



Redeveloped downtown of Irkutsk, May 2015, photo by Peilei Fan

# URBANIZATION AND SUSTAINABLE SOCIETAL DEVELOPMENT UNDER TRANSITIONAL ECONOMIES AND GLOBAL CHANGE: A SYNTHESIS OF NORTH ASIA

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# Urbanization and sustainability under global change and transitional economies: Synthesis from Southeast, East, and North Asia (SENA)



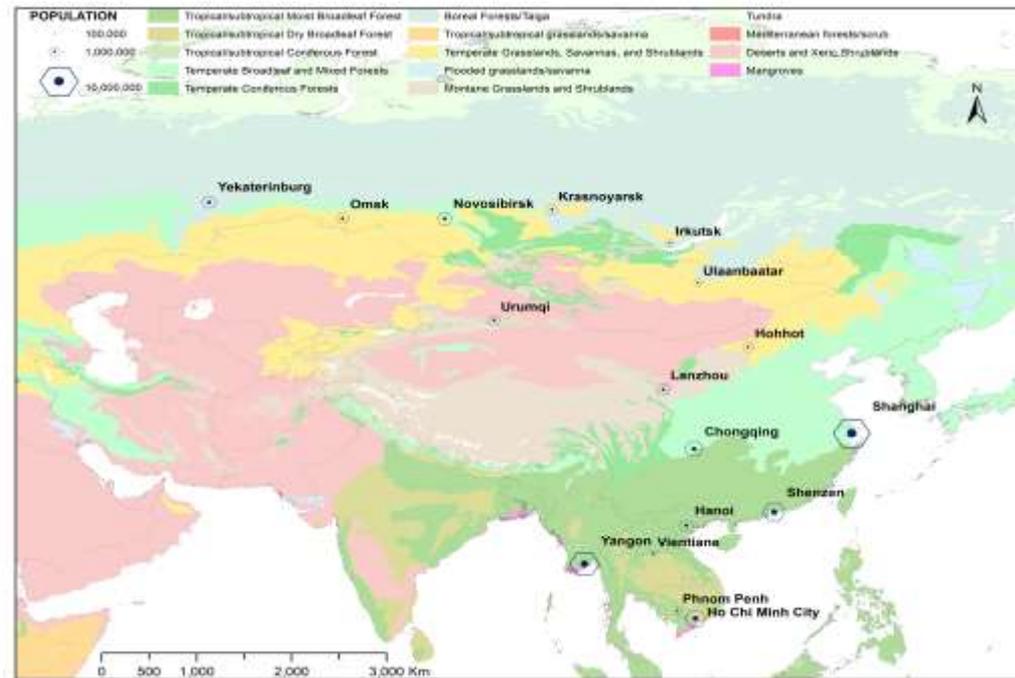
Grant #: NNX15AD51G

web: [senacgc.org](http://senacgc.org)



## Study Context:

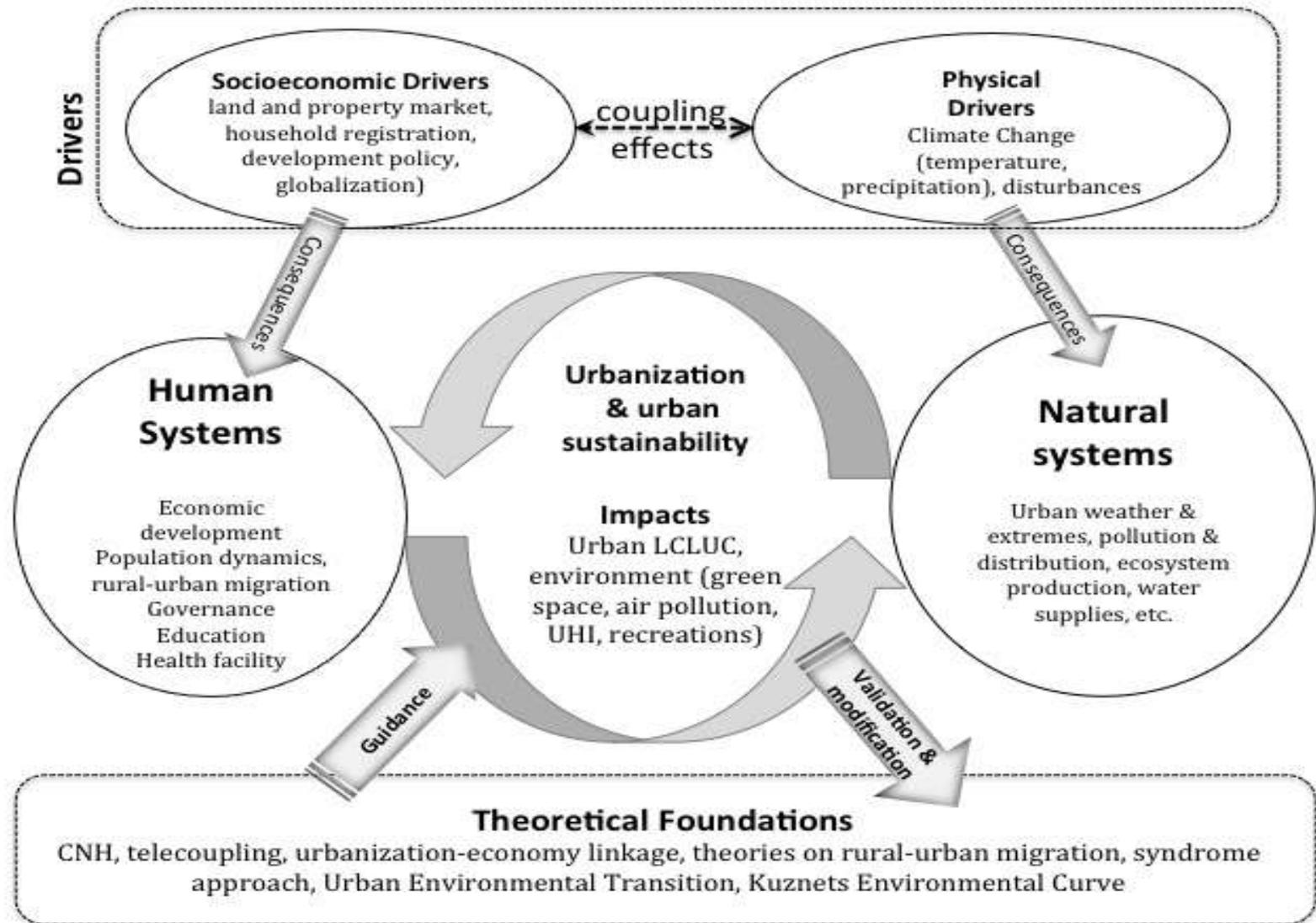
- SENA countries constitute a region that is significant in both natural and socioeconomic dimensions:
  - a land area of 25.4 million km<sup>2</sup> population of 1.54 billion in 2010
- experienced liberalization, macroeconomic stabilization, restructuring and privatization, and legal and institutional reforms over the past three decades
- urbanization at various but mostly tenacious speeds, exert tremendous pressure on social, economic, and environmental sustainability, especially under the increasingly visible climate change.



