

China's Urbanization and its Sustainability under Future Climate Change

A nighttime photograph of the Shanghai skyline. The Oriental Pearl Tower is the central focus, illuminated with blue and white lights. In the foreground, a Ferris wheel is lit up with orange lights. Other skyscrapers are visible in the background, some with red and blue lighting. The sky is dark, and the water in the foreground reflects the city lights.

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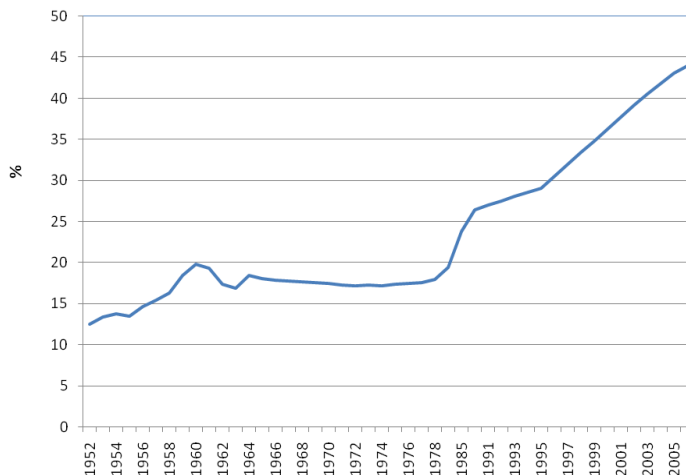
Research Background



Rapid urbanization in China after the reform

- Current research gaps in Climate change and cities
 - Local scale climate change impacts, adaptation, and feedbacks remain unclear
 - Regional impacts as cause and consequence of master development plans
 - Rare quantitative assessment for adaptation and mitigation strategies

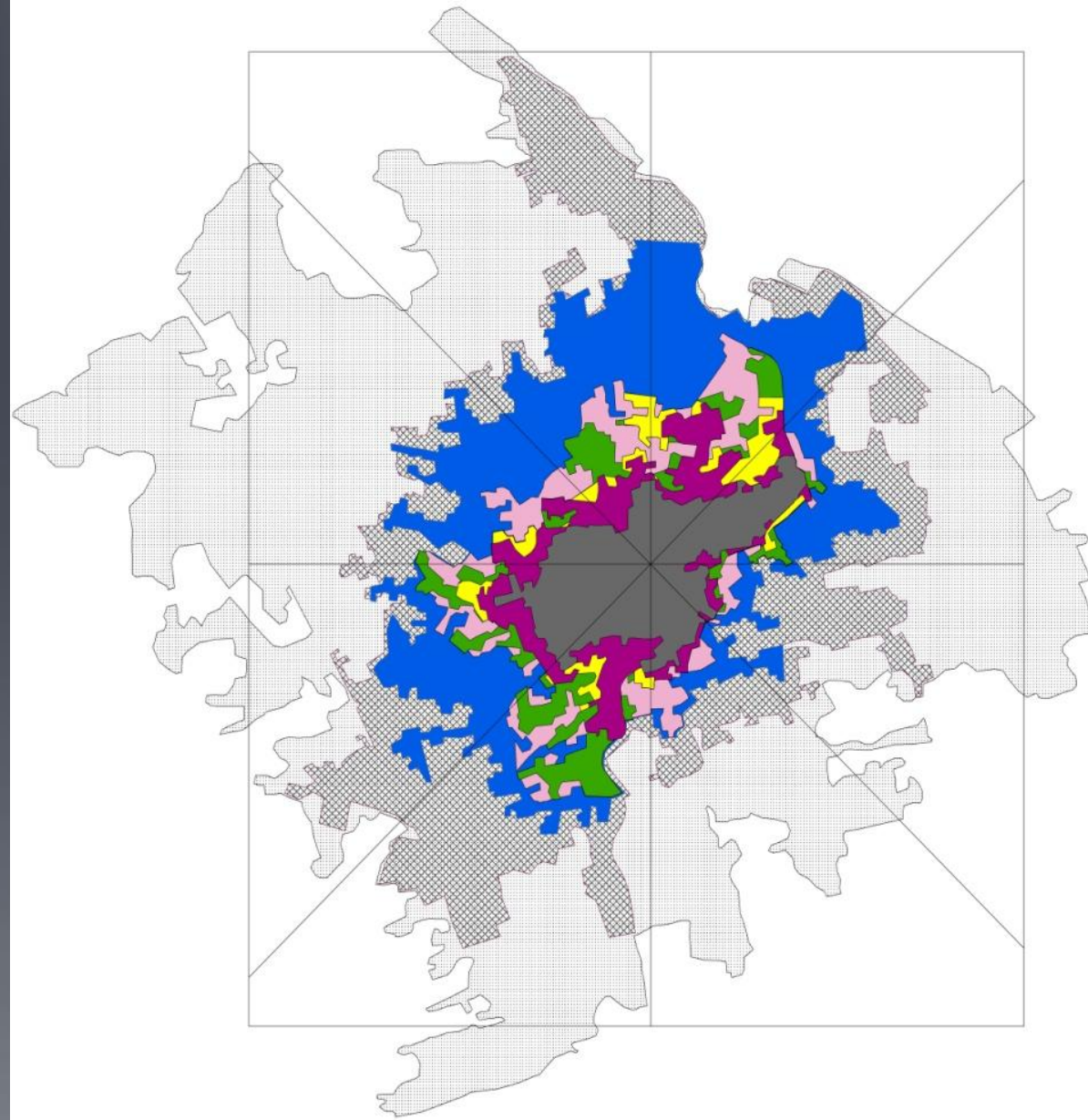
Figure 1. China's urbanization, 1952-2006



