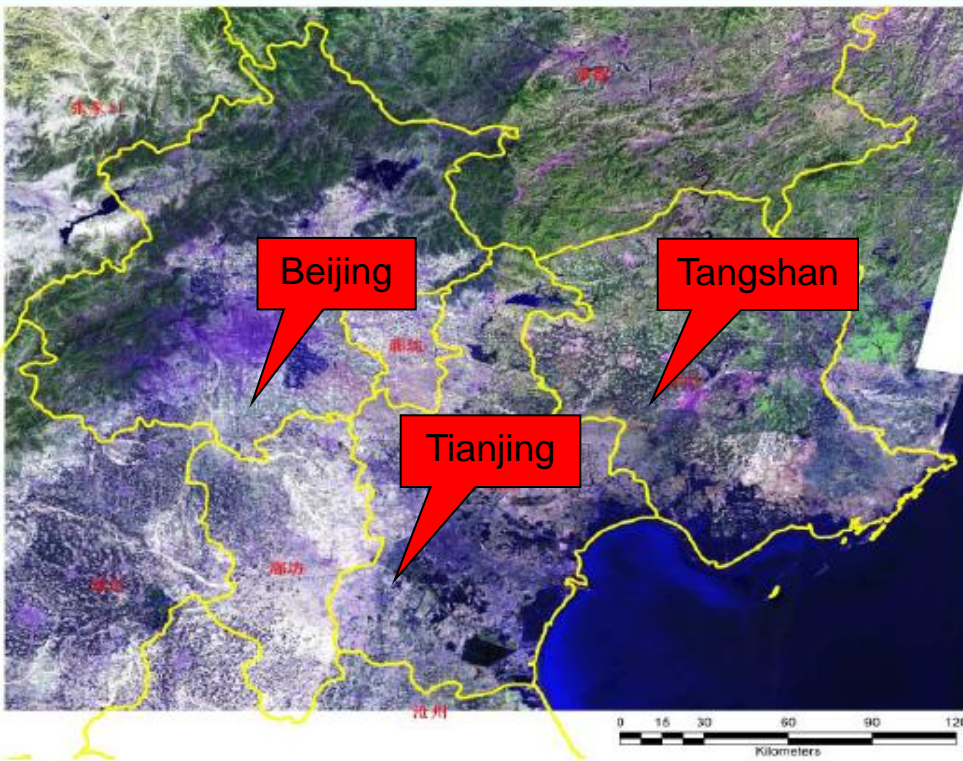
- ◆ To reveal the relations and interactive mechanism between land surface variables change of urban agglomeration and regional environment
- ◆ To investigate the different change characteristics of typical urban agglomeration between China and Canada

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# Study area and data sources



JJTang urban agglomeration is formed by three cities: Bei Jing, Tian Jin, Tang Shan(**JJTang**)

Toronto urban agglomeration is formed by several cities along the Lake

# Study area and data sources



## TM/ETM datasets of JJTang urban agglomeration

1970's	Beijing	19780910 19780920	MSS
	Tianjin	19790904 19781016	MSS
	Tangshan	19770704	MSS
1986or 1987	Beijing	19860603	TM
	Tianjin	19870514	TM
	Tangshan	19870514	TM
1999	Beijing	19990701	ETM+
	Tianjin	19990811	ETM+
	Tangshan	19990811	ETM+
2005 or 2006	Beijing	20060906	ETM+
	Tianjin	20060721	TM
	Tangshan	20050904	TM
2009	Beijing	20090602	TM
	Tianjin	20090830	TM
	Tangshan	20090830	TM



# Study area and data sources



## Landsat TM/ETM and LULC of Toronto

site	row	column	Acquired time		
			First	second	third
	17	29	1984-8-25	1993-7-17	2002-8-3
	17	30	1984-7-24	1992-6-12	2000-6-10
Southern Ontario	18	29		1993-8-25	1999-9-19
	18	30	1987-5-5	1990-9-2	1999-9-3
	19	30	1984-7-22	1991-8-11	2001-8-30
	19	31	1989-5-17	1991-8-11	2001-8-30

LULC of Toronto, Southern Ontario: son1985GTA.mos  
son2001GTA.mos, son2005GTA.mos, sontario.mos

From the Canadian Urban Land Use Survey (CUrLUS), provided by Ying Zhang and Bert Guindon, CCRS.