17 urban systems overlaid on the Ecoregion coverage (8 biomes in 7 countries)

## Research Questions:

1. What are the spatiotemporal changes of urban expansion within transitional economies?
2. What are the key socioeconomic and biophysical drivers of urbanization and urban sustainability? More specifically, which institutional mechanism is unique and crucial? How well do our models and data explain these changes through the interactions and feedback mechanisms of human and natural systems?
3. How well can we predict the changes in urban LCLUCs and functions based on the derived structure and functions of LCLUC, human systems, and natural systems?
4. What socioeconomic and institutional adaptations have been implemented and how effective have they been? What policy recommendations can be offered to enhance urban sustainability in the near future?



## Conceptual framework

for understanding drivers, process, and impacts of urbanization and sustainability

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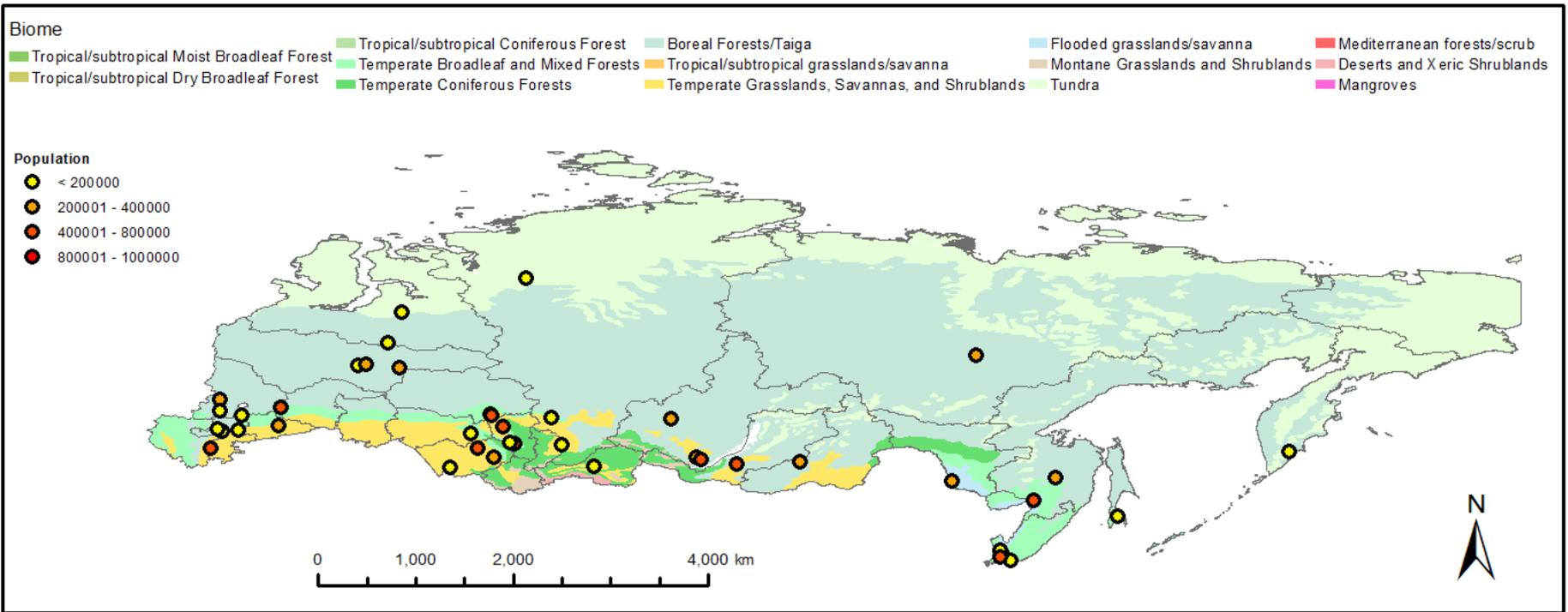
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# STUDY CONTEXT

- The collapse of the former Soviet Union triggered several destructive processes associated with (or directly caused) by it.
  - de-industrialization;
  - land abandonment;
  - depopulation of remote areas;
  - internal (e.g., from the countryside into the cities) and external (brain drain) migration;
  - weakening of social fabrics (decrease/elimination of state support for less-fortunate groups of population such as elderly);
  - market reforms in health service;
  - moral demise that manifested itself in higher crime rates, corruption, and overexploitation of millions “illegal immigrants” from other republics of the USSR, who have no law protection on the job market; and,
  - finally, interethnic conflicts in North Caucasus.

# STUDY OBJECTIVES

- To synthesize the data and knowledge for urbanization and sustainability in North Asia in the context of socioeconomic transformation and (possibly) climatic change. Specifically
  - Spatio-temporal patterns of urbanization (urban built-up land and urban population) of North Asia
  - Spatio-temporal patterns of regional sustainability and its three dimensions, i.e., economic development, social development, environment conservation of North Asia
  - The interrelationships between urbanization and sustainability in North Asia through structural equation models



Federal district	Ural	Siberia	Far East	Total North Asia	Total Russia	North Asia as a % of Russia
Land area (km2)	1,788,400	5,114,800	6,179,900	13132800	17,075,400	77%
Population	12,308,103	19,324,031	6,194,969	37630081	144,221,341	26%
# of federal subjects	6	12	9	27	85	32%
# of municipalities	1344	4082	1355	6781	22923	30%
# of cities > 100000	16	21	10	47	165	28%
Urbanization (%), (2014)	79.9	72.7	75.4	75.5	74.0	
Capital city	Yekaterinburg	Novosibirsk	Khabarovsk			

Data is from the Russian Federation Federal State Statistics Service ([http://www.gks.ru/wps/wcm/connect/rosstat\\_main/rosstat/ru/](http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/)). All data refer to estimate on Jan. 1, 2016 unless specified.

# DATA AND METHOD

- used a suite of methods: remote sensing, sustainability index construction, and structural equation models, relying on a variety of data sources, including satellite imageries, statistical data on socio-economic variables, and field trips for validation image interpretation and interviews with local experts.
- We first evaluated the urbanization by examining both urban population and urban built-up area from 1992 to 2014 based on night-light and/or MODIS satellite images.
- We then evaluated sustainability for all 25 federal subjects in the three federal districts of the Russian Federation (4 in Ural , 12 in Siberia, and 9 in Far East), including conditions in economic development (by GDP per capita), environment condition (by air pollutants from stationary source and waste water discharges per capita), and social wellbeing in health care, housing, and education.
- We studied the interrelationship between urbanization and sustainability in North Asia through structural equation models.
- To illustrate the different urbanization processes and the common and unique challenges faced by cities in North Asia, we also complemented the quantitative analysis with case analysis of six major cities in the three federal districts; Yekaterinburg in the Ural, Novosibirsk, Krasnoyarsk, and Irkutsk in Siberia, and Khabarovsk in the Russian Far East.

