



Presentation at SURE 2013 @ Berlin, Germany

Urbanization in the Shanghai-Yangtze River Delta Urban Agglomeration (SHYRDUA) region, China

~ Its trajectories, landscape impacts, and ecological effects ~

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Outline



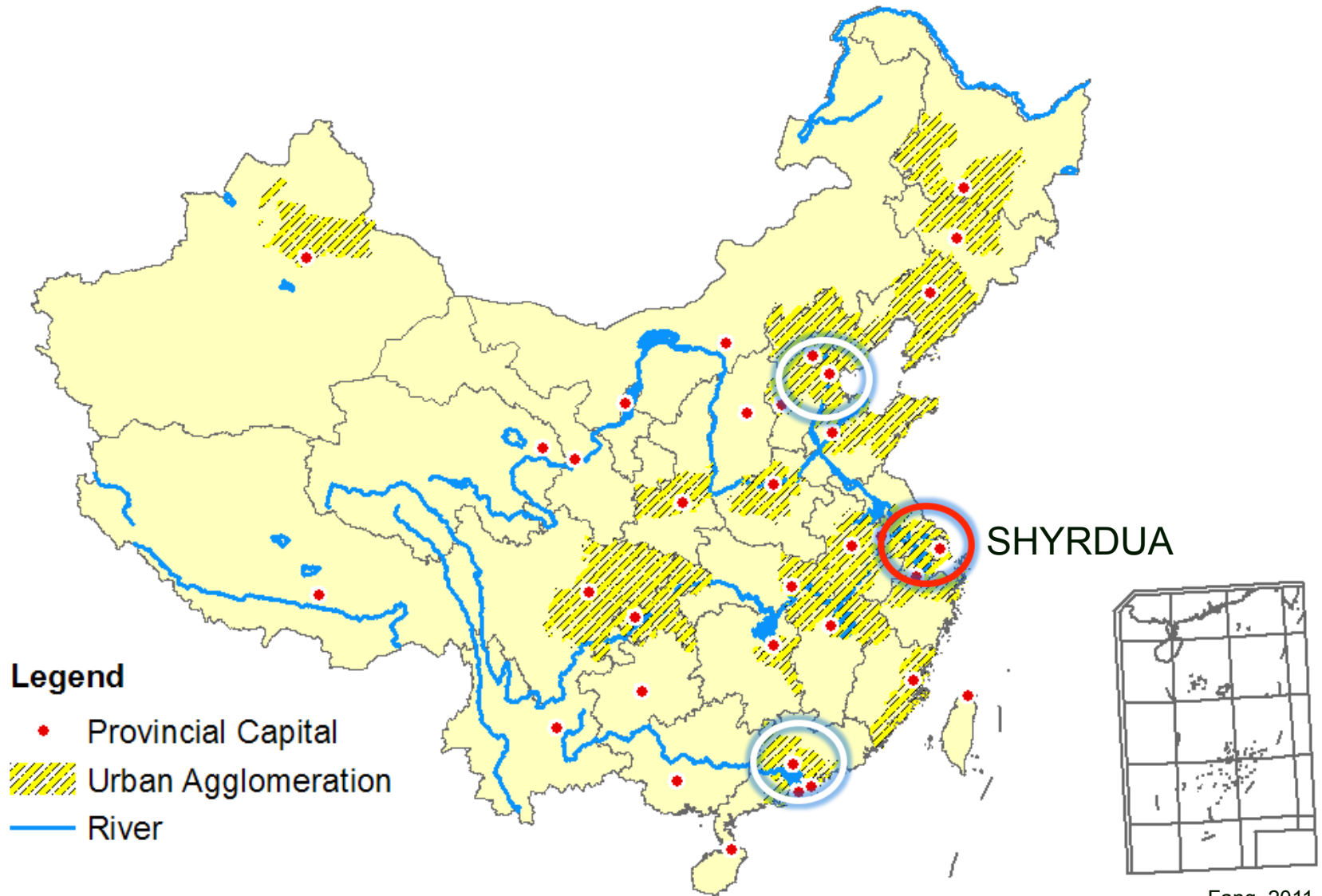
Introduction to SHYRDUA

The urbanization trajectories of SHYRDUA and
China

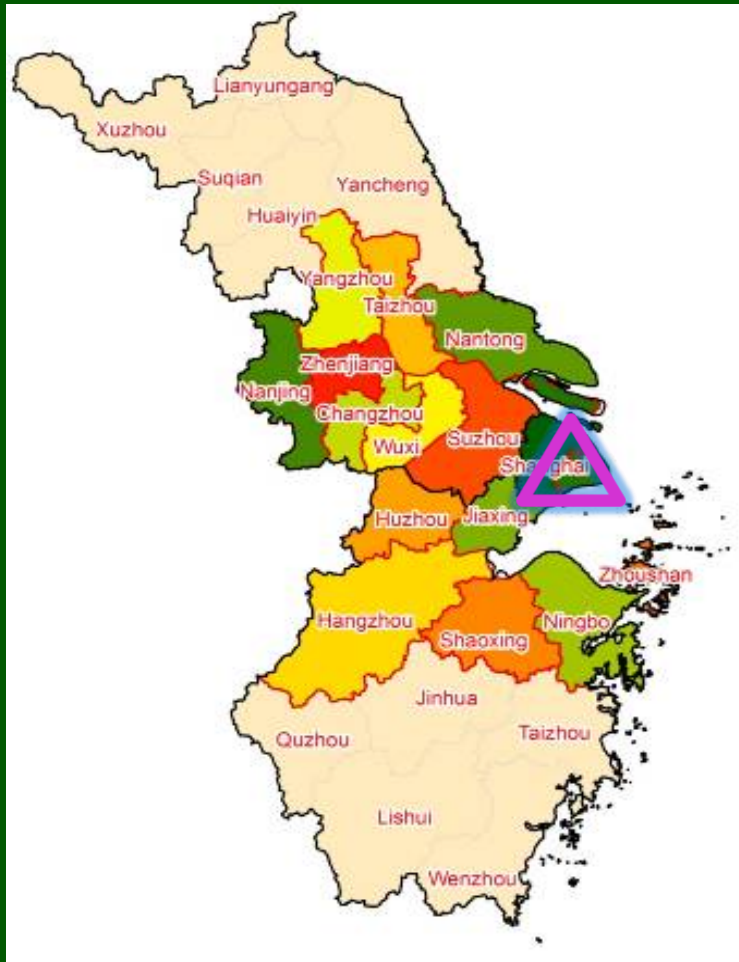
Landscape Impacts

Ecological Effects: overall ecosystem quality &
Carbon sources/sinks

15 Urban Agglomerations in China



Study Area



- Jiangsu, Zhejiang, Shanghai: 15 cities
- Area: 210,000 km² (2% of China total)
- Pop: 80 million (6% of China total)
- GDP: 8600 billion RMB (20% of China total) in 2010
- Rapid and massive urbanization since 1990s
- Currently unsustainable

SHYRDUA is a living laboratory for increasing our knowledge and developing solutions

Key Questions to be Answered

- ❖ What are the intrinsic characteristics and driving forces of the urbanization trajectories on the SHYRDUA from 1960s to 2010s ?
- ❖ To what extent and exactly how have the rapid and massive urbanization processes changed the region's landscapes since 1990s??
- ❖ What effects have landscape changes induced on the region's ecosystems?