Objective 1. Linkages among urbanization, LULC, and climate change

Shanghai

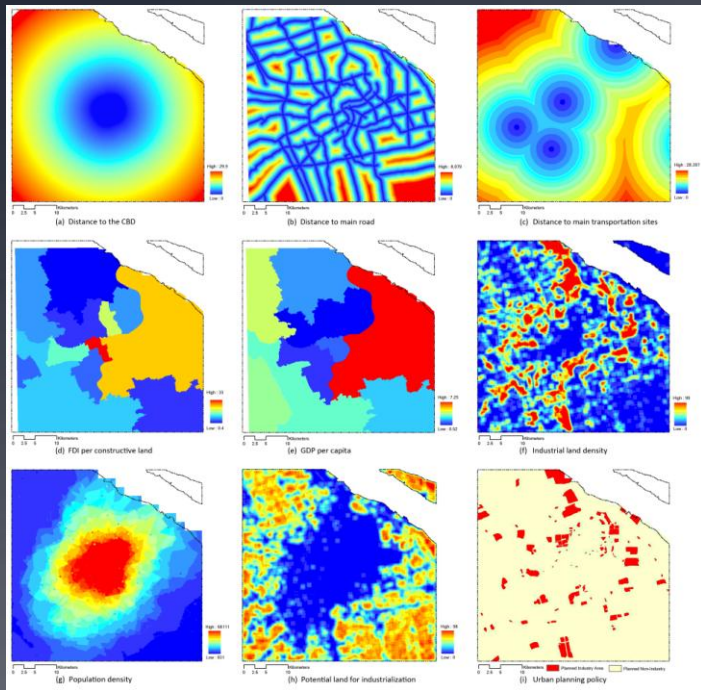
- A globalizing city
 - largest economic center since 1850
 - manufacturing center during Maoist period (1949-78)
 - transition to tertiary sector
 - international prominence
- Urbanization:
 - 59% (1978) => 86% (2007)
- Urban sprawl:
 - 76 km² (1947) to 1,462 km²(2008)



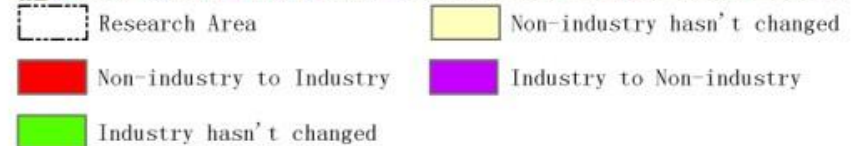
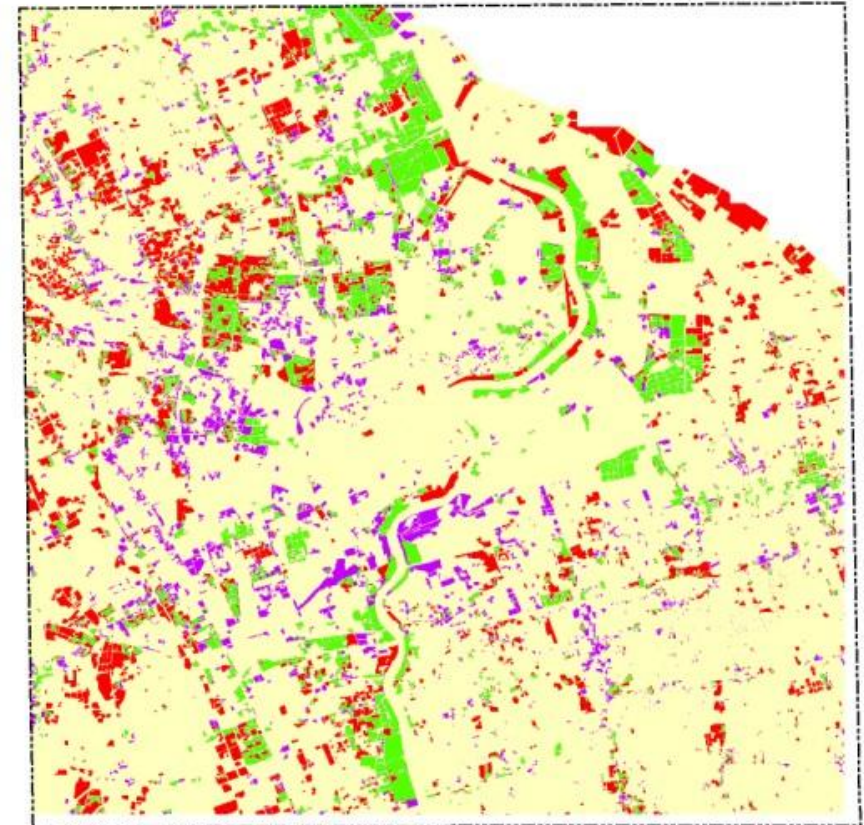
Urban built-up area growth (1947-2008) (sq.km.)

 1947-1958	50.93	 1958-1964	19.05	 1964-1979	40.33
 1979-1988	54.10	 1988-1996	209.13	 1996-2002	261.13
 2002-2008	751.38				

Shanghai – spatial determinants of urban industrial land (2002-2009)