# REGIONAL SUSTAINABILITY INDEX

- Economic index (ECI): measured by employment rate as an indicator of economic development and standard of living,
- Environment index (EVI): environment condition of a region, measured by air pollutants per capita from the stationary sources (with 1/2 weighting) and the wastewater discharge per capita (with 1/2 weighting)
- Social development index (SDI): social development, measured by health, housing condition, and education aspects, with variables of doctors per 10000 people, living space per capita (m<sup>2</sup>), and high education students (bachelor, master programs etc) enrollment per 10000 people

$$ECI = EMPI$$

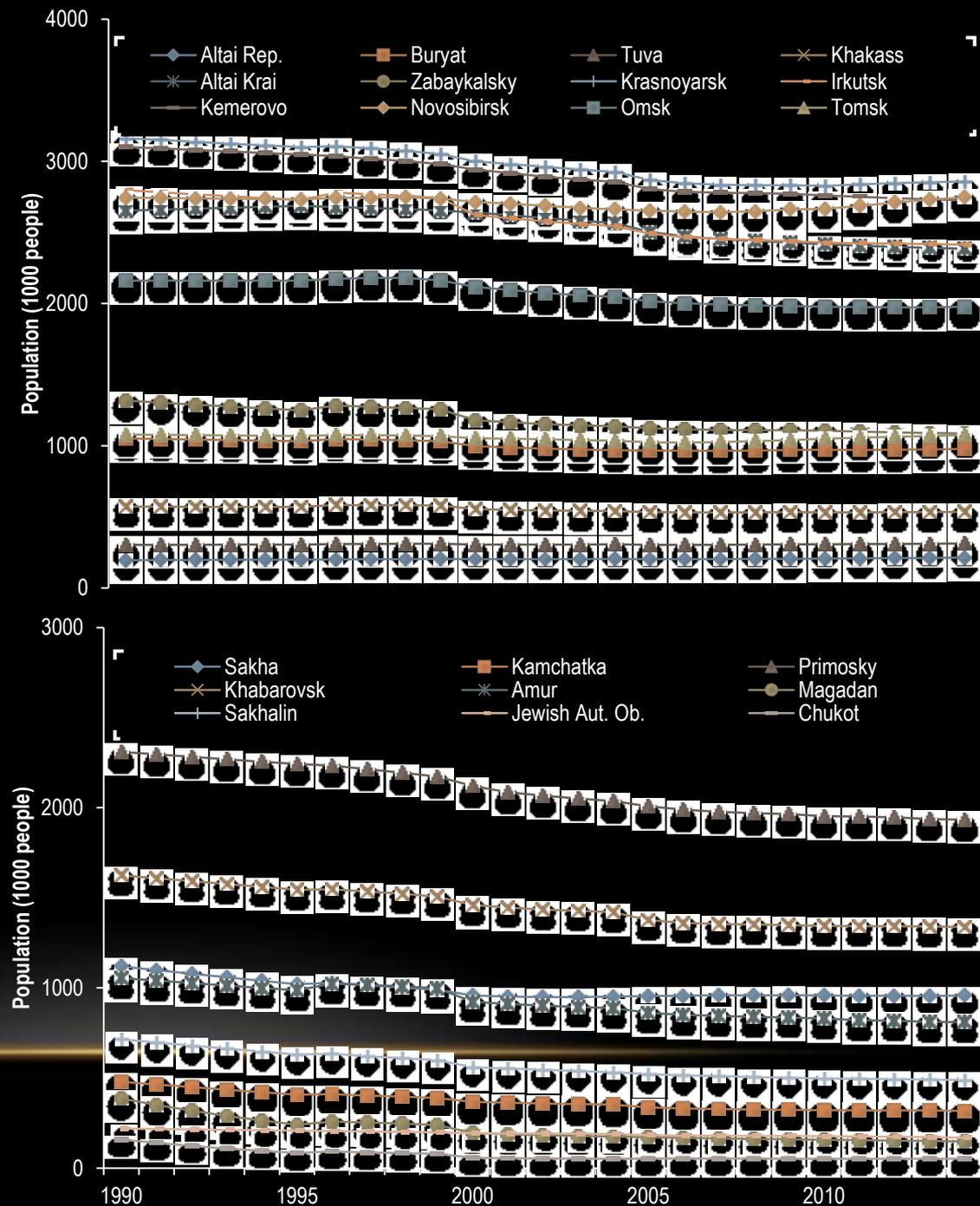
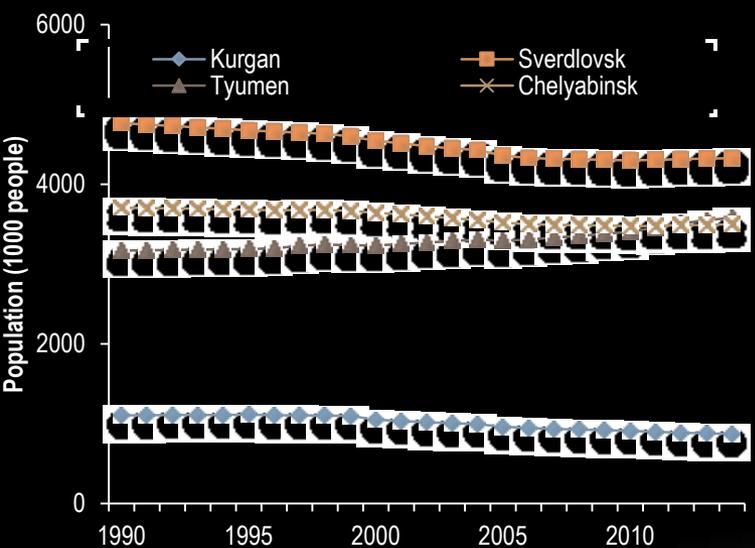
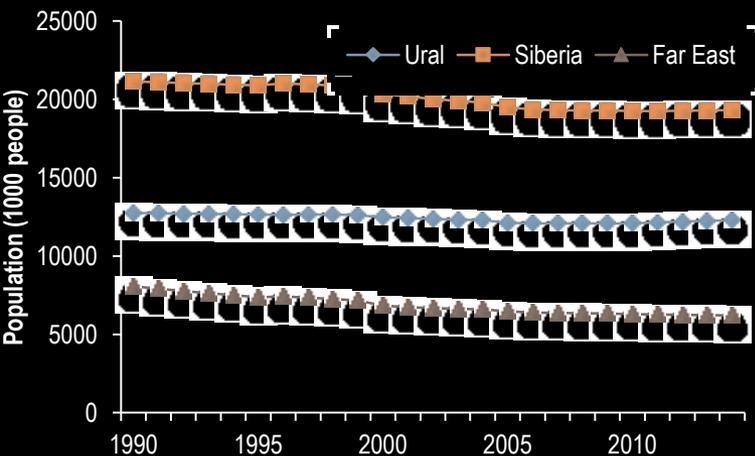
$$EVI = \frac{1}{2}API + \frac{1}{2}WWI$$