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# Research contents



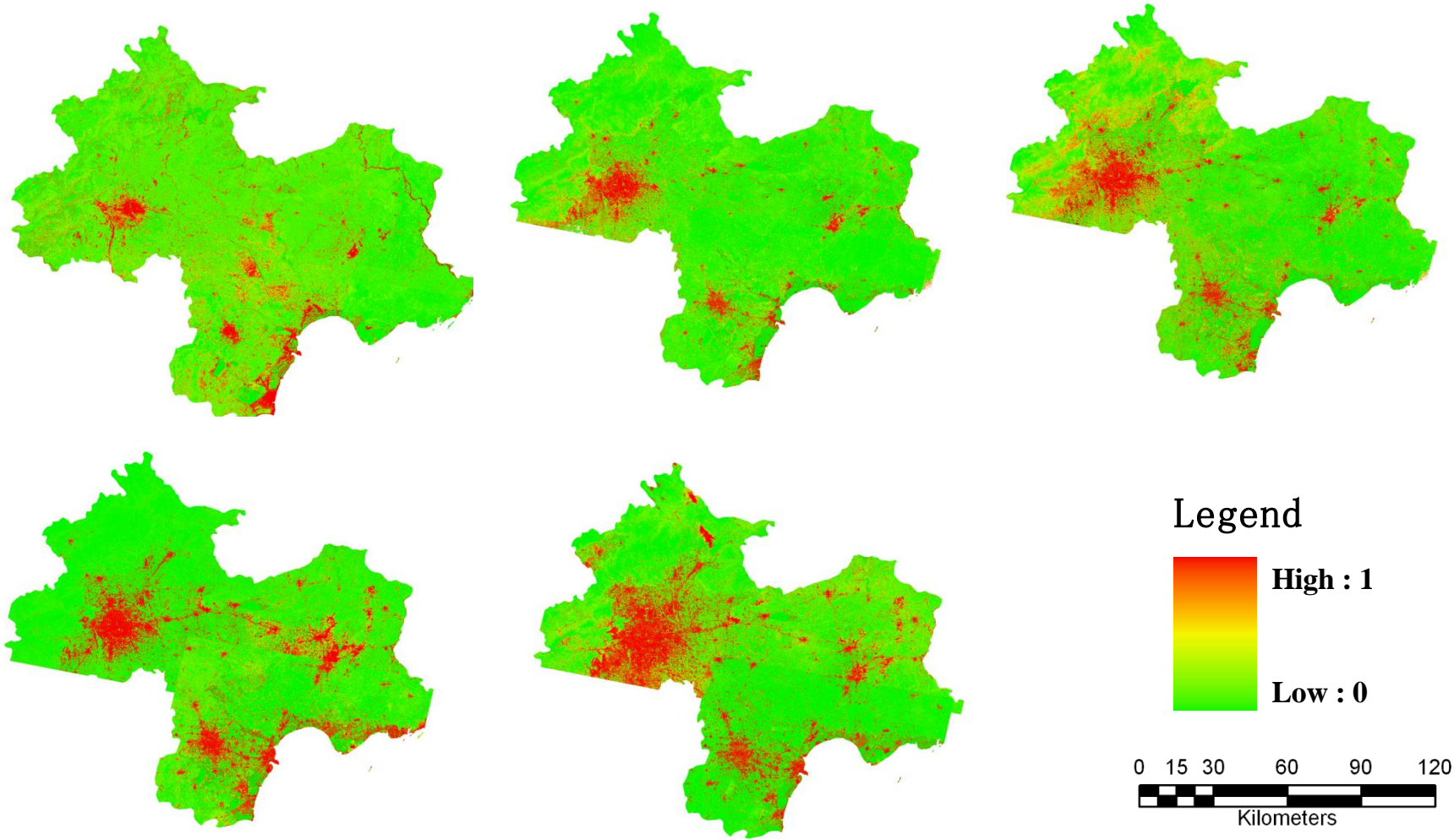
1. To investigate the spatial-temporal change characteristics of land surface variables from time series TM/ETM datasets of JJTang urban agglomeration,
2. To conduct the spatial-temporal comparison analysis of land surface variables from time series TM/ETM datasets of JJTang and Toronto urban agglomeration,

# Outline

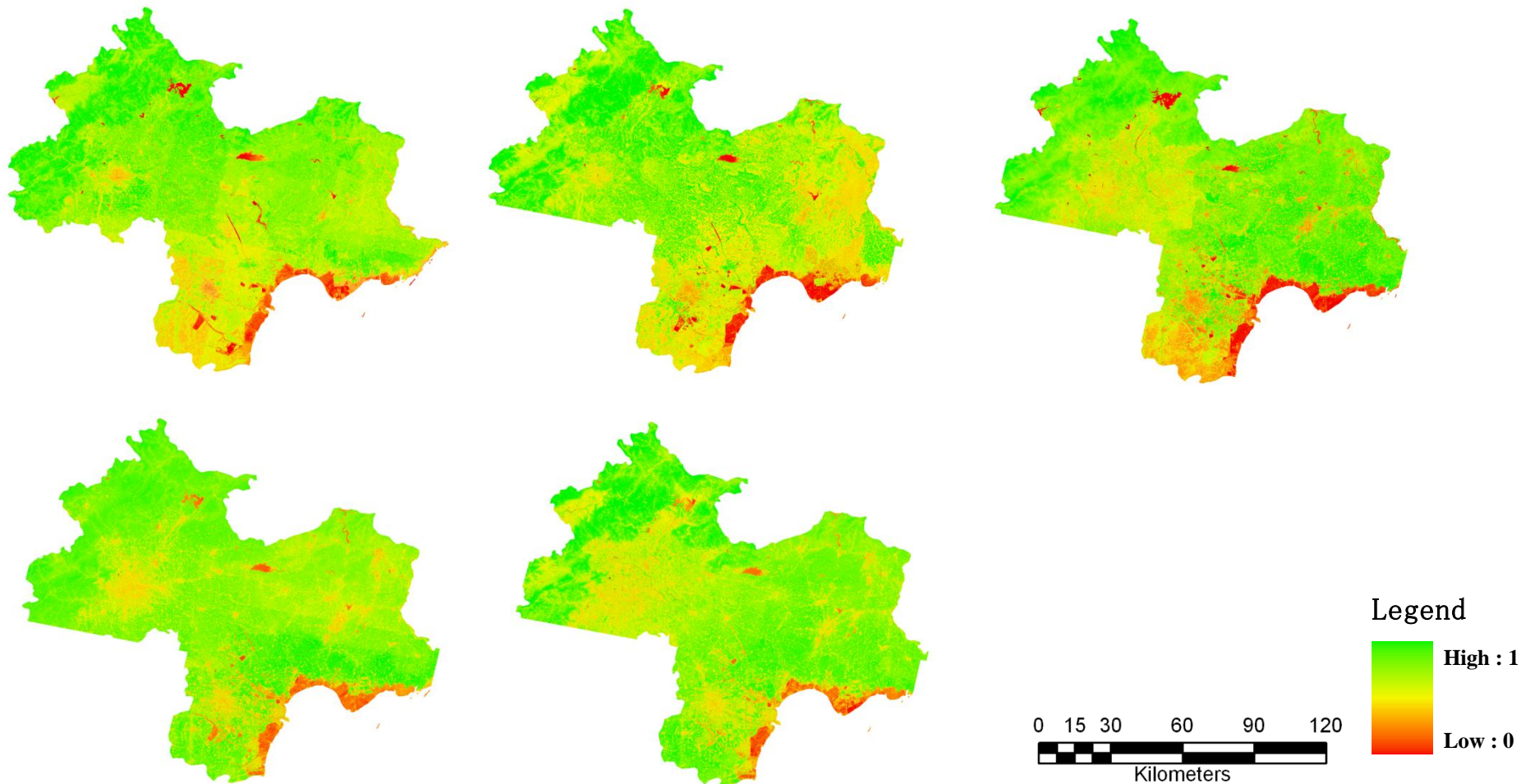


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# The analysis of LSVs of JJTang urban agglomeration