Approaches to answer the key questions

Key questions

1. Urbanization trajectories?
2. Landscape impacts?
3. Ecological effects?

Suitable modeling tools and reliable data

SHYRDUA
Geo-database

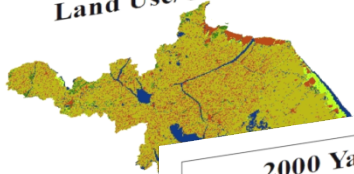
inte**G**rated u**R**ban
Ecology
Assessment**T** model
(GREAT) model

SHYRDUA Geo-database: Socioeconomic

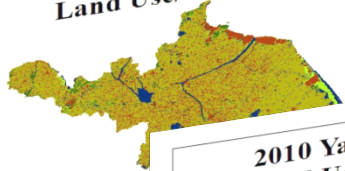
Indicator	Year	Remarks
Pop. migration for inter- and intra-province	1990, 2000, 2010	
Pop natural birth and death rate	1979-2010	Available at China statistical yearbook
City/region layout plan	After 2010	Need to be searched
Per capita floor area	1979-2010	2009 and 2010 data need to be supplemented
Newly constructed residential building area		
Total floor area at the end of each year		
Length of road, railway and water pipeline		

SHYRDUA Geo-database: Geospatial

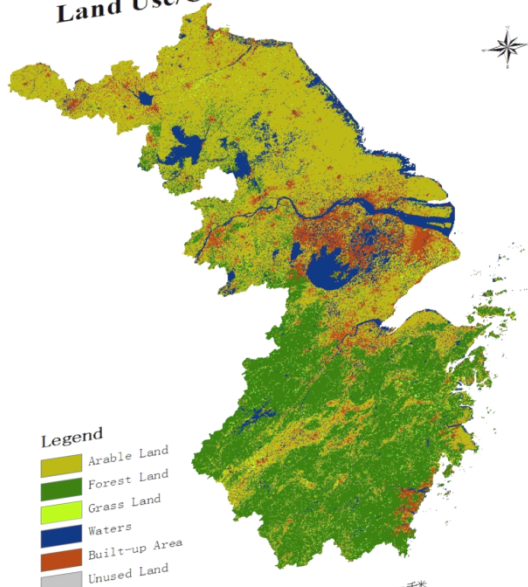
1990 Yangtze River Delta Region
Land Use/Cover Distribution Map



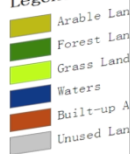
2000 Yangtze River Delta Region
Land Use/Cover Distribution Map