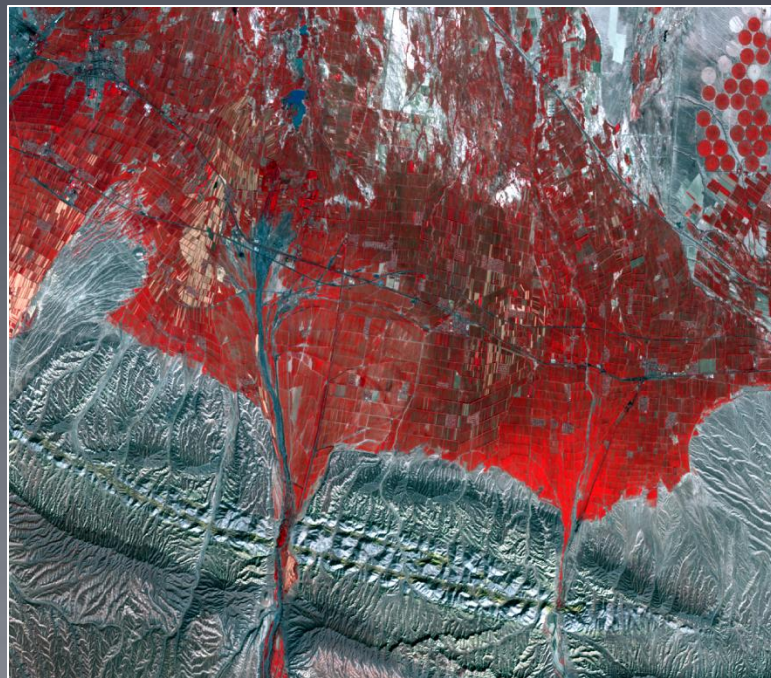
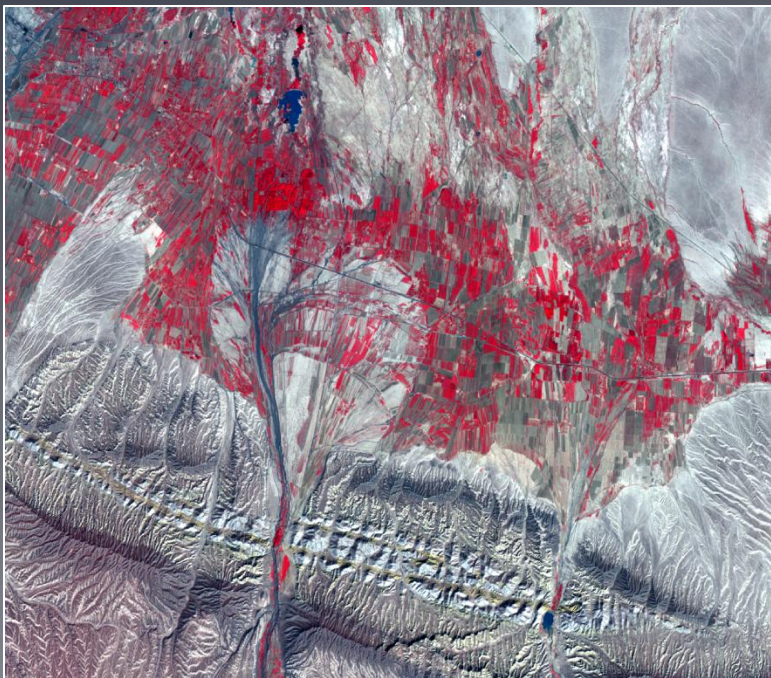
Major spatial determinants:
distance to CBD, distance to major stations,
population density, existing industrial land,
and industrial land planning

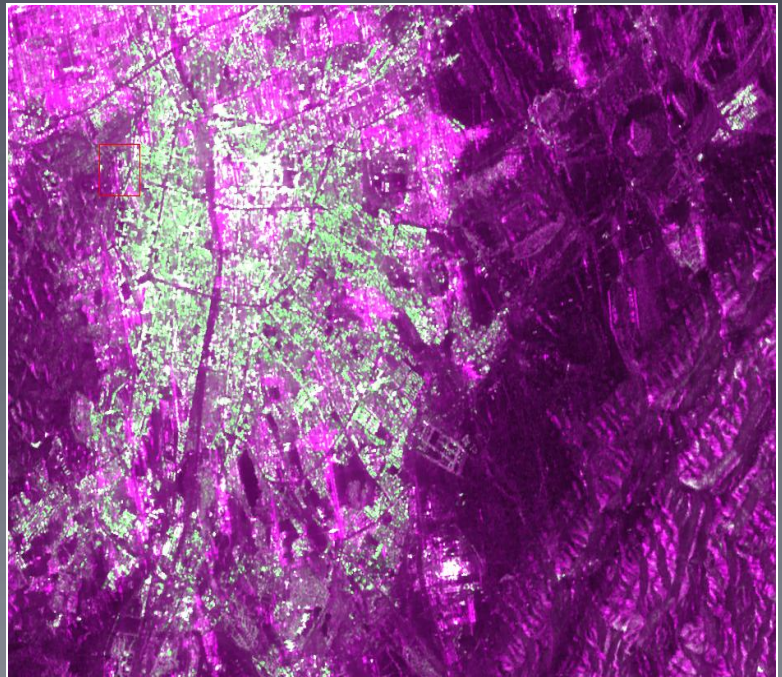
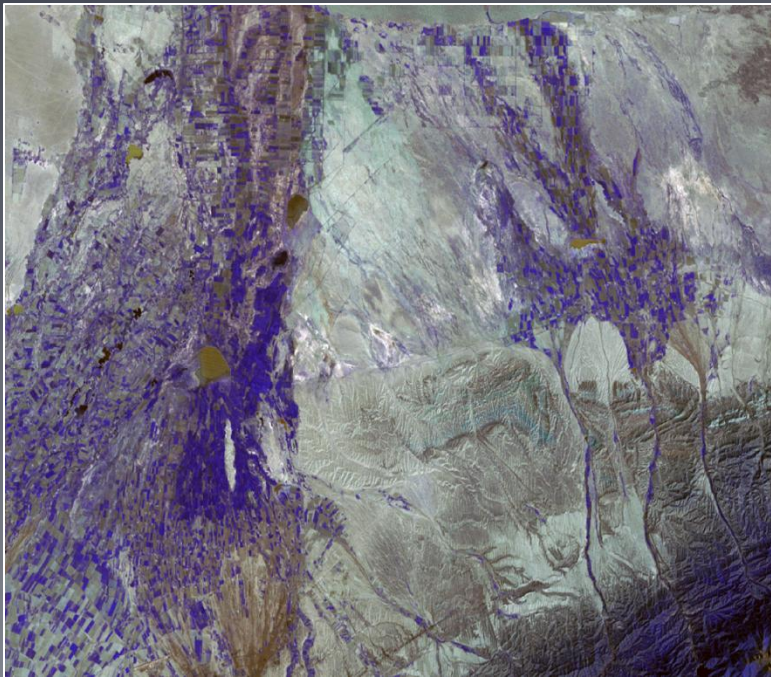