$$SDI = \frac{1}{3}DOCI + \frac{1}{3}HUSI + \frac{1}{3}EDUI$$

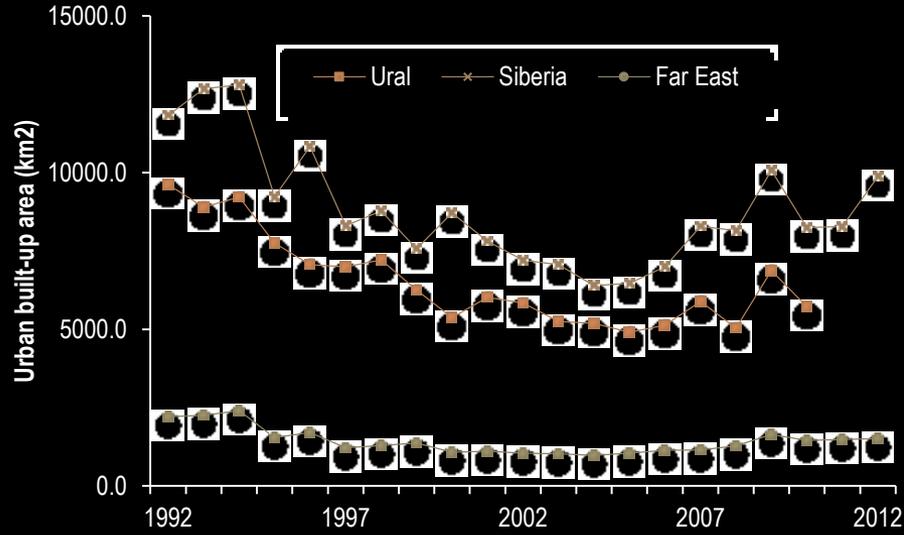
$$RSI = \frac{1}{3}ECI + \frac{1}{3}EVI + \frac{1}{3}SDI$$

(partial & on-going)

# RESULTS

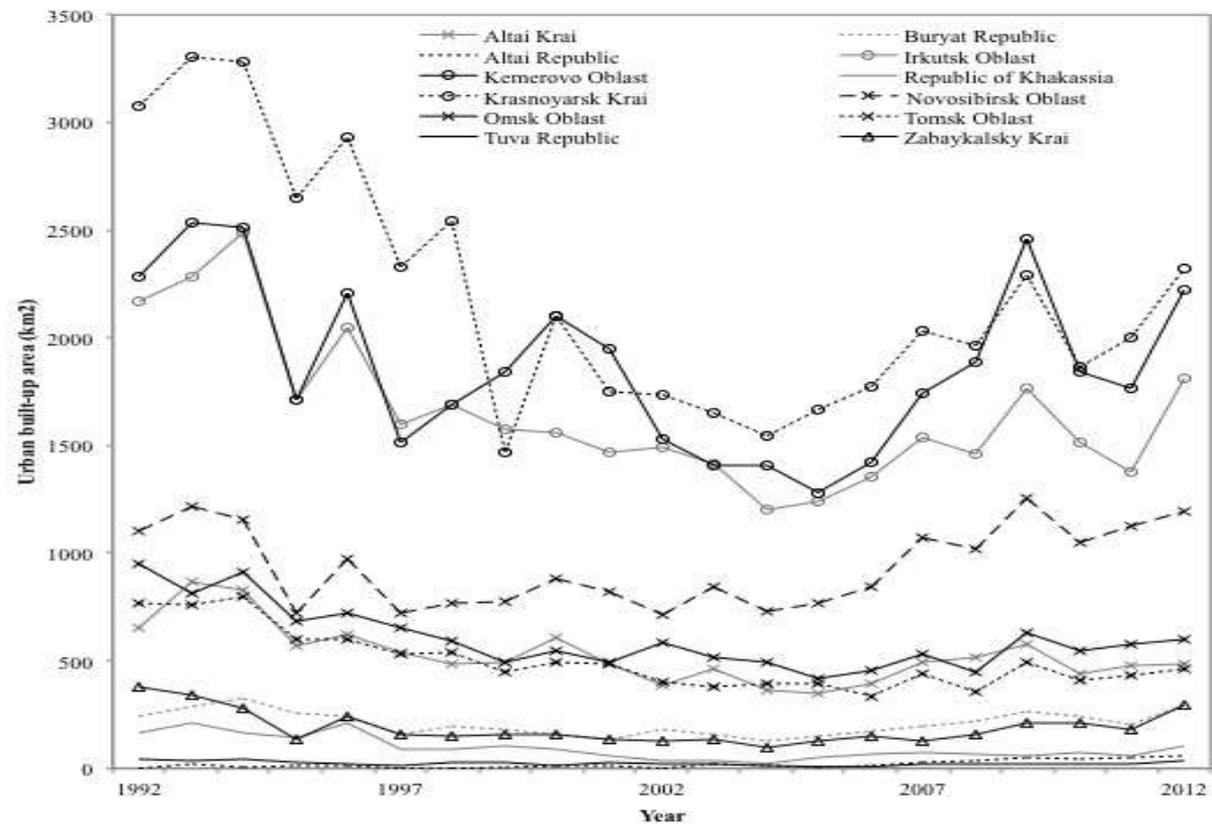


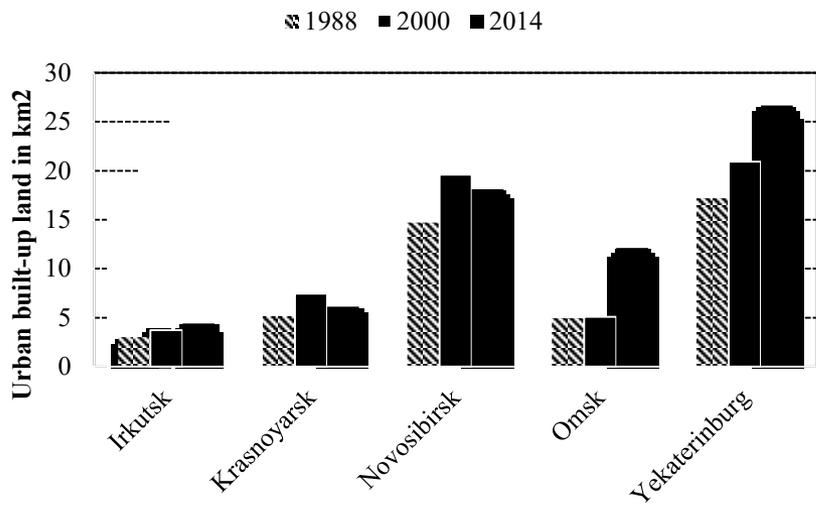
**Population dynamics of North Asia**  
**Total population change in North Asia,**  
**1990-2014**