2010 Yangtze River Delta Region
Land Use/Cover Distribution Map



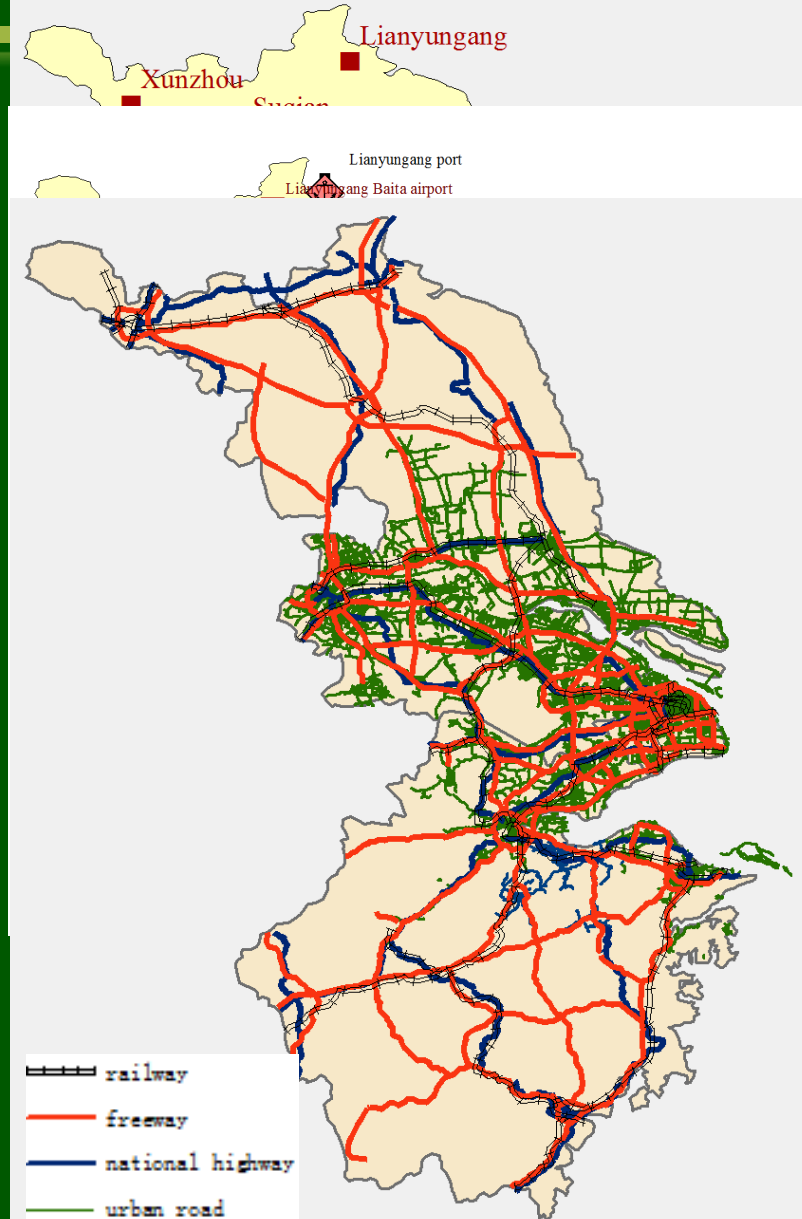
Legend



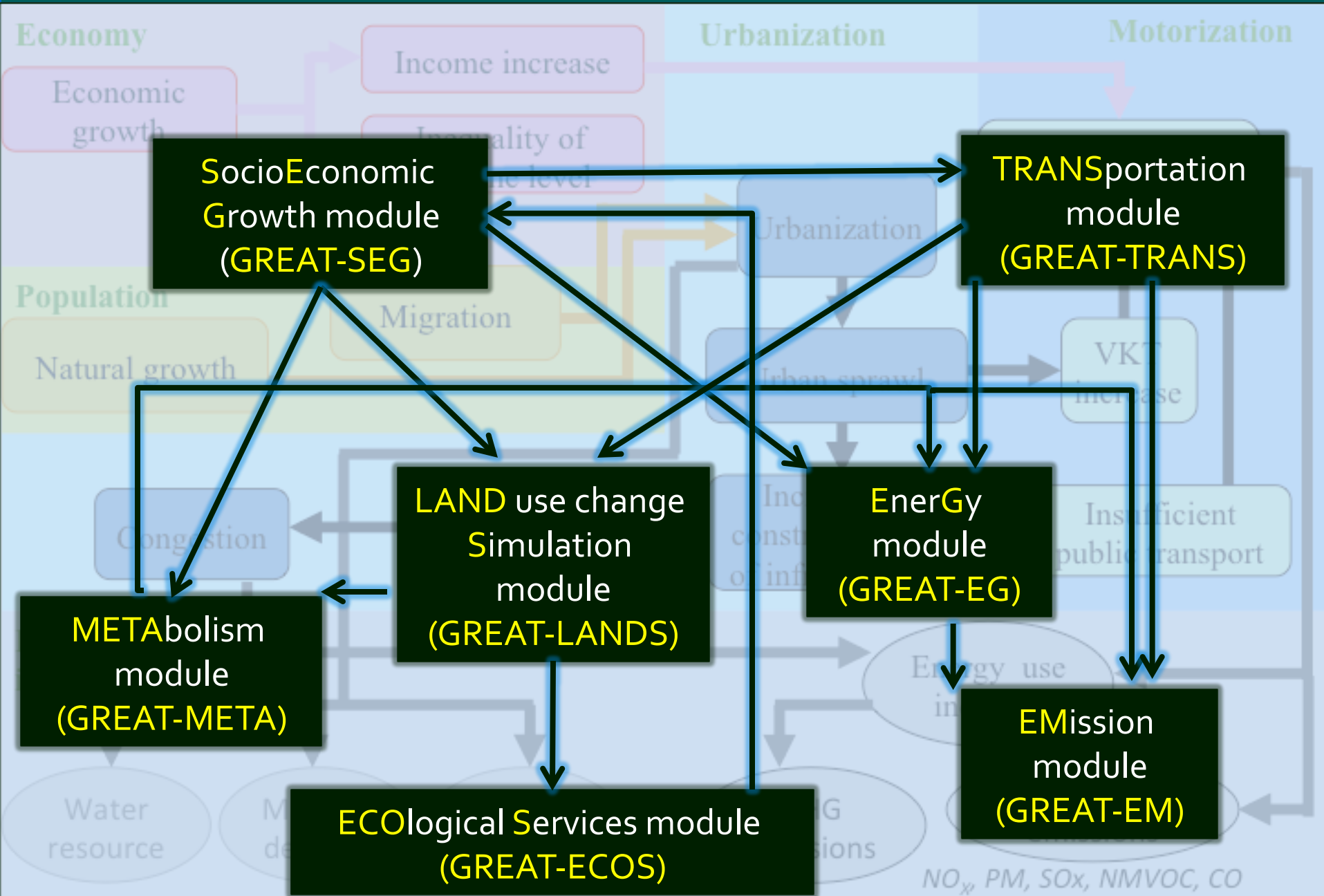
Legend



Legend



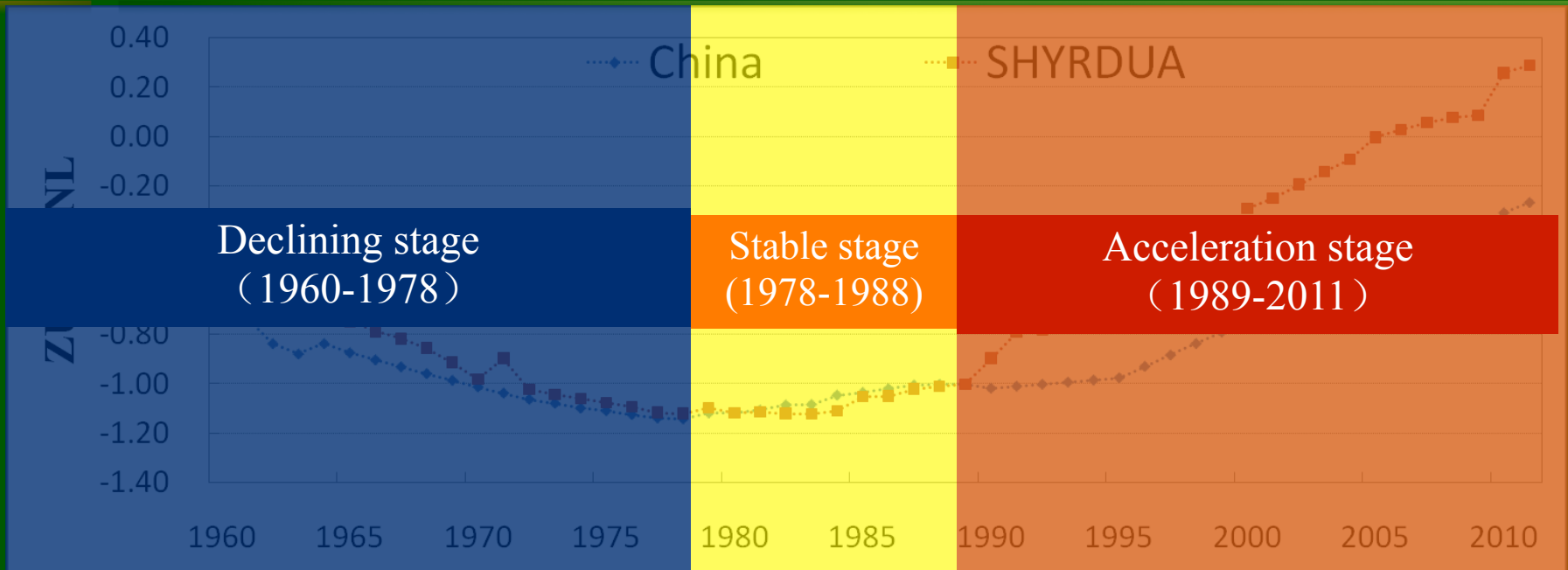
inteGrated uRban Ecology Assessment (GREAT) model



Trajectory of Urbanization: Indicators

Indicators	<ul style="list-style-type: none">• Urbanization level (URBANL)• GDP per capita(GDPPC)• CO₂ emissions per capita (fossil fuels burning, and cement manufacture only)
Data	<ul style="list-style-type: none">• Sample of 226 countries and regions in the world• 1960-2011
Source	<ul style="list-style-type: none">• World Bank online database (http://data.worldbank.org/)• China statistical yearbook• Tokyo statistical year book

Trajectory of Urbanization: Stages & Drivers



(1) Declining stage(1960-1978) :

Cultural Revolution (1966-1976),

Down to the Countryside Movement(1968-1978), Chinese economic reform (1978)

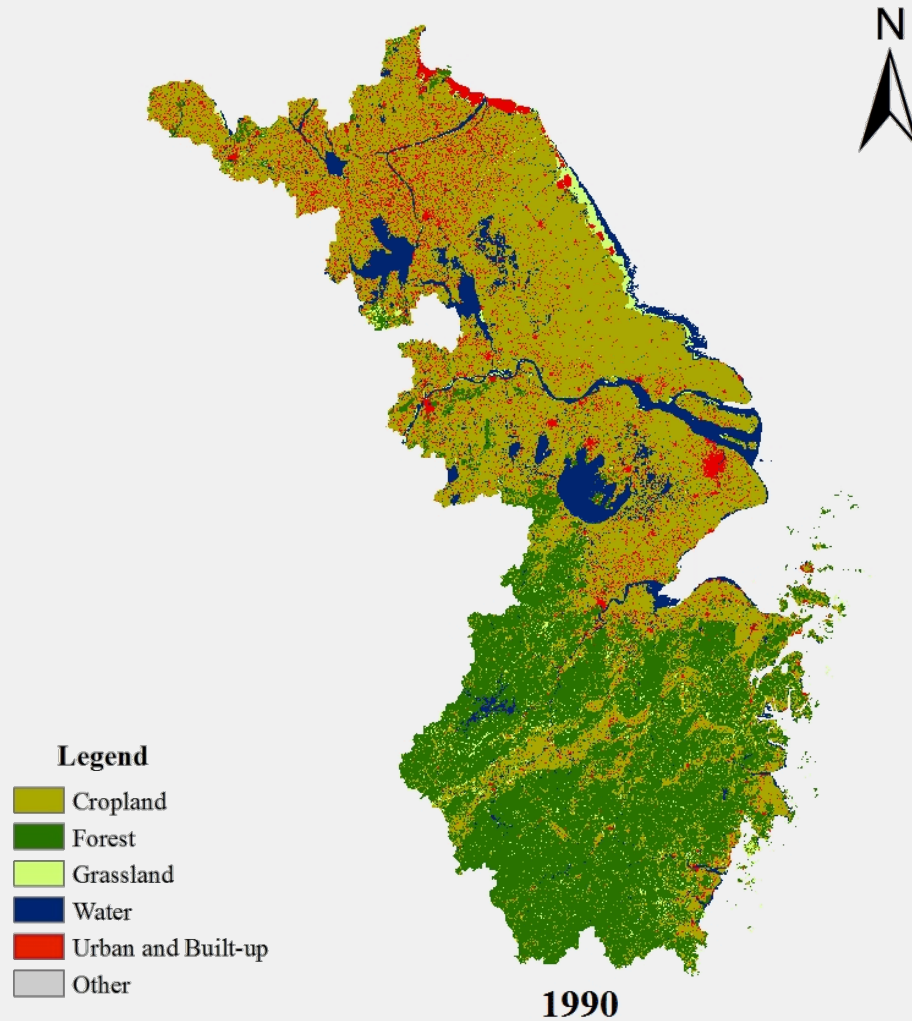
(2) Stable stage (1979-1988):

Reform of *hukou* (1984)

(3) Acceleration stage (1989-2011):

Emergence of YRD (1992), Pudong New Area (1993),
YRD Regional Planning(2010)

LULC in SHYRDUA 1990-2010



LULC in SHYRDUA 1990-2010

1990-2000			2000-2010		
Types of land use change	Total area (Unit: km ²)	Area percentage (%)	Types of land use change	Total area (Unit: km ²)	Area percentage (%)
Remain unchanged	203 061.4	97.6%	Remain unchanged	192 627.4	92.6%
From cropland to built-up area	3 328.6	1.6%	From cropland to built-up area	8 455.5	4.1%
From cropland to forest	559.7	0.3%	From cropland to forest	845.3	0.4%
From cropland to water	436.5	0.2%	From cropland to water	1 157.8	0.5%
Other types	753.6	0.3%	Other types	5 031.2	2.4%

Policy Drivers behind the LUCC

1978

- China adopted its famous “**opening-up**” policy
- Before 1978, the constitution banned land transactions and all land was state- or collectively owned.