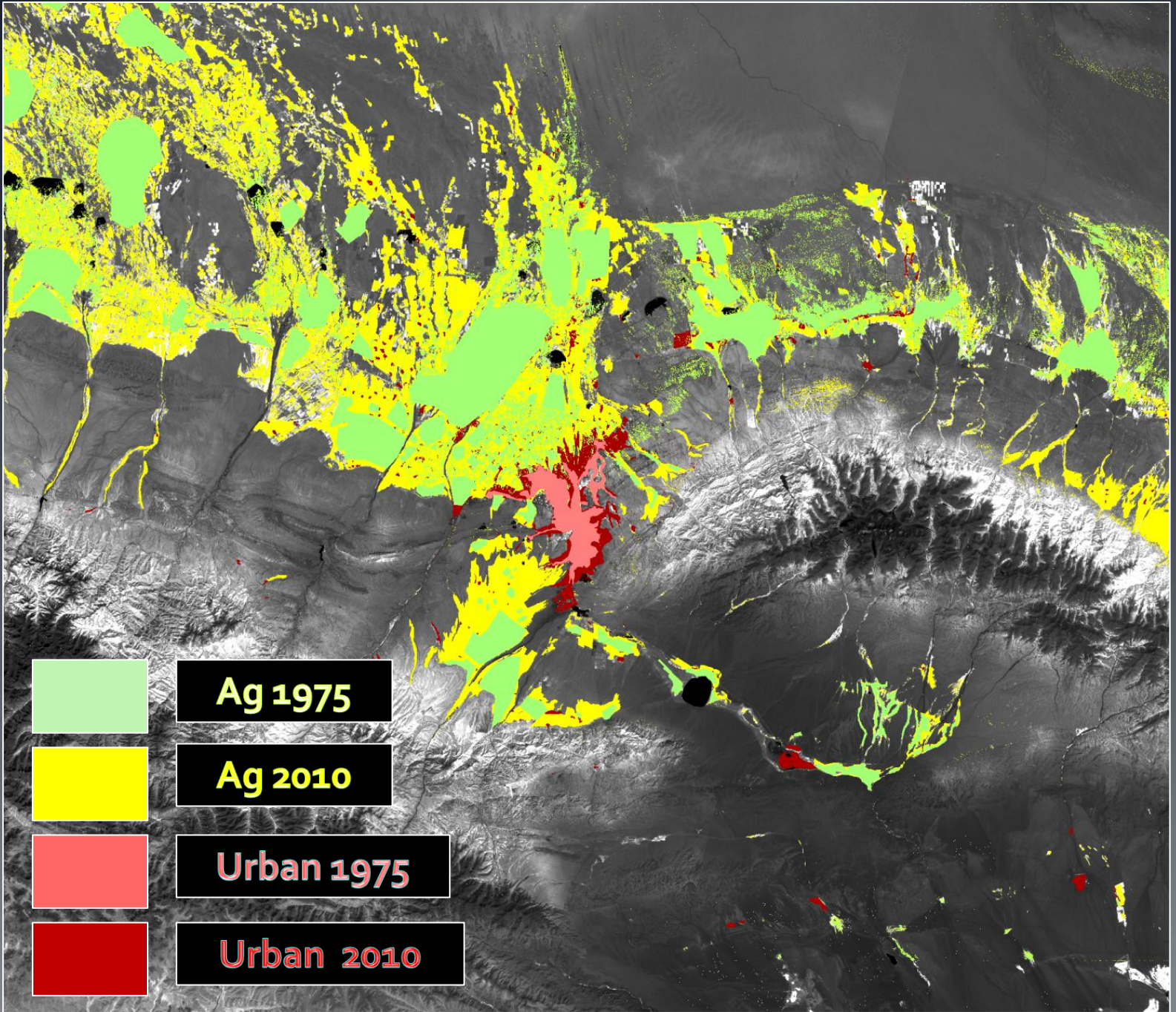
Case 2: Urumqi - Capital of Xinjiang Uyghur Autonomous Region



- Important trading center
- Important migration pole
- exponential economic growth 1990s onward
- Energy industry
- Growth in tertiary sector
- One of ten most polluted cities in the world
- Water resources are scarce, severely polluted -- available water per capita is $\frac{1}{4}$ of national average
- Human impacts - overgrazing, mushroom cultivation







Continuing work

- **Objective 2. Simulation of future LULC and regional climate changes, impact of climate change, and adaption and mitigation strategies**
 - 2a. Simulation of current and future LULC
 - 2b. Regional climate simulation under IPCC scenarios
 - 2c. Impact of climate change on cities
 - 2d. Adaptation and mitigation strategies
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Urumqi: Uncertainty via MODIS (MLCT) through RAMS