## Urban built-up land change is more dramatic

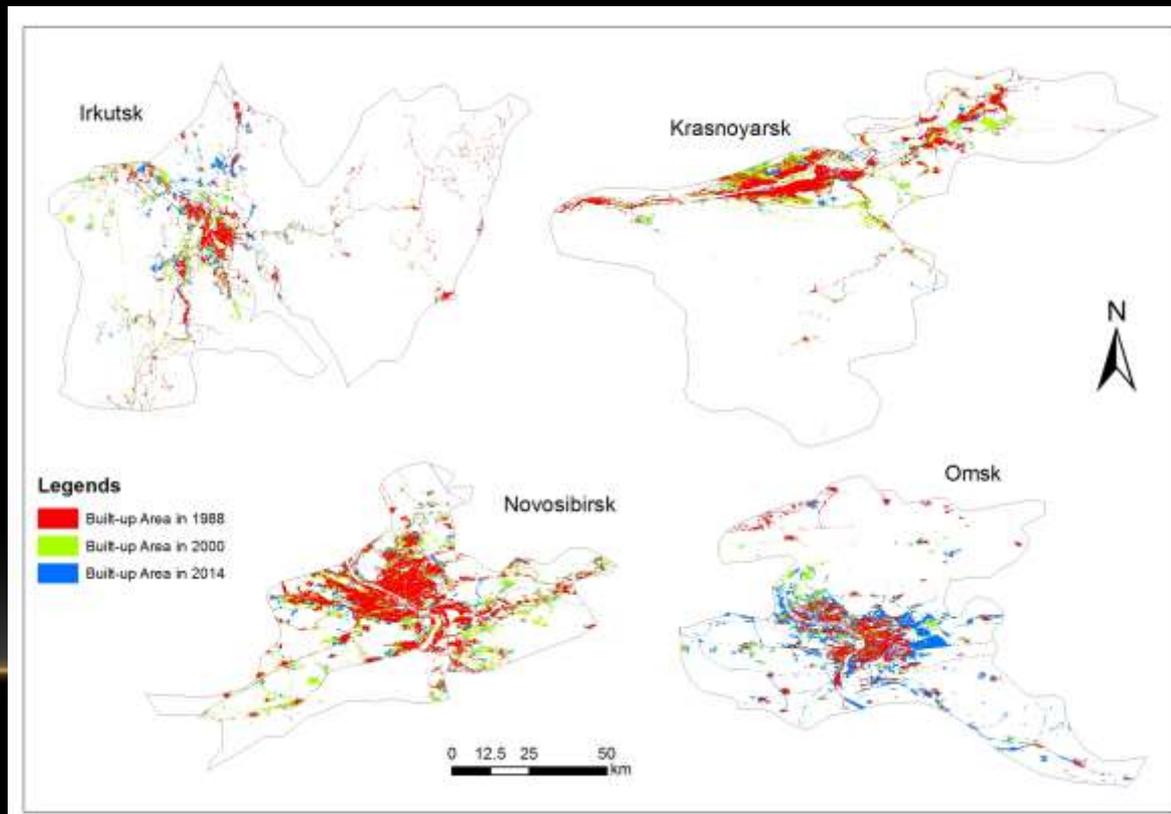
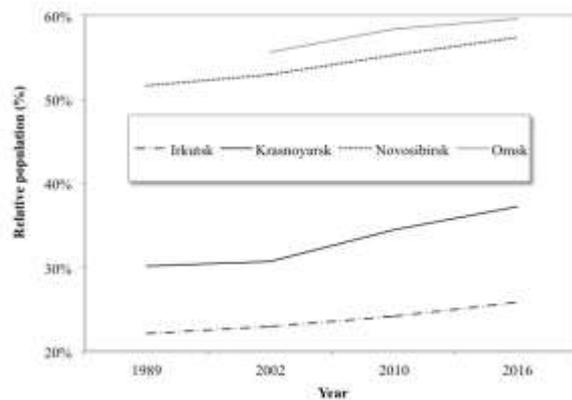
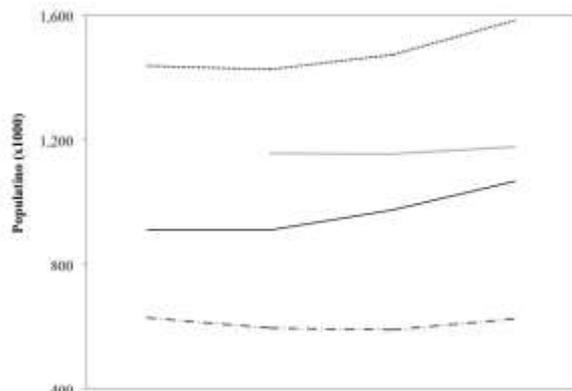
- Significant amount of conversion in the reverse direction at regional level (i.e., de-urbanization)
- Urban built-up land: first decreased then increased but not to recovered to its level of 1992.