1980s

- **The Land Administration Law** was passed in 1986
- State-owned land transactions was legalized to develop land market.

1994

- **The Basic Farmland Protection Regulation** was passed
- The high-quality cropland was strictly protected to ensure food security in China.

1999

- **The New Land Administration Law** was enacted
- Protect environmentally sensitive lands, further promote market development.

2003

- **The act of Conversion of degraded farm land into forest** was passed
- Encourage farmers to convert degraded farmland into forest to improve ecological condition.

Conversion from farmland into forest in SHYRDUA

1990-2000

560 km²

2000-2010

845 km²

The overall quality of ecosystem: Methodology

Basic information

Data source: LUCC、MOD09A1、national 4 million basic geographic data、 administrative division data & statistical data in SHYRDUA

Analytical units: 500*500m per cell size

Method: based on the *Technical criterion for eco-environmental status evaluation*, improve weight and normalized coefficient.

Ecological quality index

Biology
Plentiful
Degree

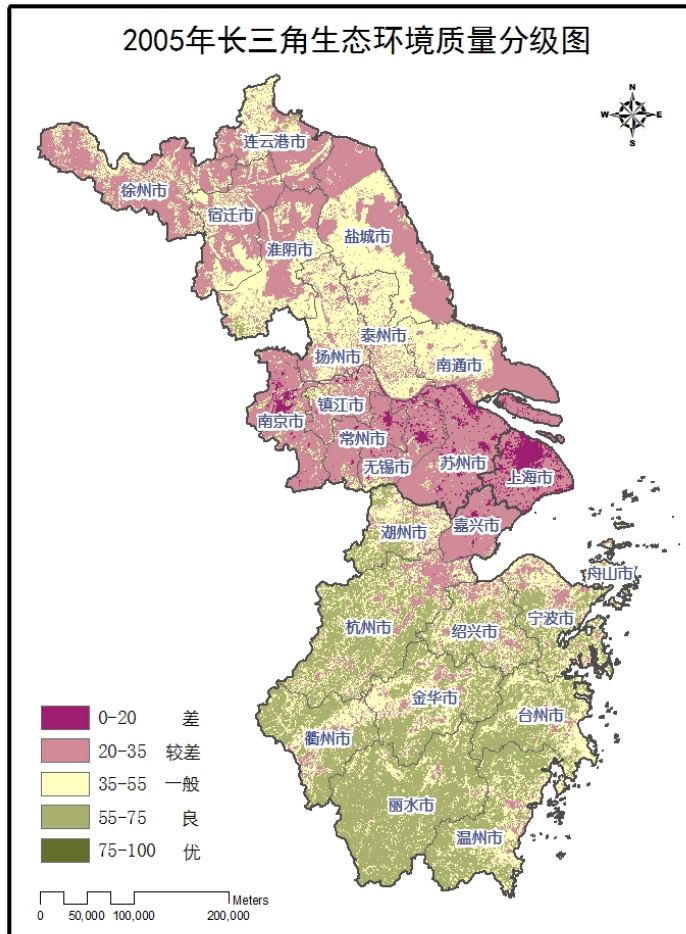
Vegetation
Cover
Index

Waternet
Density
Index

Land
Deterioration
Index

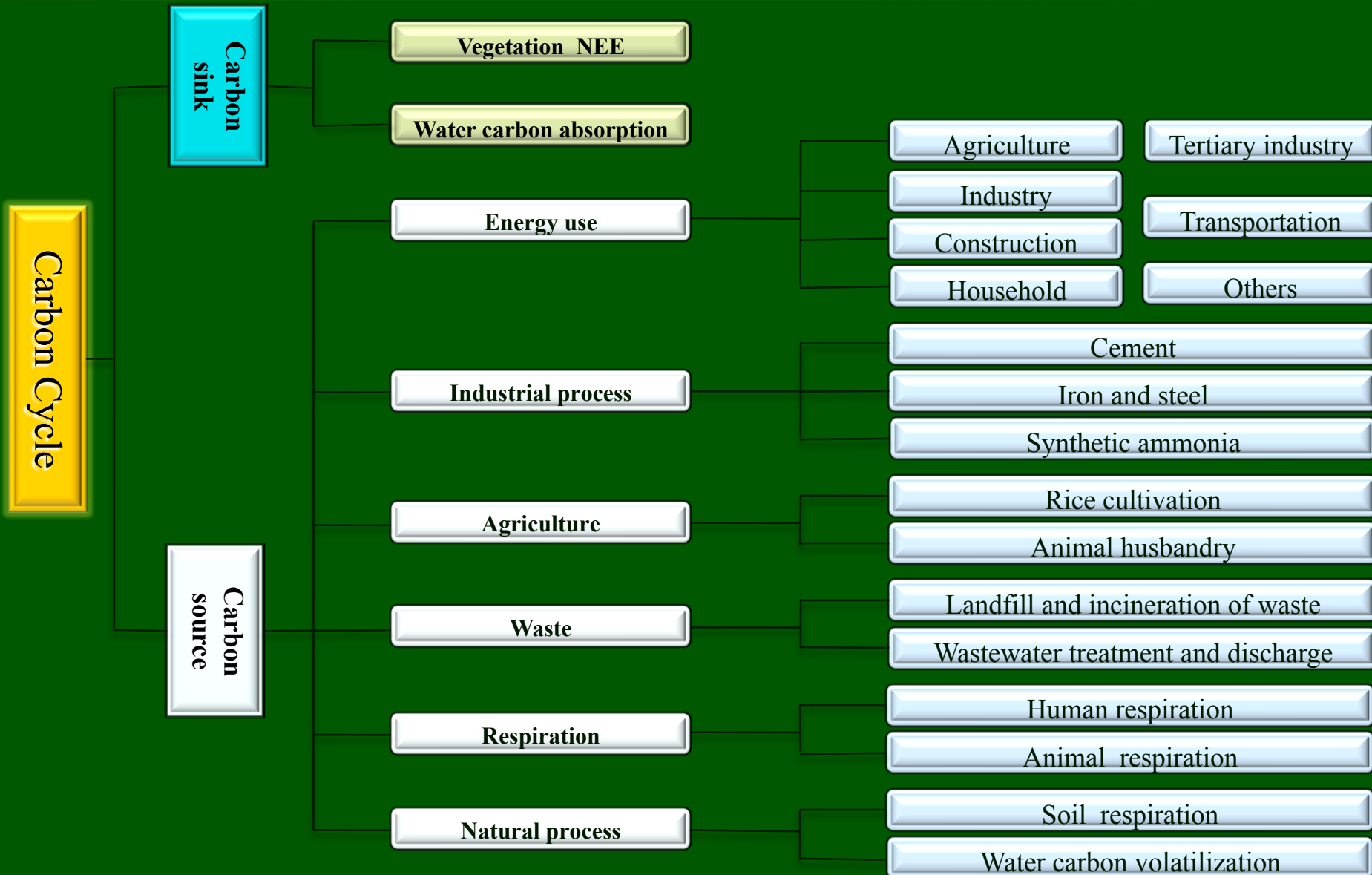
Pollution
Load
Index

The overall quality of ecosystem: Result in 2005



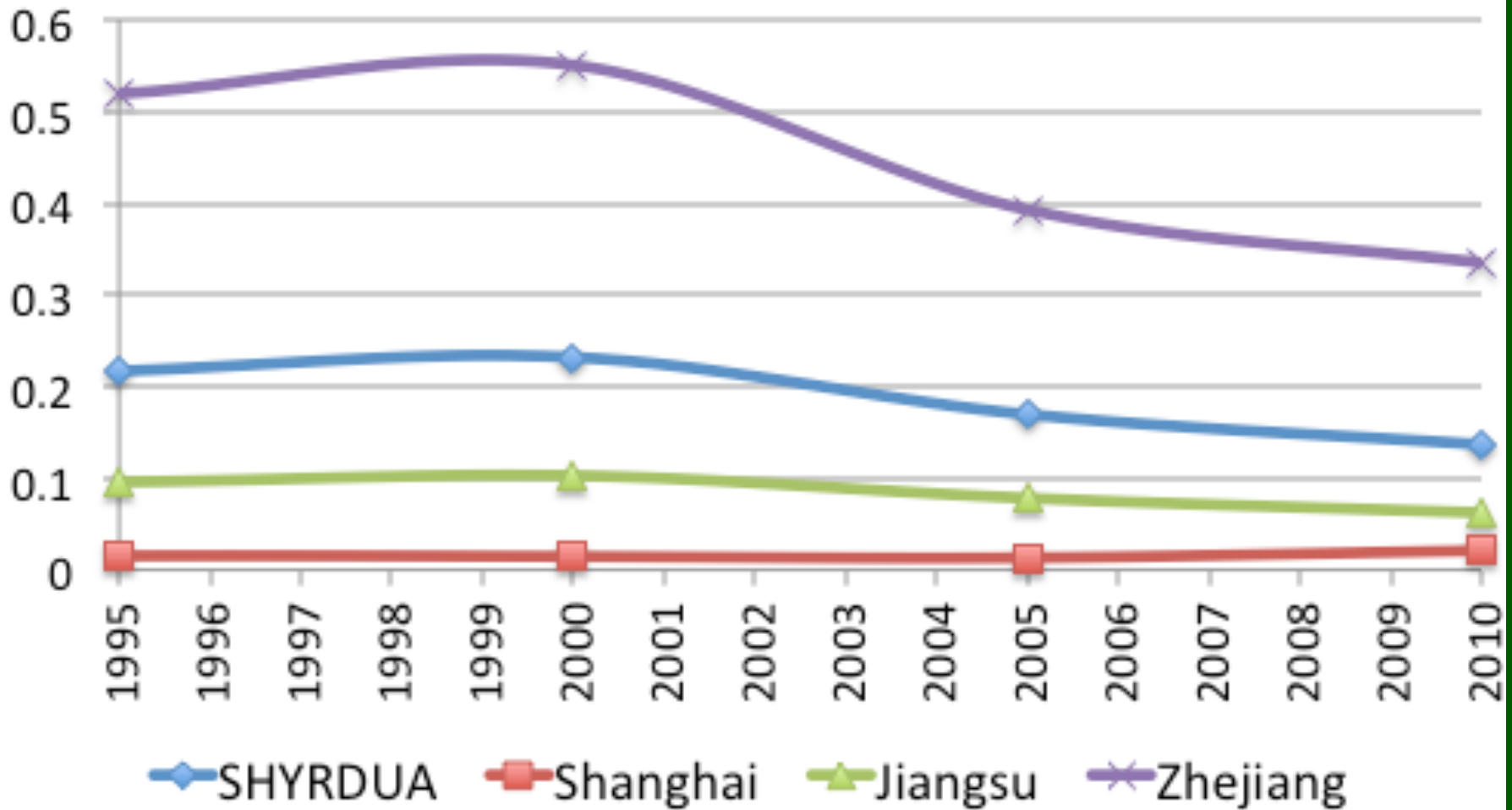
1. The general ecological environment quality in SHYRDUA demonstrated increased tendency from north to south, with the worst quality distributed in the central area.
2. Almost all the ecological environment quality with BETTER grade districted in Zhejiang province.
3. Along Shanghai to Nanjing, including Suzhou-Wuxi-Changzhou districts, the ecological environment quality were the WORST grade in SHYRDUA.

Carbon sources & sinks: Methodology



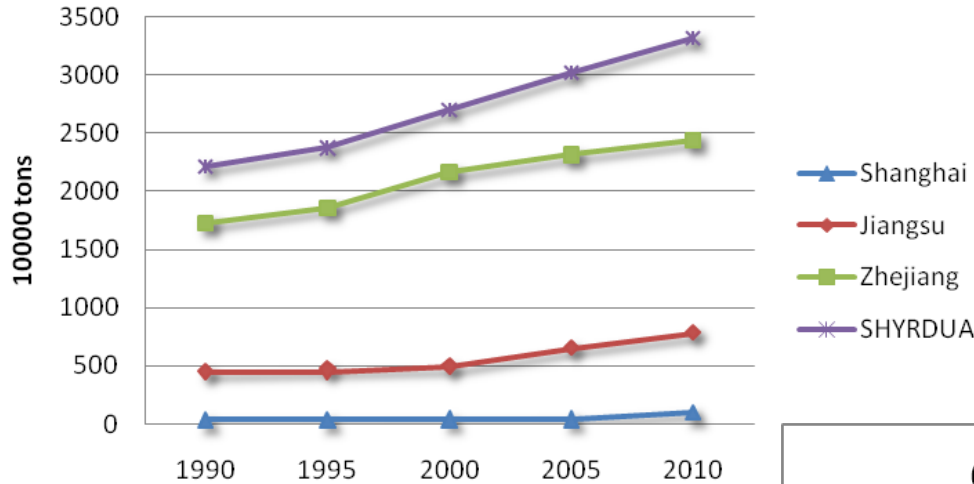
Carbon sources & sinks: Results

Ratio change of carbon sinks/sources in SHYRDUA



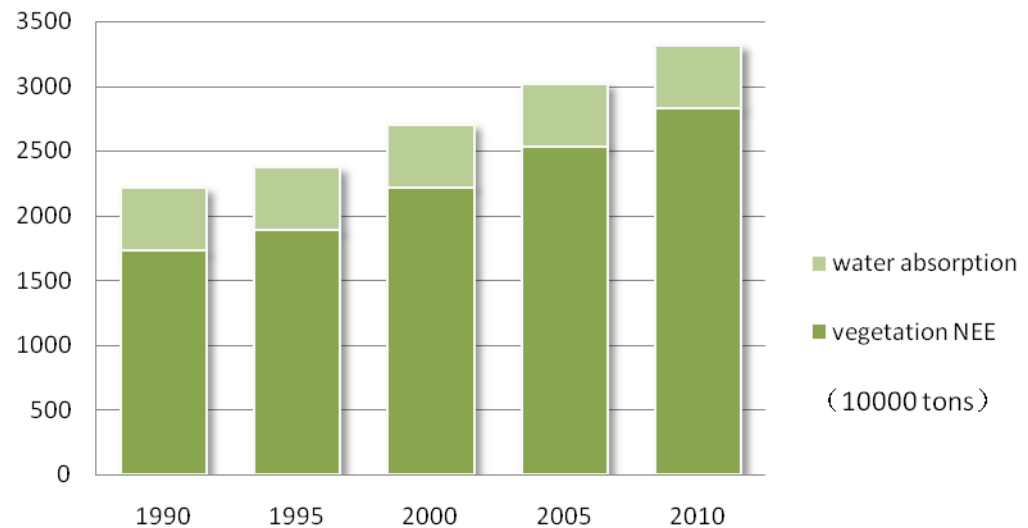
Carbon sources & sinks: Results

Carbon Sink in SHYRDUA



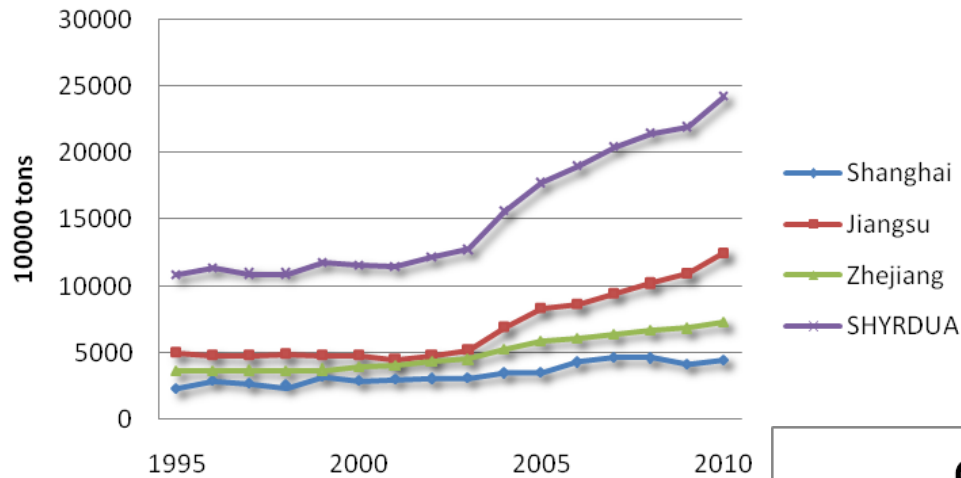
Policy of Returning Farmland to Forest (Grass)