- MLCT 2001-2008

2001

2002

2003

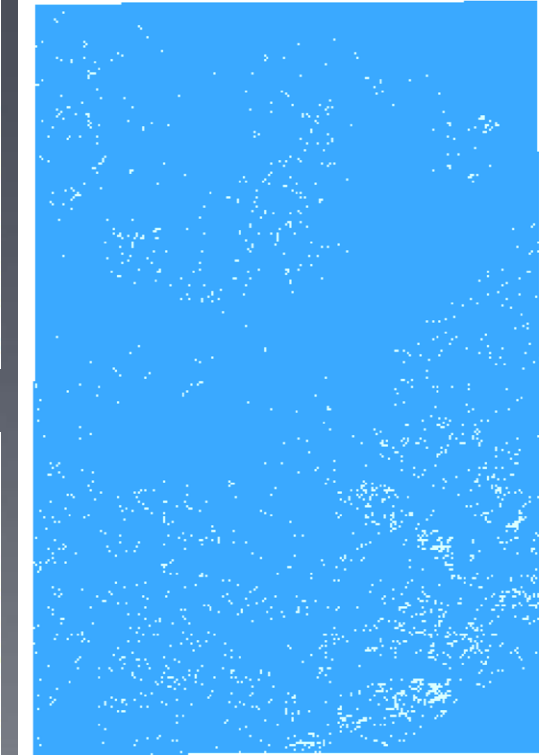
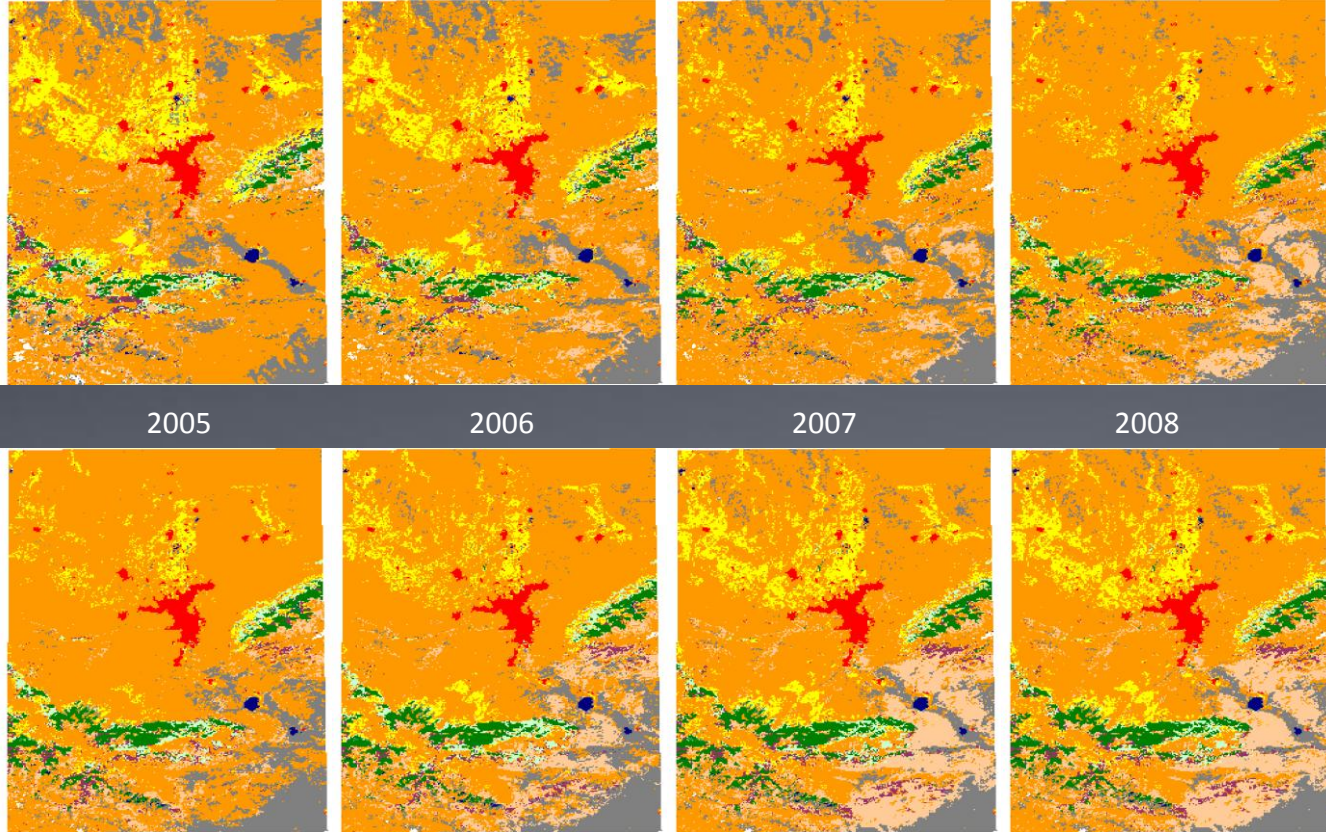
2004