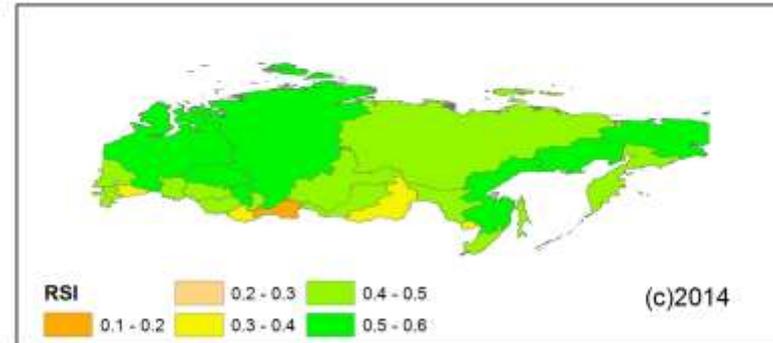
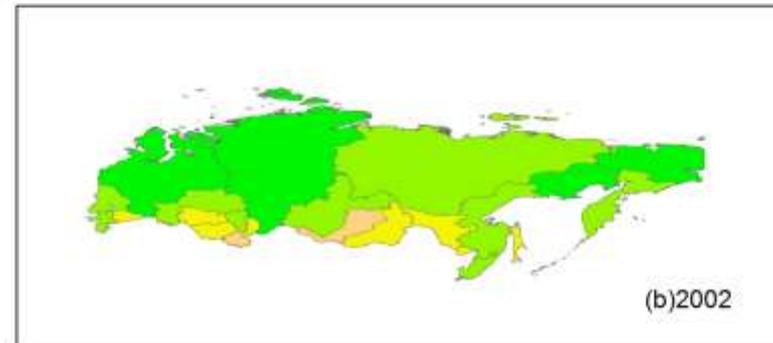
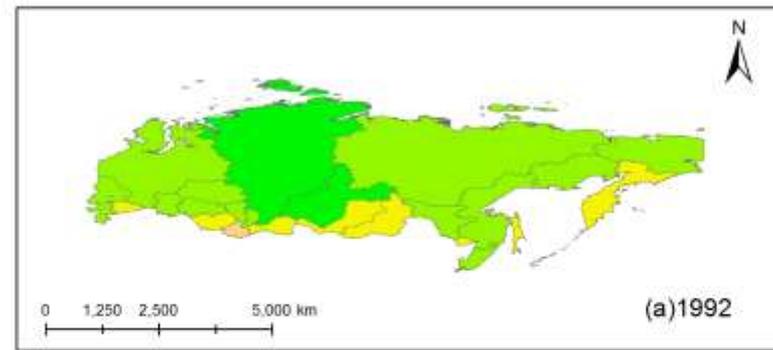
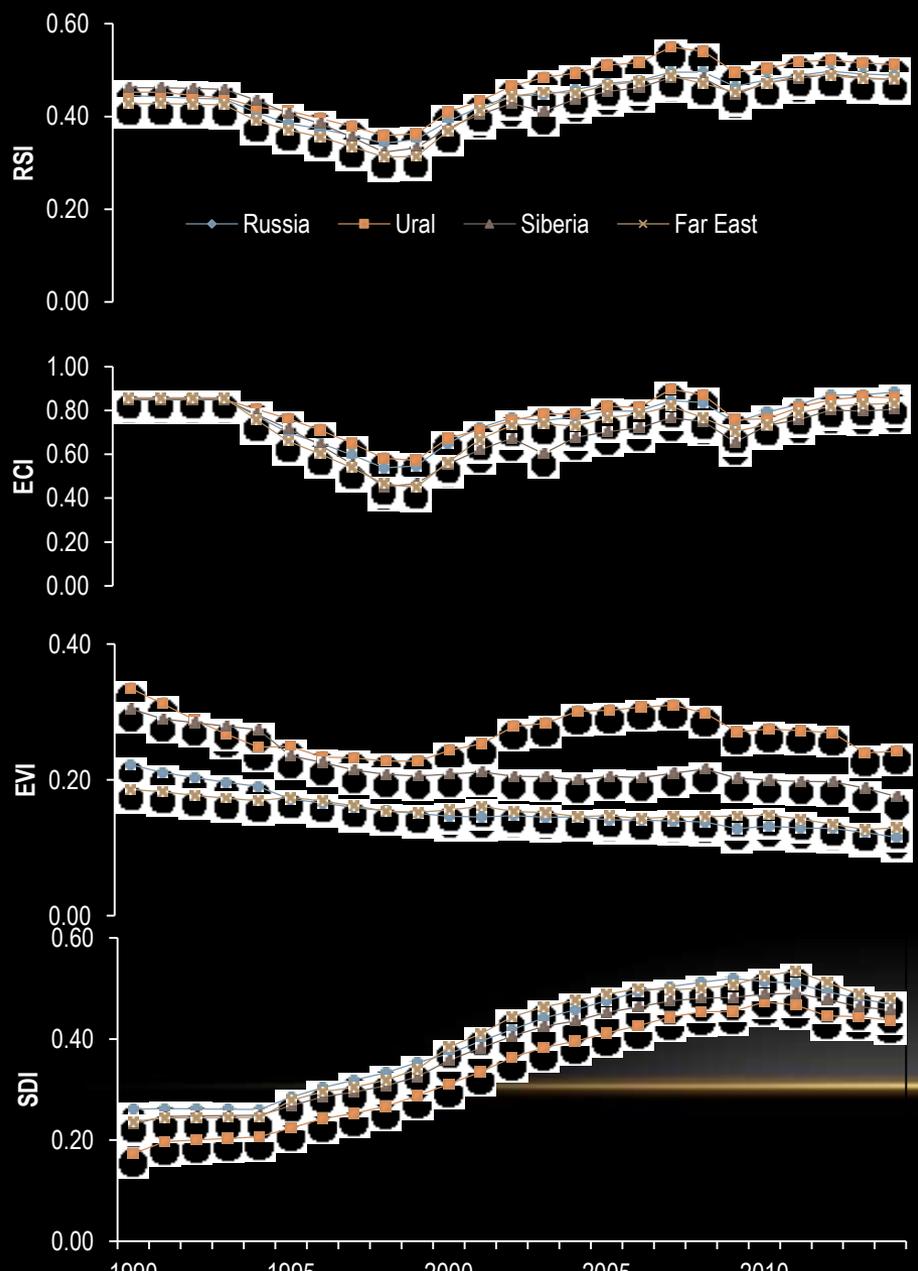