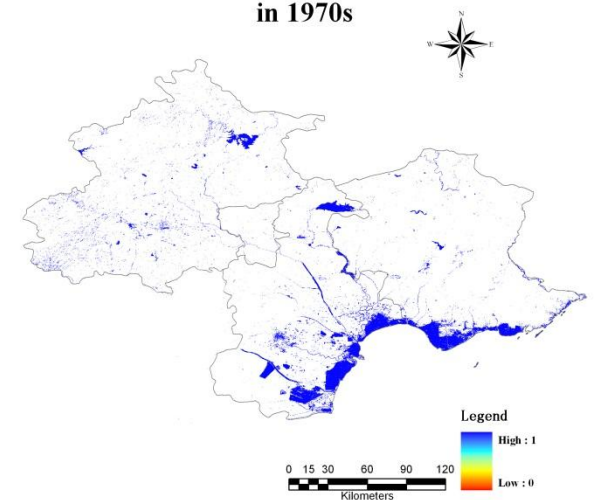


Spatial-temporal distribution of impervious surface percent of JJTang urban agglomeration in 1970,1986, 1999, 2006, 2009

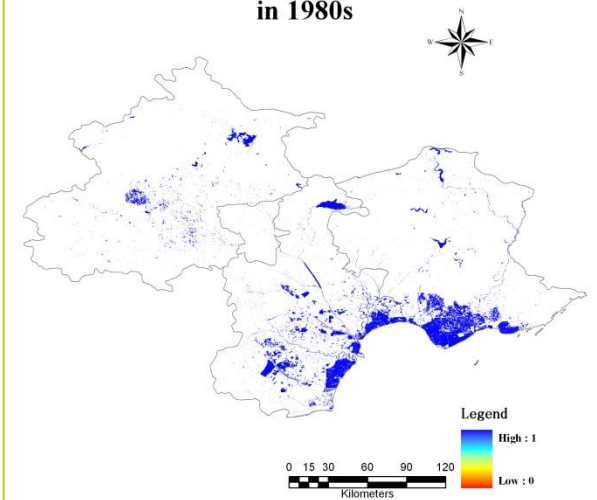


Spatial-temporal distribution of NDVI of JJTang urban agglomeration in 1970,1986, 1999, 2006, 2009

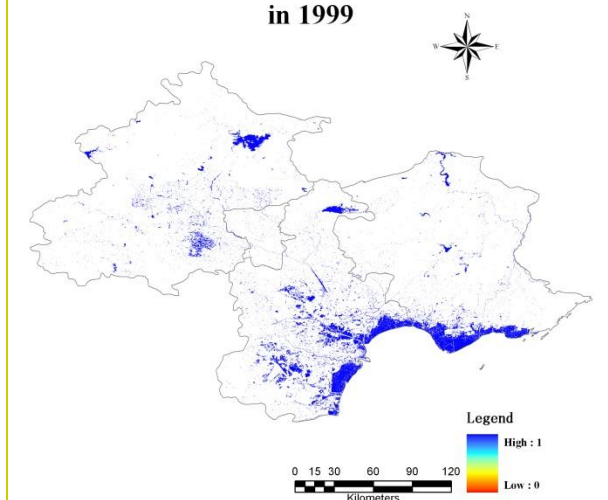
**Spatial distribution of waterbody of JingJinTang in 1970s**



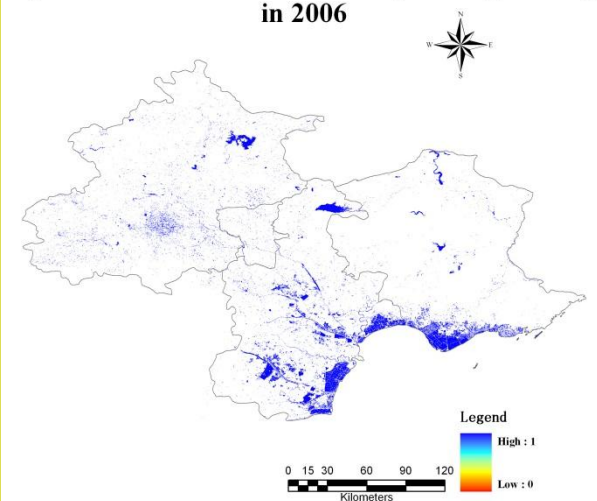
**Spatial distribution of waterbody of JingJinTang in 1980s**



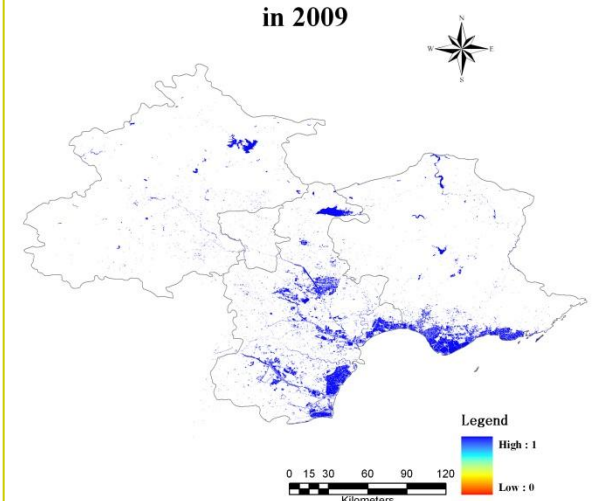
**Spatial distribution of waterbody of JingJinTang in 1999**



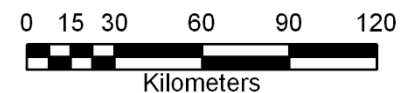
**Spatial distribution of waterbody of JingJinTang in 2006**