2005

2006

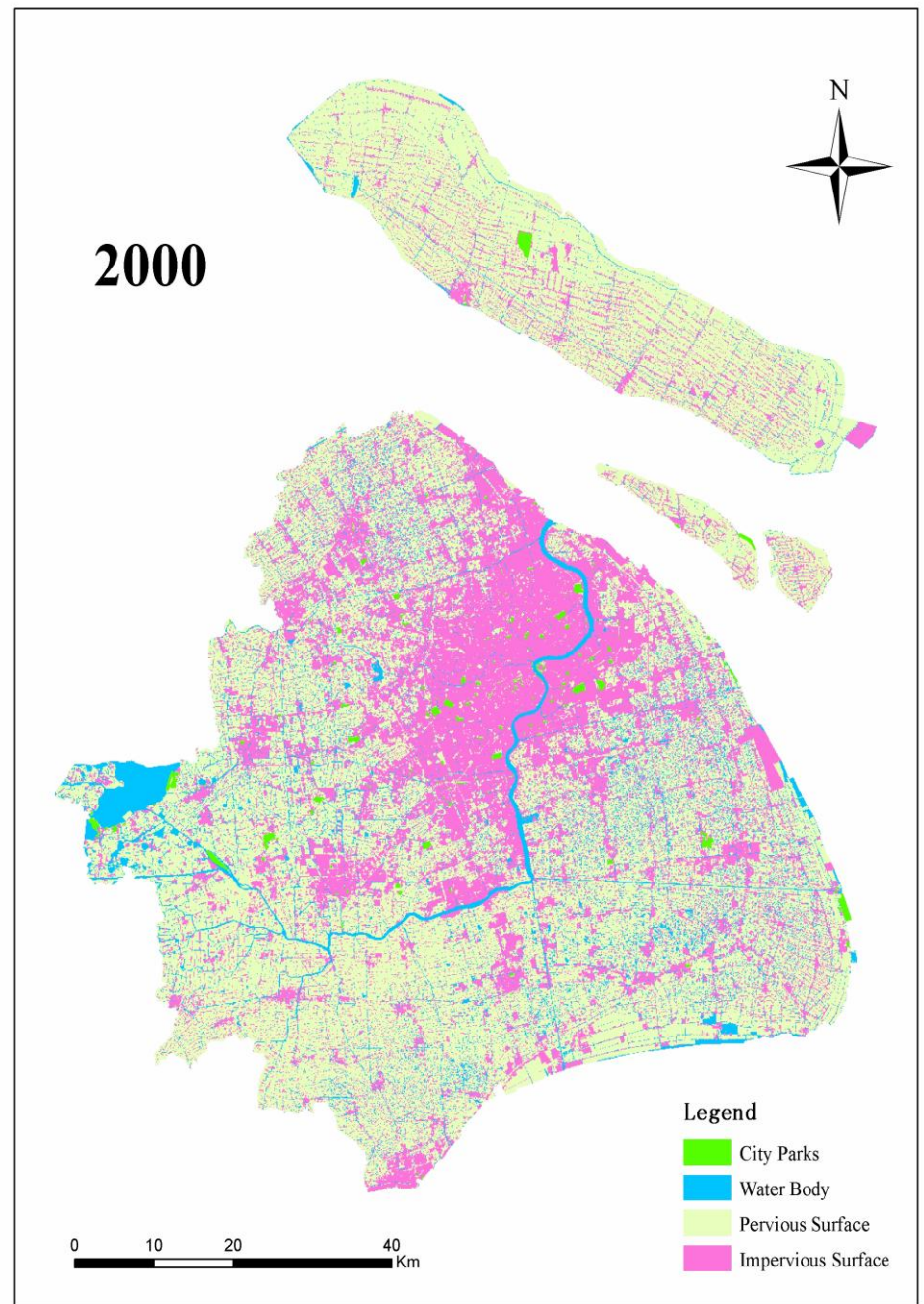
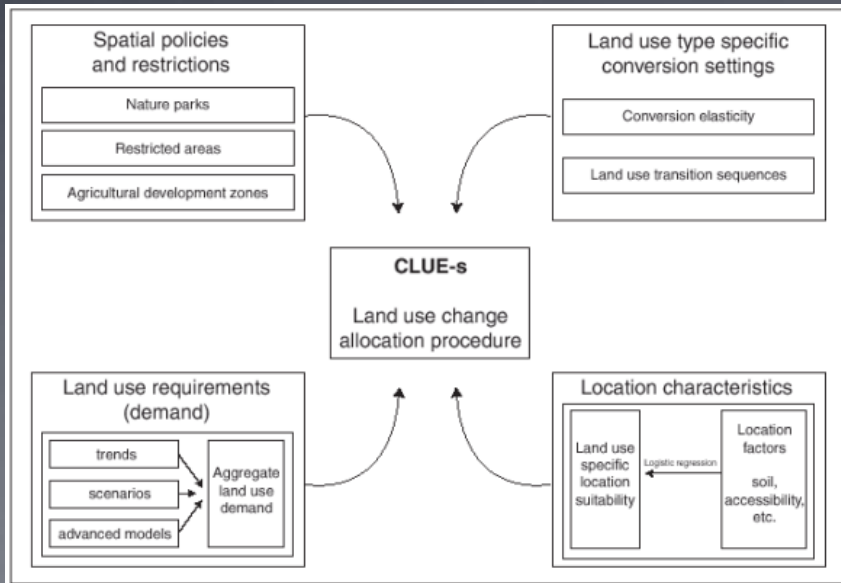
2007

2008



Objective 2a: Simulation of LULC

Shanghai, Impervious surfaces 2000 => 2020



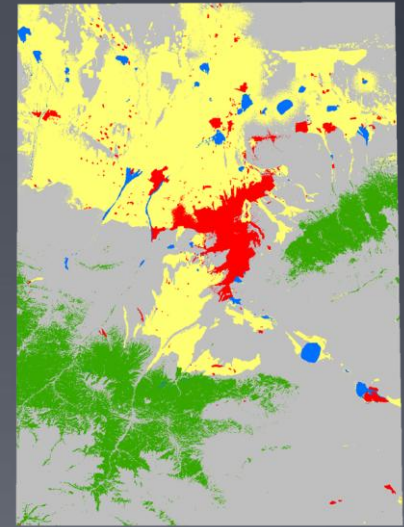
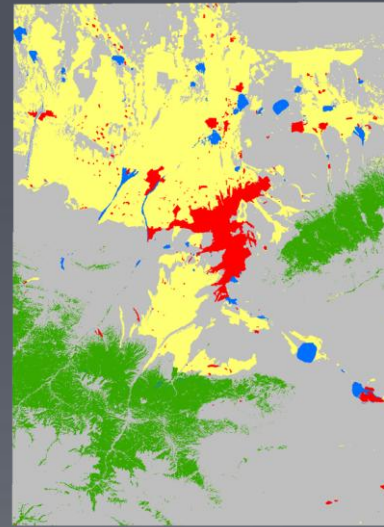
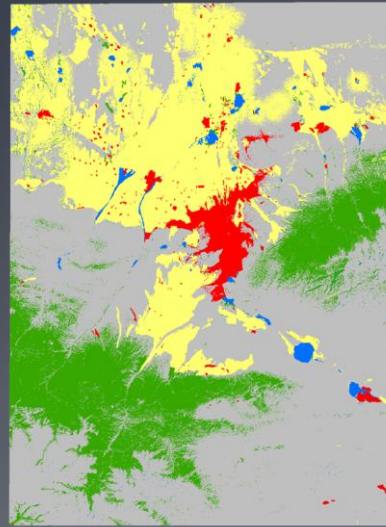
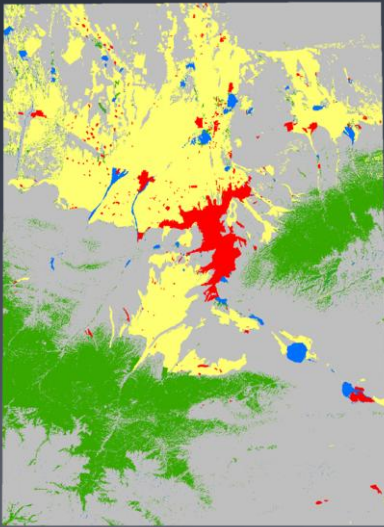
Urumqi LULC change simulation