Carbon Sink in SHYRDUA

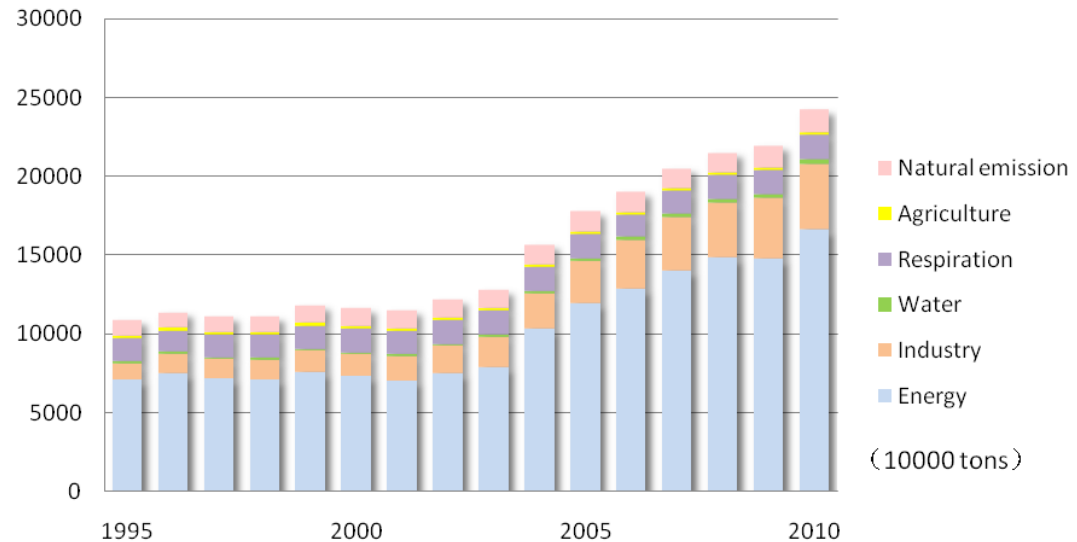


Carbon sources & sinks: Results

Carbon Source in SHYRDUA



Carbon Source in SHYRDUA

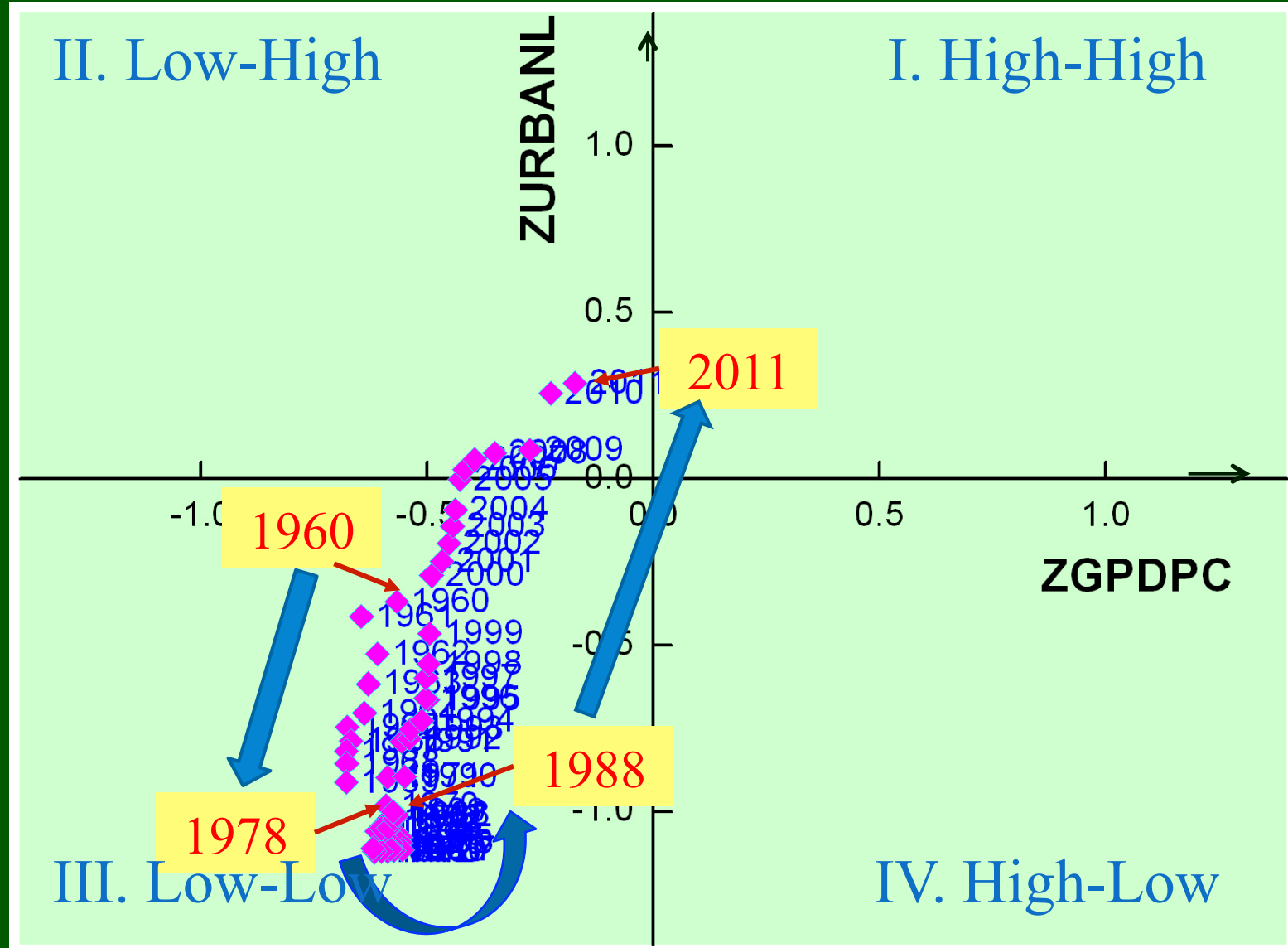




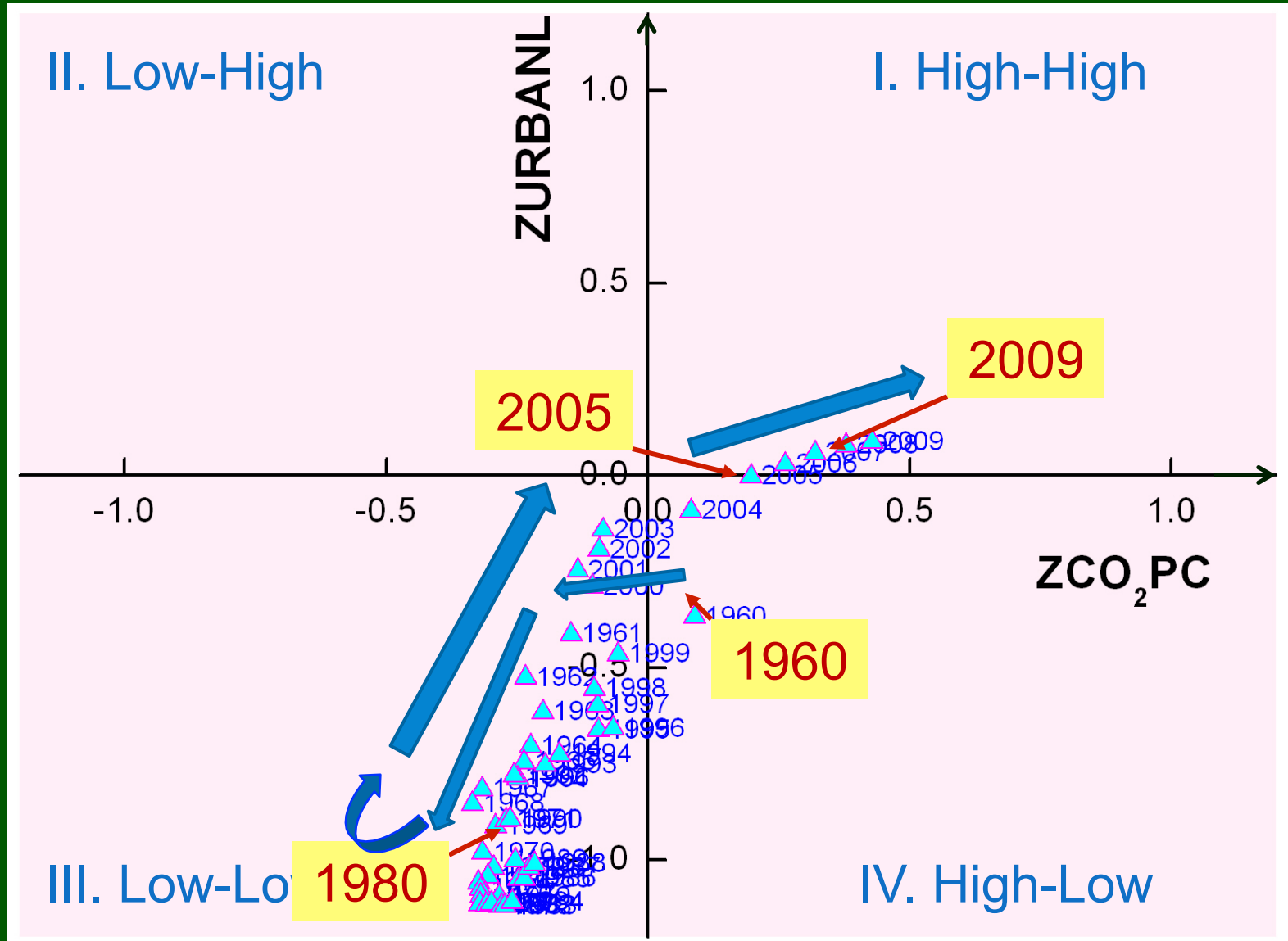
Thank you!