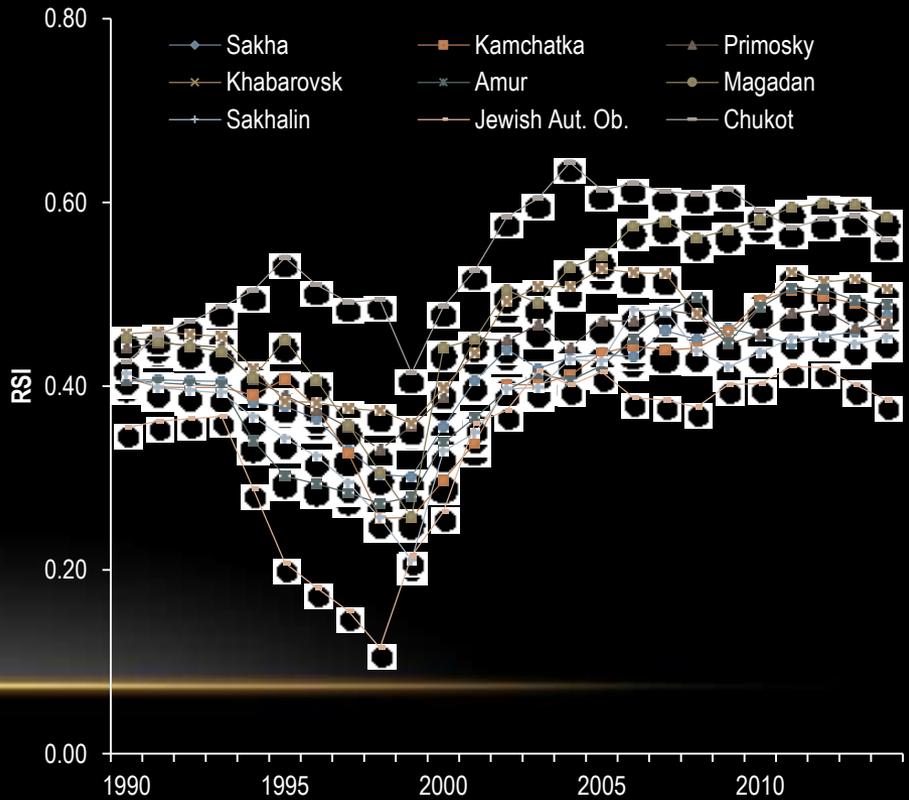
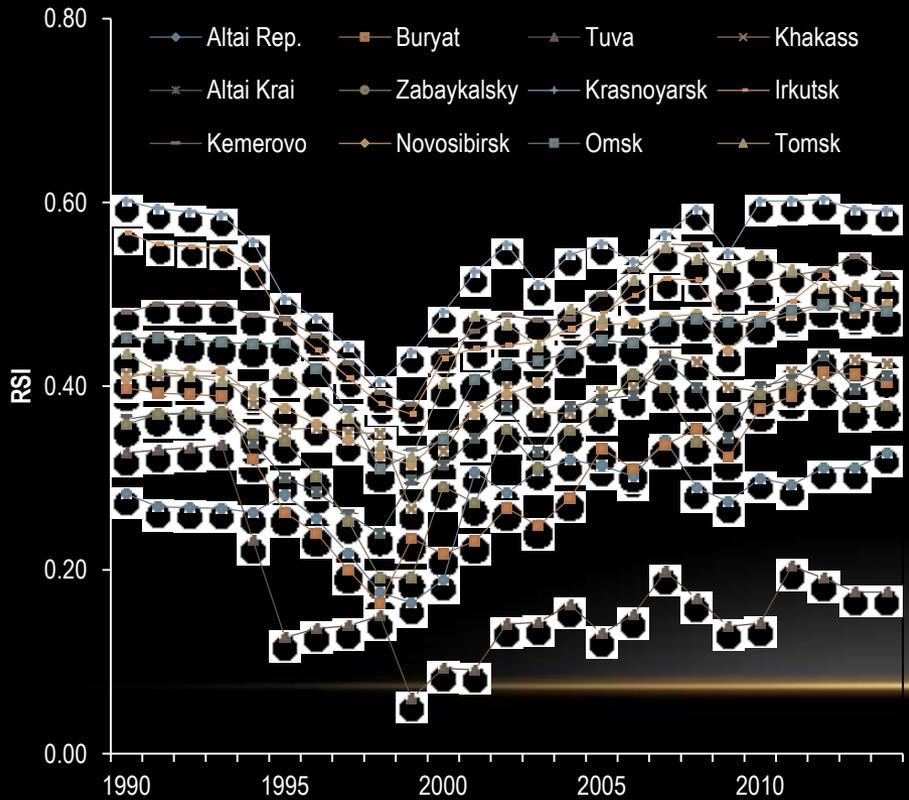
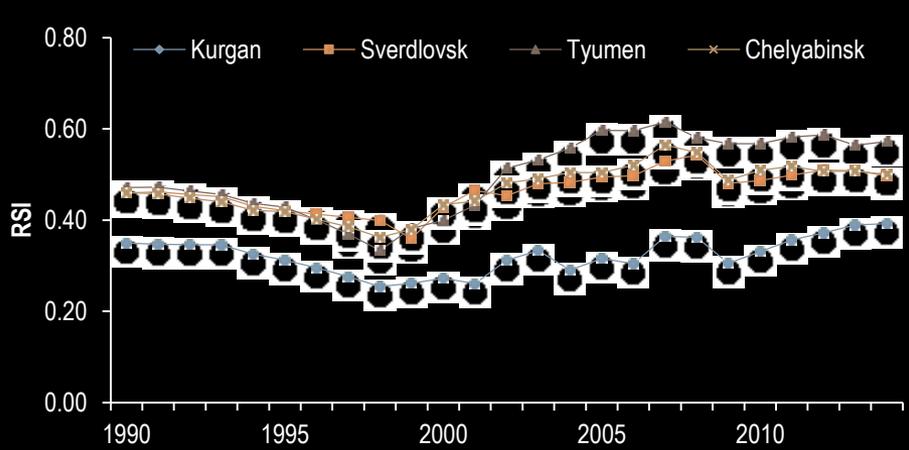
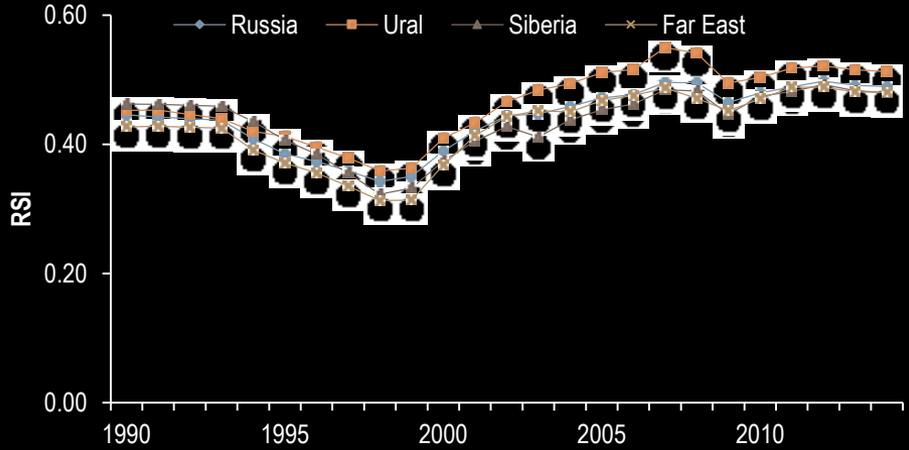
## Urban built up area and population of major cities

- Nevertheless, major cities have experienced an overall urban built-up area expansion and population despite the regional trend.