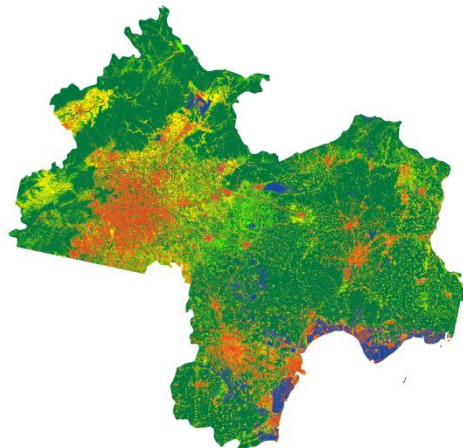
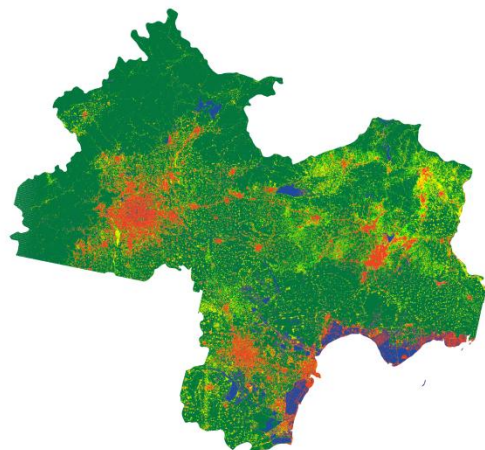
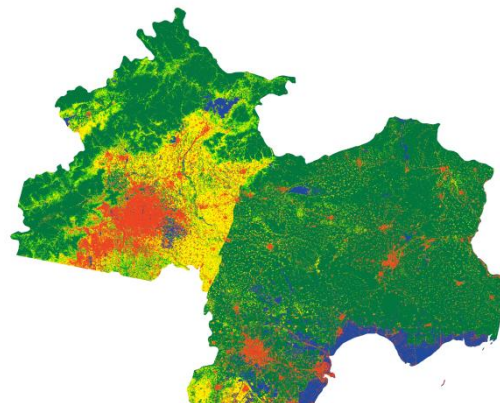
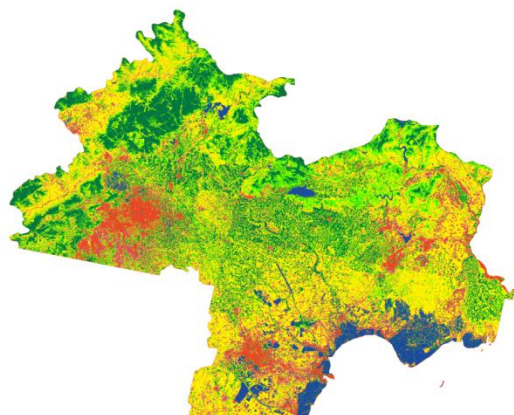


**Spatial distribution of waterbody of JingJinTang in 2009**

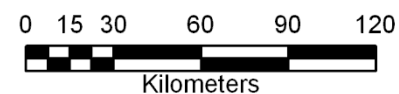
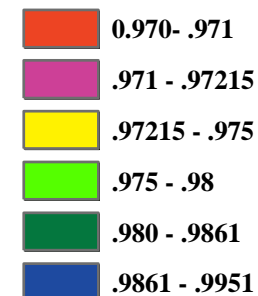


Spatial-temporal distribution of water body of JJTang urban agglomeration in 1970,1986, 1999, 2006, 2009