Email: jhan@re.ecnu.edu.cn

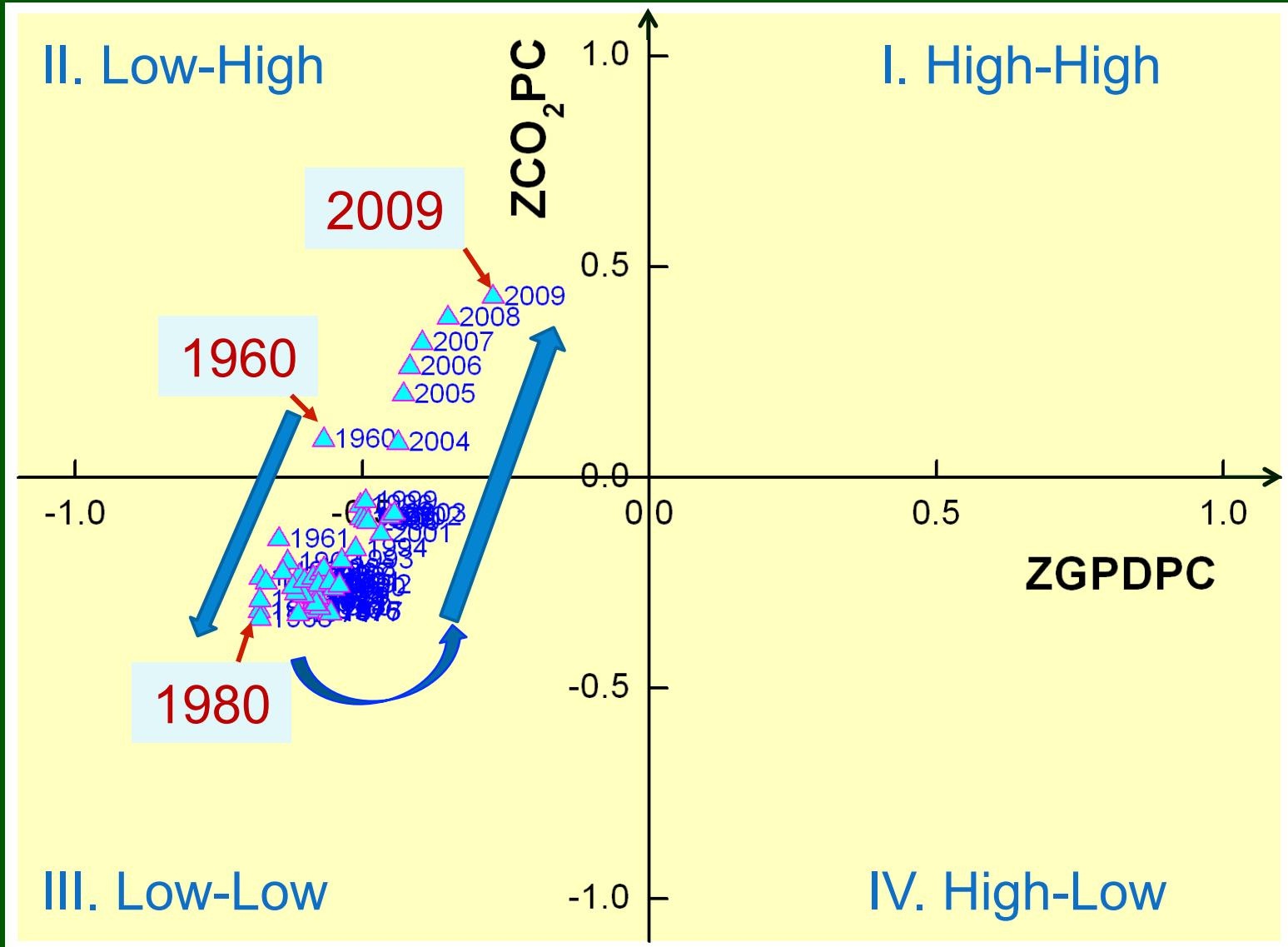
Trajectory of Urbanization: Urbanization v.s. GDP/cap