2000






2010 (simulated)

2010

2020 (simulated)



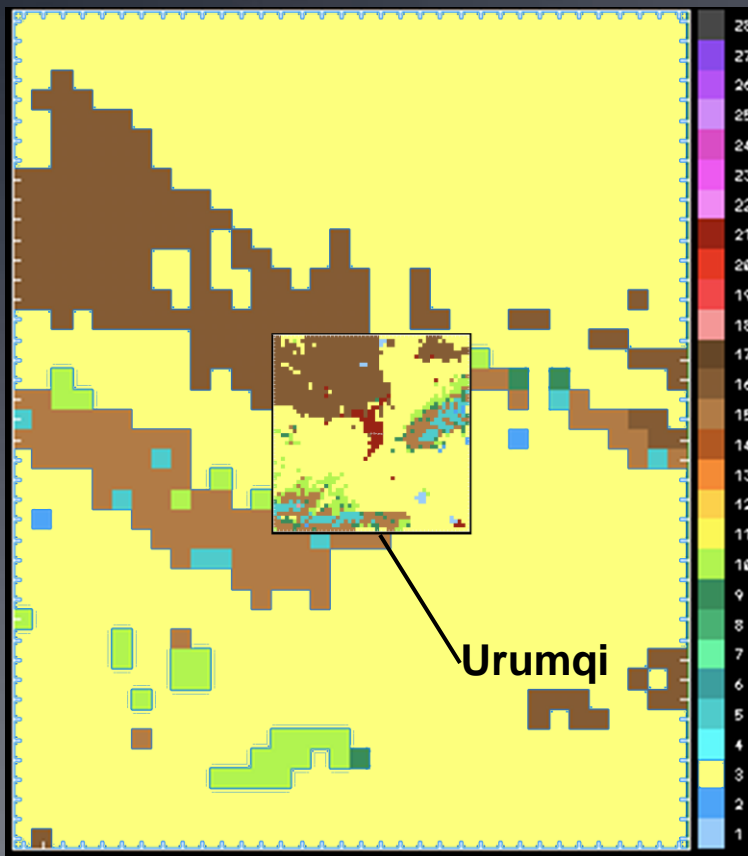
Legend

-  water
-  agriculture
-  urban
-  low density vegetation
-  high density vegetation

Urumqi - understanding environmental change

Modeling Climate

Regional Atmospheric Modeling System (RAMS) 6.0



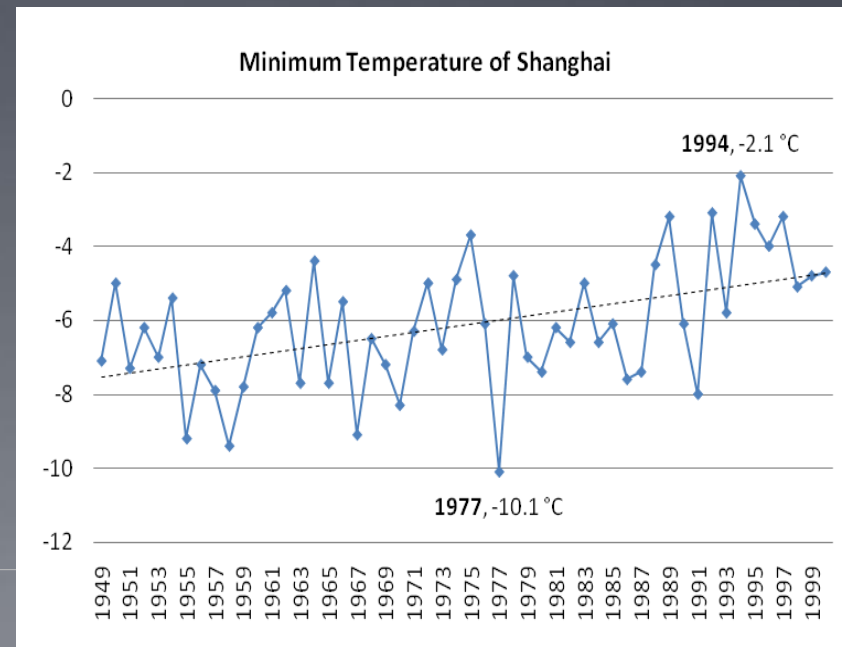
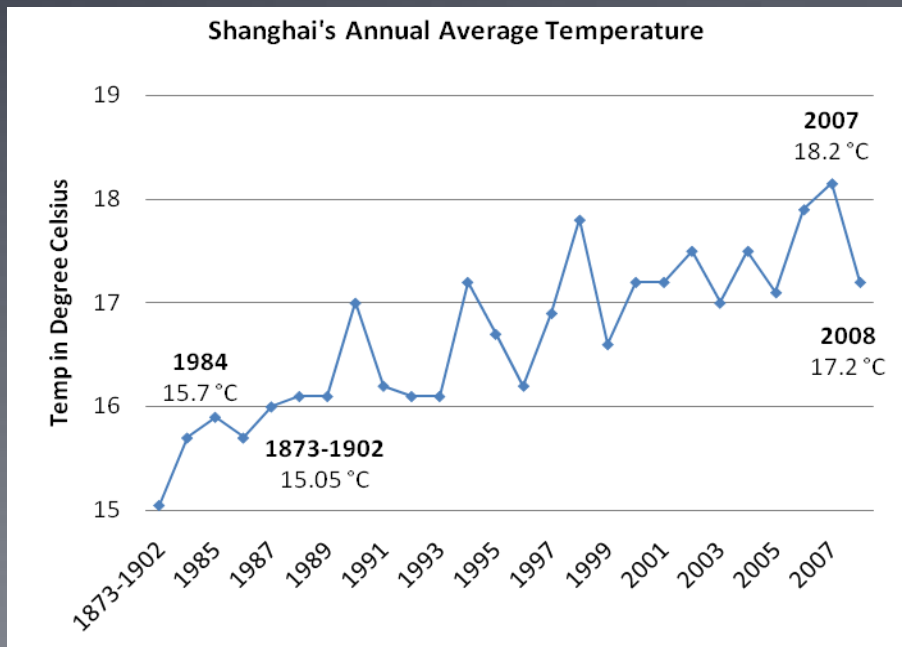
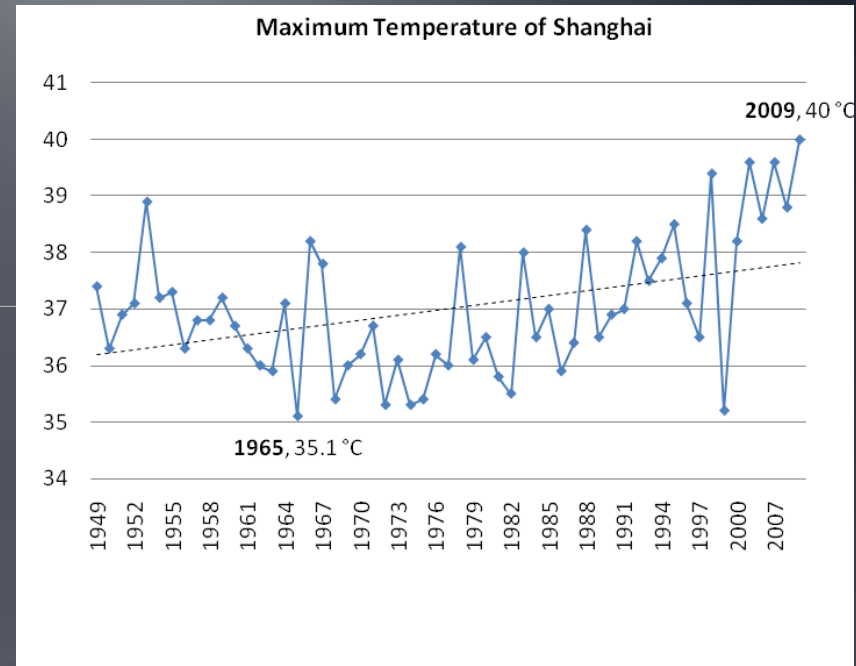
Preliminary results