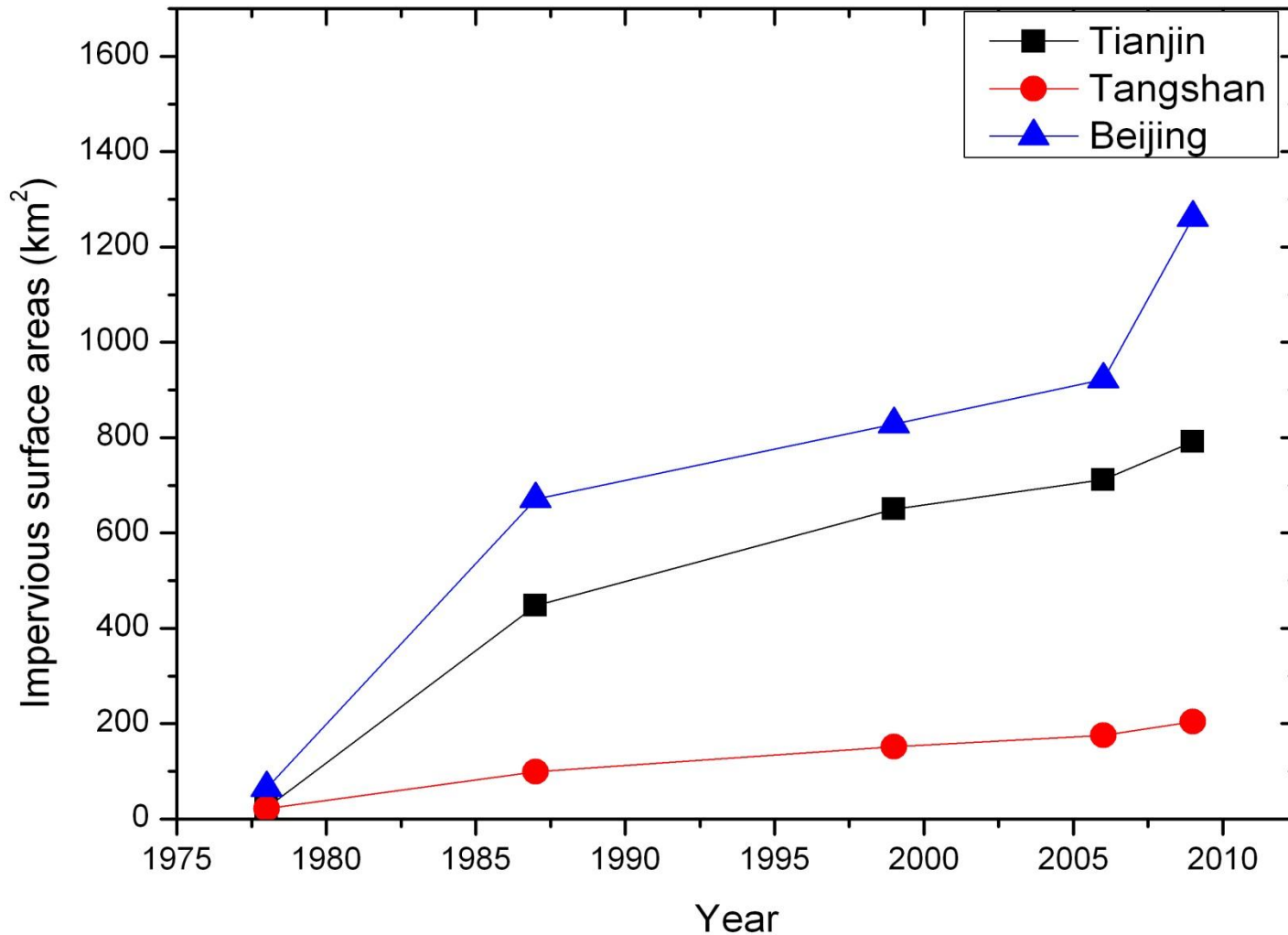
### Legend



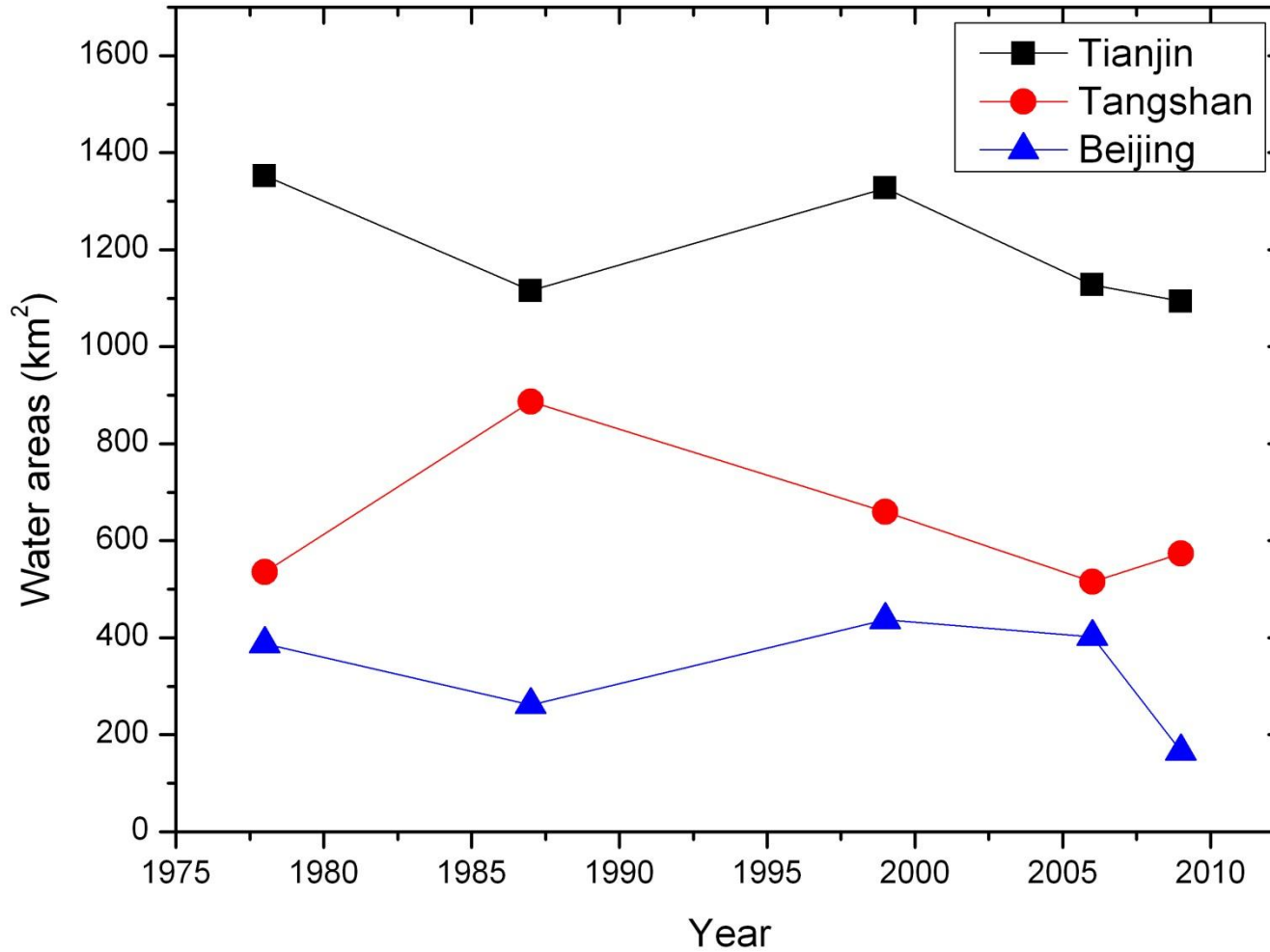
Spatial-temporal distribution of emissivity of JJTang urban agglomeration in ,1986, 1999, 2006, 2009