Trajectory of Urbanization: Urbanization v.s. CO₂/cap

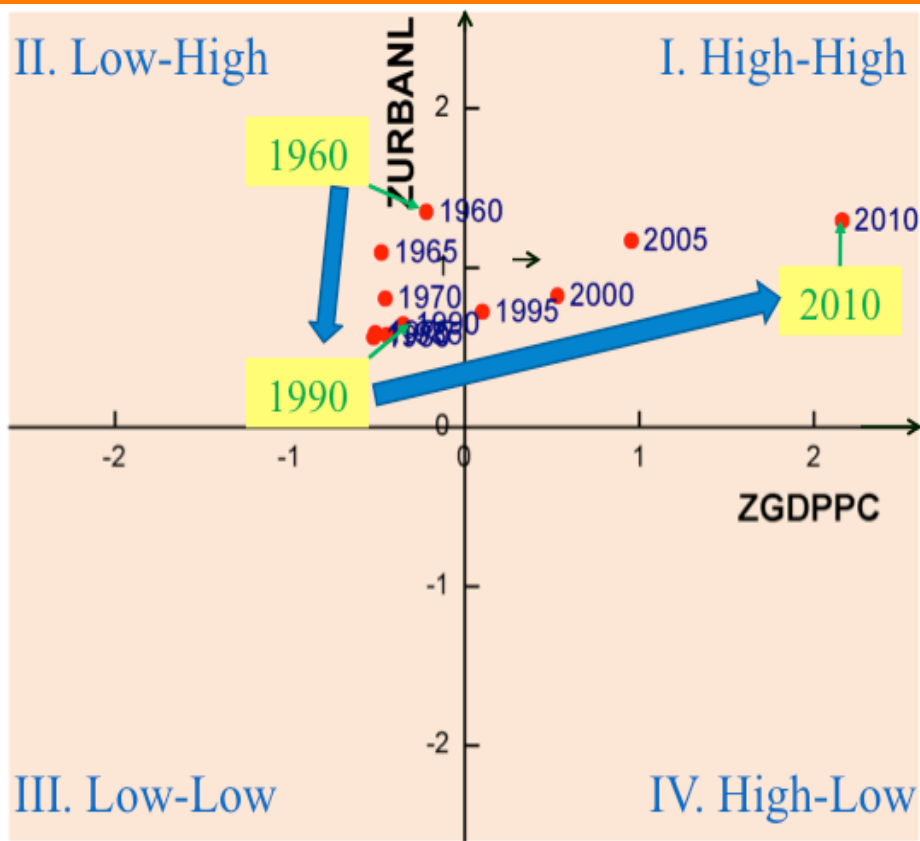


Trajectory of Urbanization: CO₂/cap v.s. GDP/cap

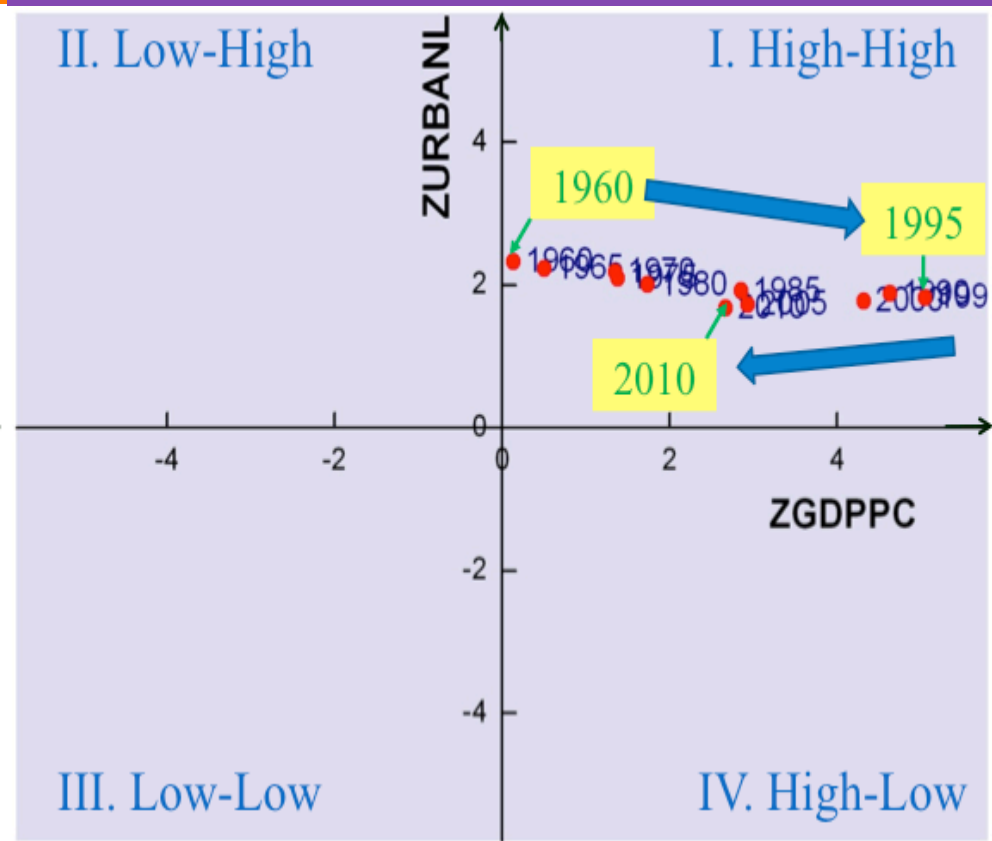


Trajectory of Urbanization: Urbanization v.s. GDP/cap

Shanghai



Tokyo



Estimation of Ecosystem Services Value (ESV)

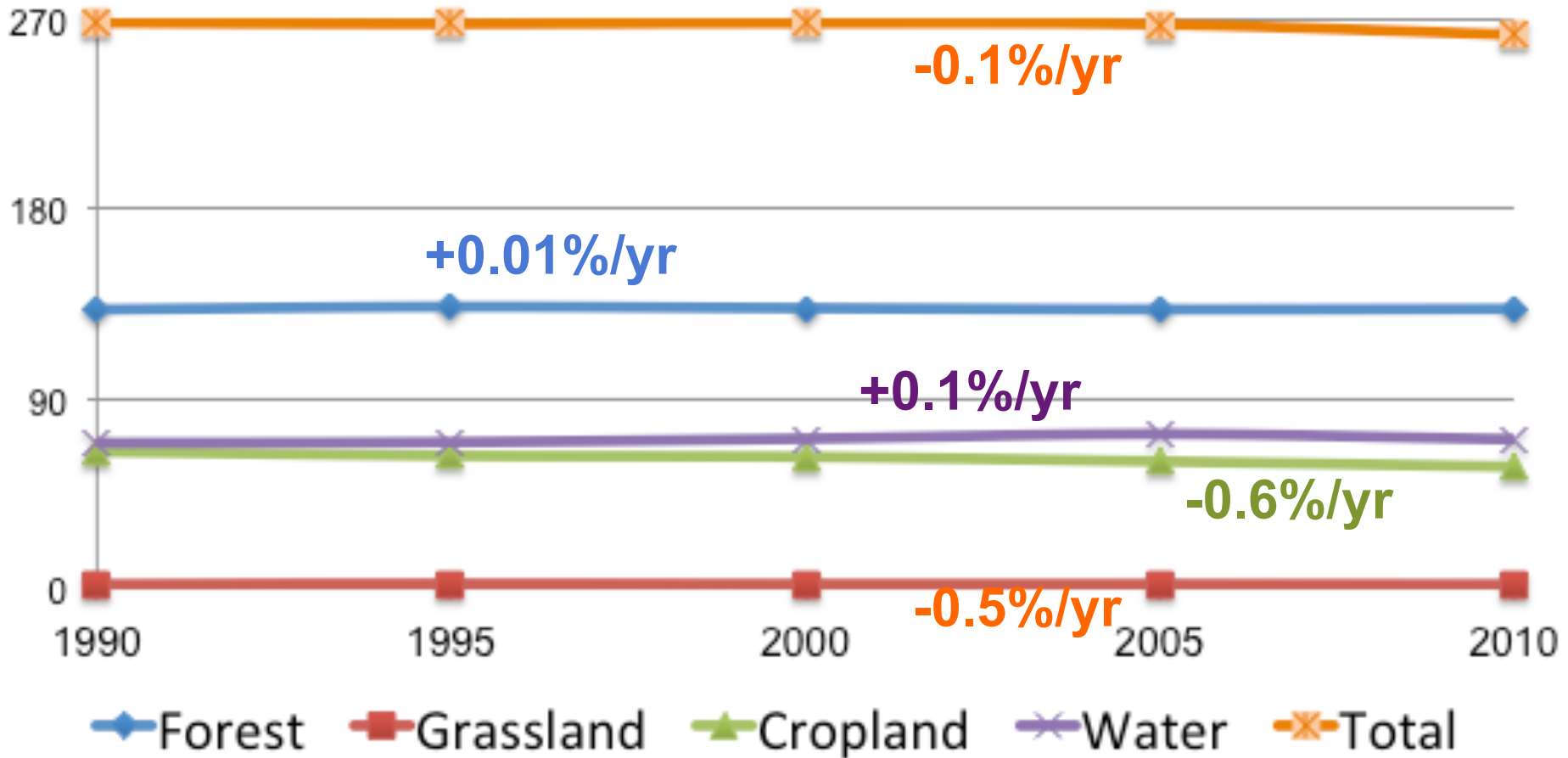
$$ESV = \sum \sum Area_i \times Valuecoefficient_{ij}$$

i is land use type; j is eco-service function type

Unit: Yuan RMB / ha	forest	grassland	cropland	water	built-up
Gas regulation	3097	707.9	442.2	796.4	0
Climate regulation	2389.1	796.4	787.5	7769	0
Water conservation	2831.5	707.9	530.9	15874.2	0
Soil formation and protection	3450.9	1725.5	1291.9	761	0
Waste treatment	1159.32	1159.2	1451.2	16086.6	0
Biodiversity conservation	2884.6	964.5	628.2	2207.8	0
Food production	88.5	265.5	884.9	177	0
Raw material	2300.6	44.2	88.5	35.4	0
Recreation and culture	1132.6	35.4	8.8	4375.6	0
total:	19334.1	6406.5	6114.1	48083	0

Changing Level of ESV: By Land Type

Billion Yuan



Changing Level of ESV: Spatial Pattern