- previous work shows region will experience higher temperatures
- changes in fractional vegetation cover - models show higher wind speeds may better disperse pollutants; may lead to better air quality

Multiple nested grids (2 and 8 km shown) of the *RAMS* model, and aggregated land cover classes

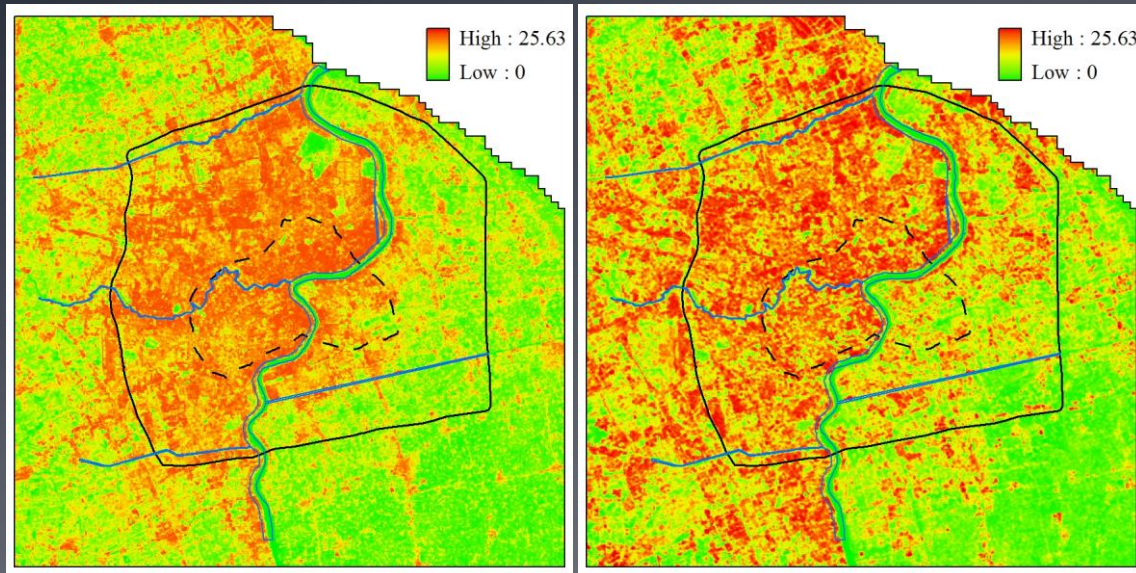
2c Impact of climate change on cities & 2d Adaptation and mitigation strategies

- Changing climate in Shanghai
- max temp increases 1949-2007, hotter summers
- min temp increases 1949-2000, warmer winters



2c Impact of climate change on cities & 2d Adaptation and mitigation strategies

----Urban Heat Island in Shanghai



Shanghai's urban thermal environment (unit: °C) (L: 2000, R: 2008)

- change in intensity of thermal environment at the urban core
- spread of heat island effects to periphery
- **Findings** - leading factors contributing to the urban thermal environment
 - land surface modification,
 - landscape configuration
 - anthropogenic heat release

Conclusions, so far...



- Integrated system
 - urbanization, LCLUC, urban environment change and climate change
- LCLUC:
 - Urban sprawl ++
 - Different dynamics of different types of urban land
 - urban China in a transitional economy: **spatial policy** + market forces
- Climate Change
 - City level: Contribution of LCLUC to CC?
 - Microclimate: significantly affected by landscape configuration

Spatial policy plays a critical role
----Shanghai Urban Planning Museum, 03/2010

Thank you!



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