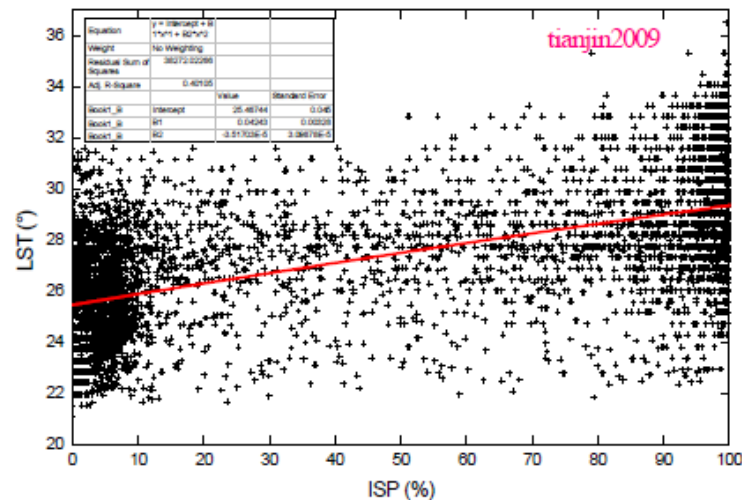
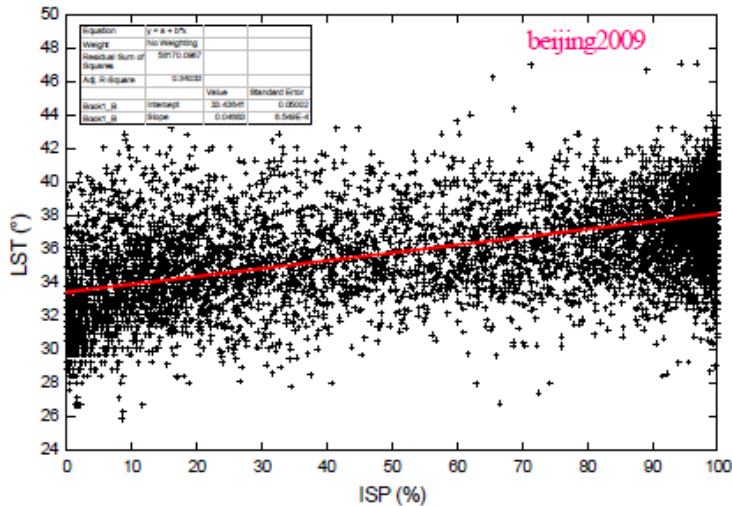
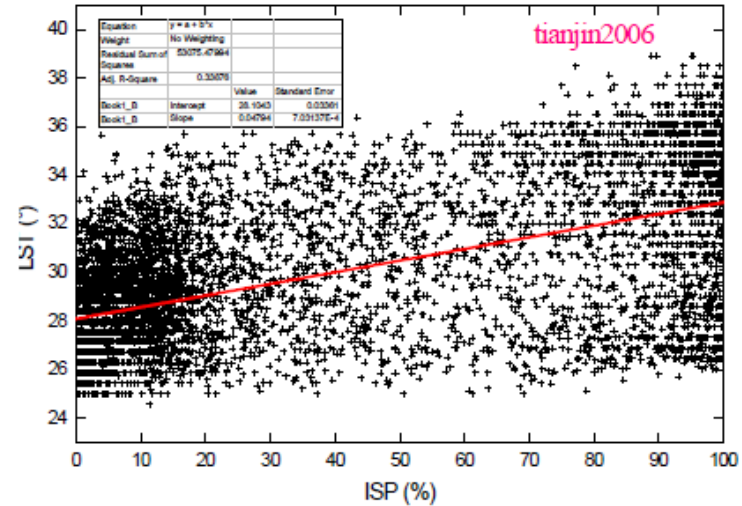
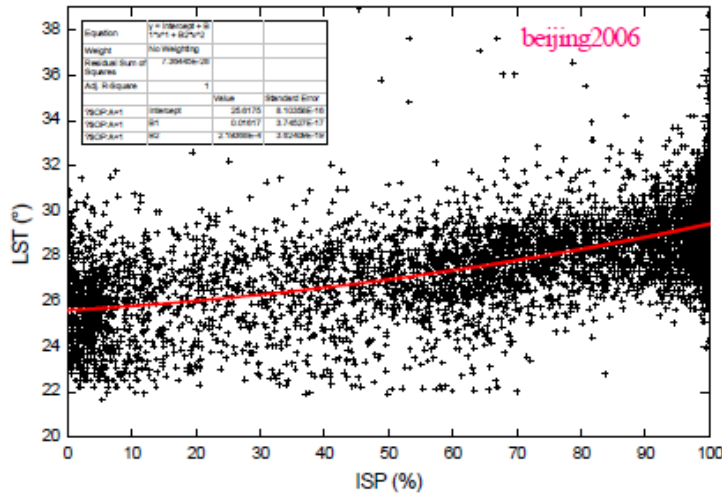
The time series graph of impervious surface area area in JingJinTang



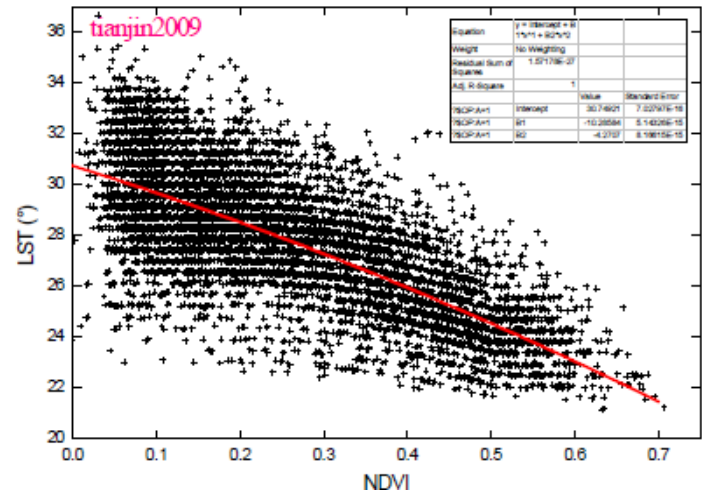
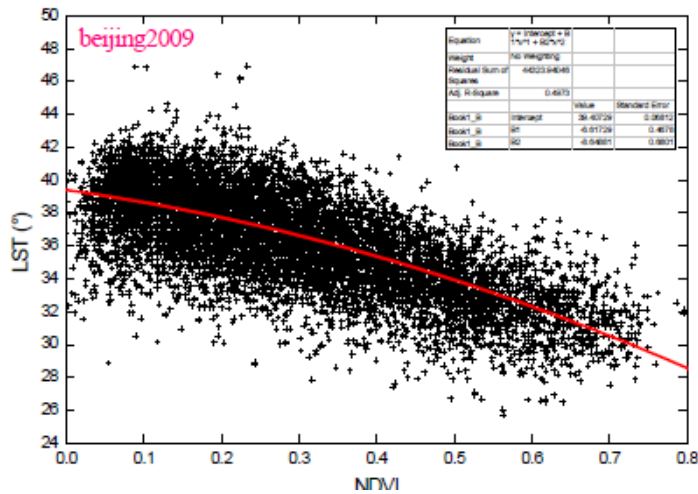
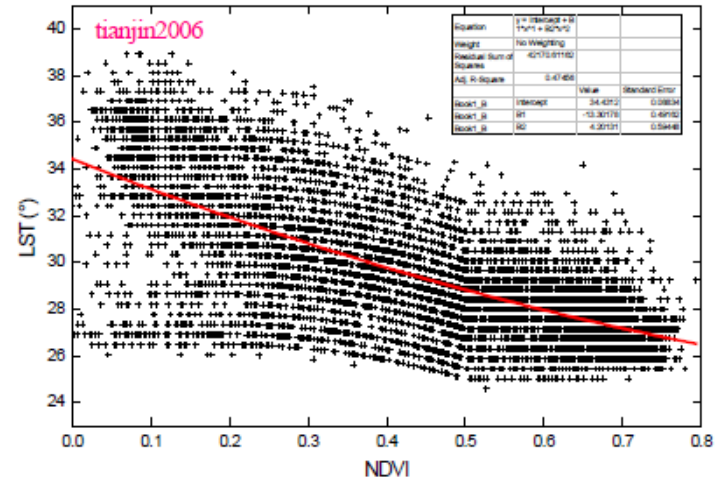
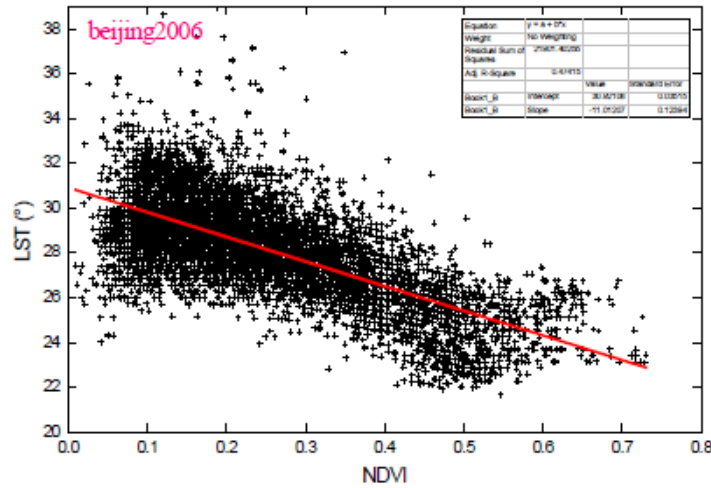
The time series graph of waterbody area in JingJinTang



# □ The relation between impervious and LST



# □ The relation between NDVI and LST



# Outline

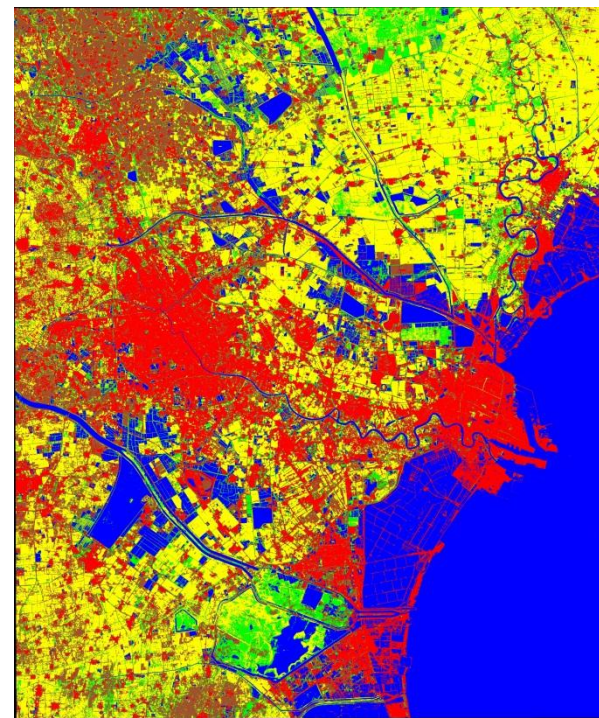
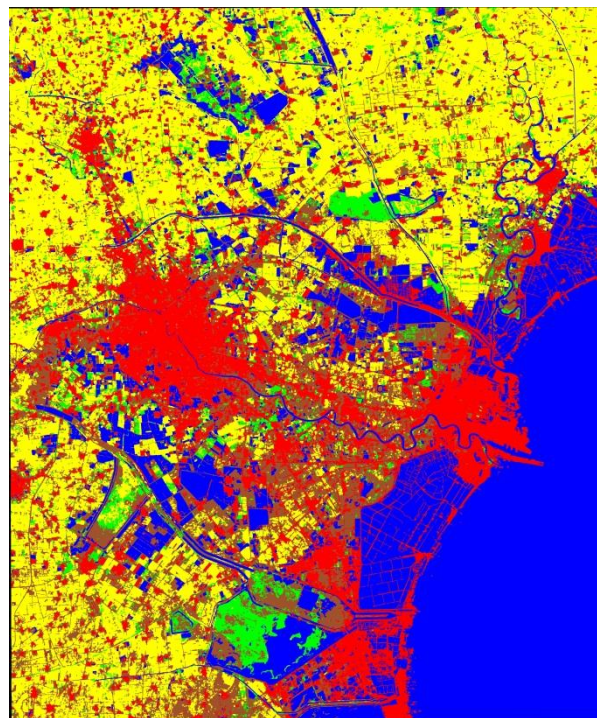
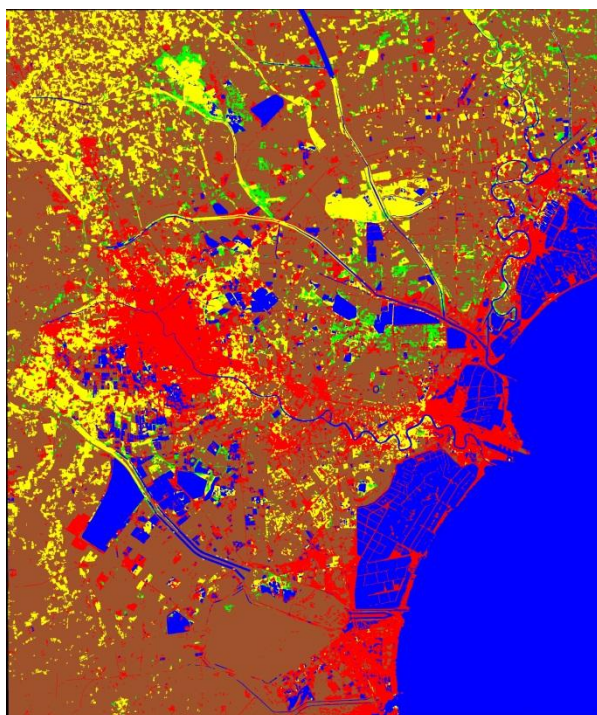


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# Toronto, Southern Ontario, Canada

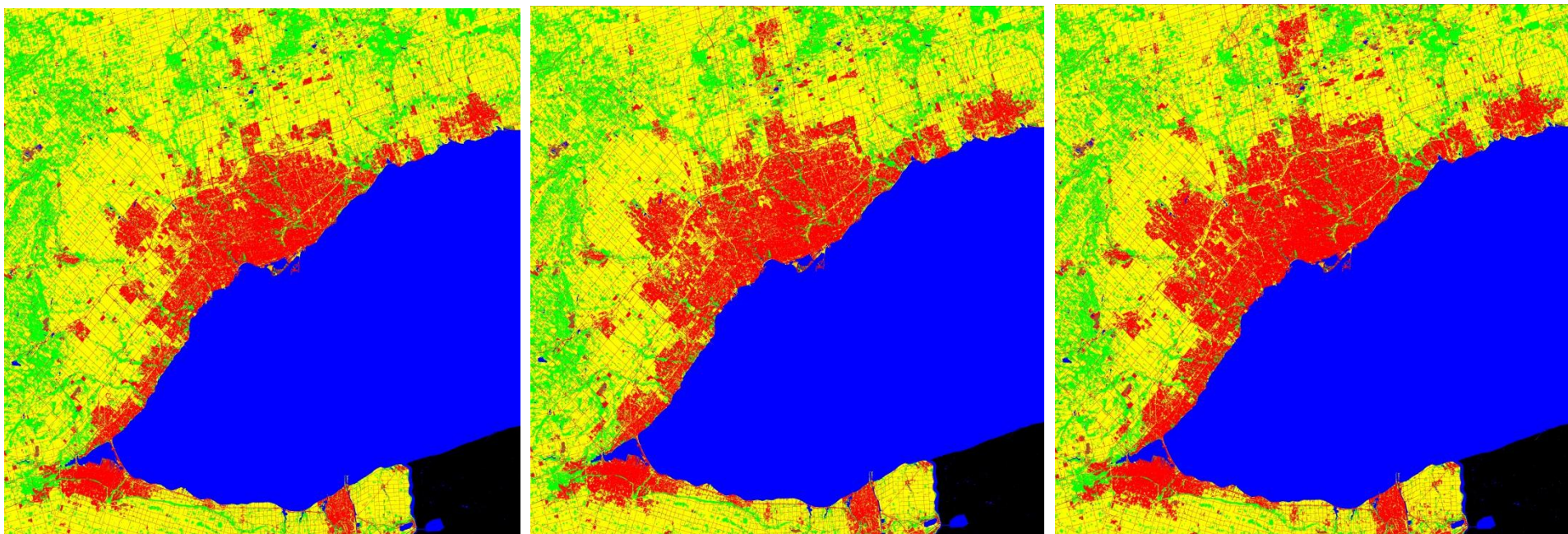
## Tianjin, China





urban	
tree	
water	
crop/grass	
soil	

The land cover distribution of Tianjing area in 1987, 2001, 2006



urban	
tree	
water	
crop/grass	
soil	

The land cover distribution of Toronto area in 1985, 2001, 2005

Derived from the data of Canadian Urban Land Use Survey (CUrLUS) database (Ying Zhang and Bert Guindon, CCRS)



- From the land cover change analysis for twenties years, the urban expansion of both Tianjin and Toronto are obvious, but the expansion speed of Tianjin is faster than that of Toronto
  
- The development pattern of two cities is different, Tianjin: multiple centers(Tianjin, Tanggu, Hangu and Dagang) and get together each other; Toronto: centered around the Toronto and expanded to satellite city of inland.

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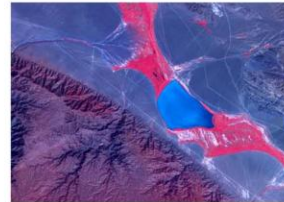
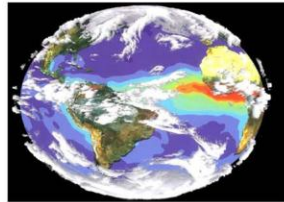
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## Future work



1. The further analysis and discussion of LSVs of JJTang urban agglomeration will be conducted using quantitative method and social, economic data.
2. Spatial-temporal change characteristics of Tianjin and Toronto will be further investigated.
3. To relate these changes to regional environmental change and understand Megacity or urban agglomeration is how to drive and response to regional environment.

# Thanks



Center for Earth Observation and Digital Earth  
Chinese Academy of Sciences

Add: No.9 Beiyitiao Road, Zhongguancun, Beijing China 100190

Tel: 86-10-58887301 Fax: 86-10-58887302

E-mail: [office@ceode.ac.cn](mailto:office@ceode.ac.cn)

Web: [www.ceode.ac.cn](http://www.ceode.ac.cn)