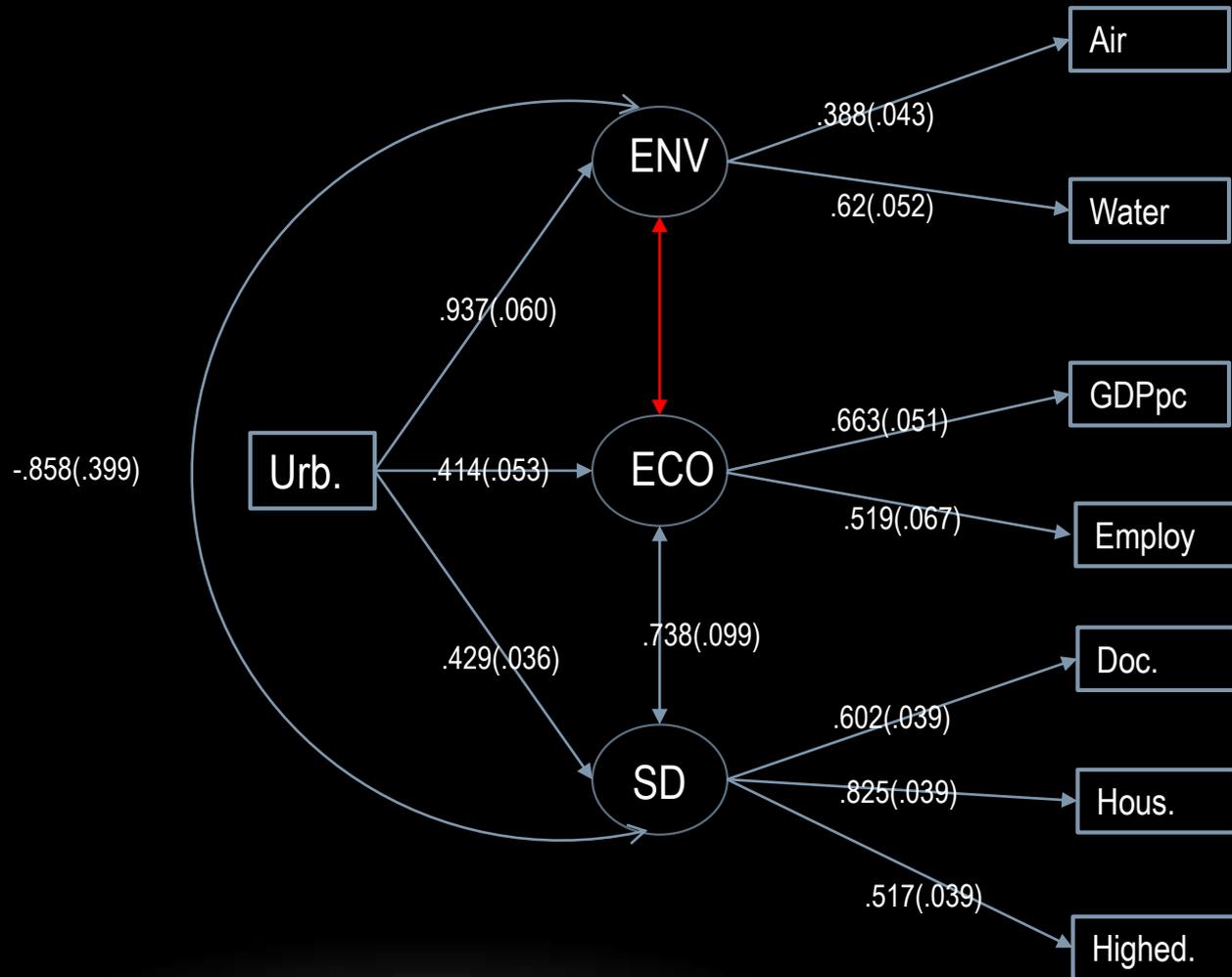
# Sustainability index and its sub-index for the region (RSI, ECI, EVI, SDI)





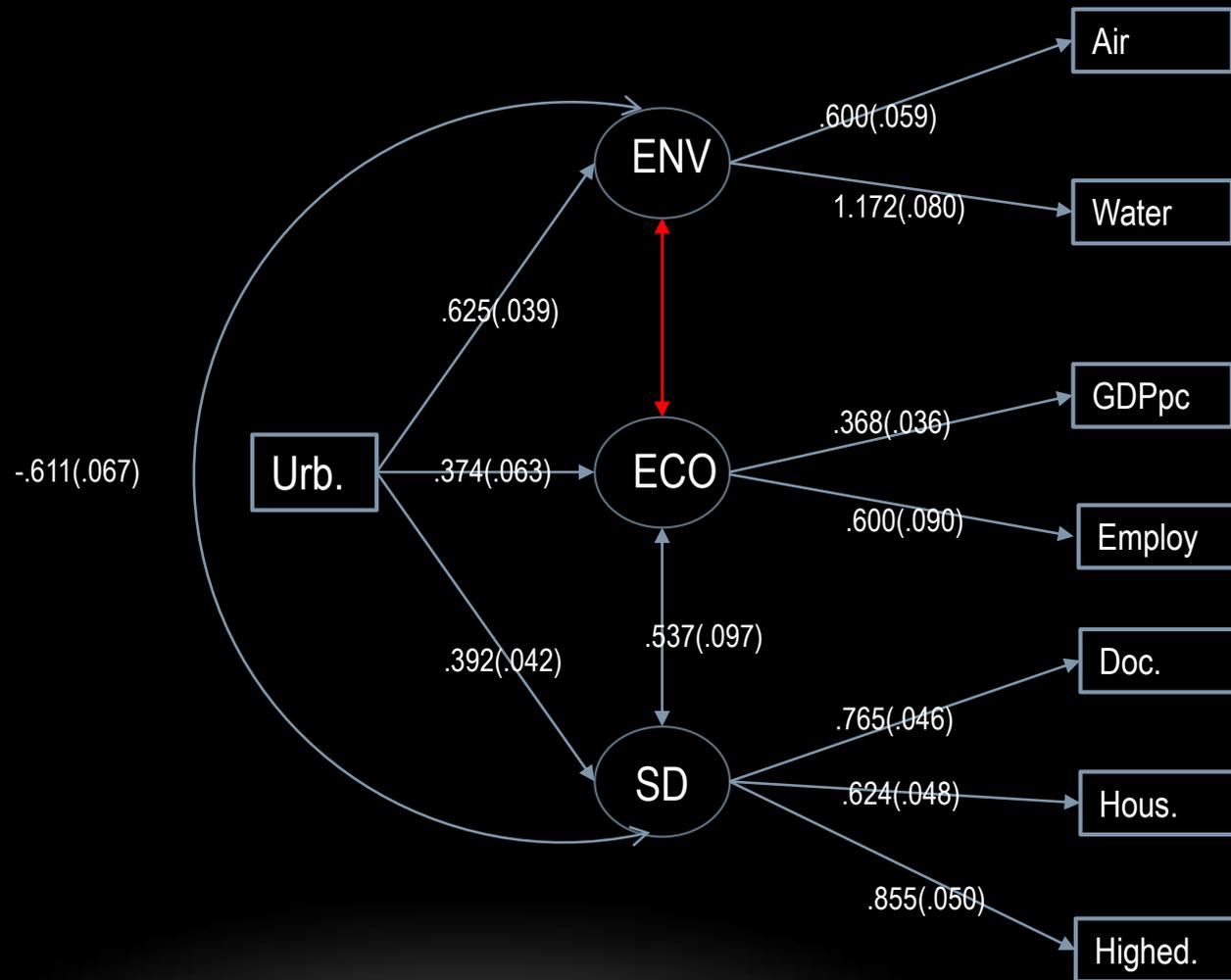
**Sustainability index (RSI) at federal district and federal subject levels**

SEM result  
For North Asia,  
1990-2014

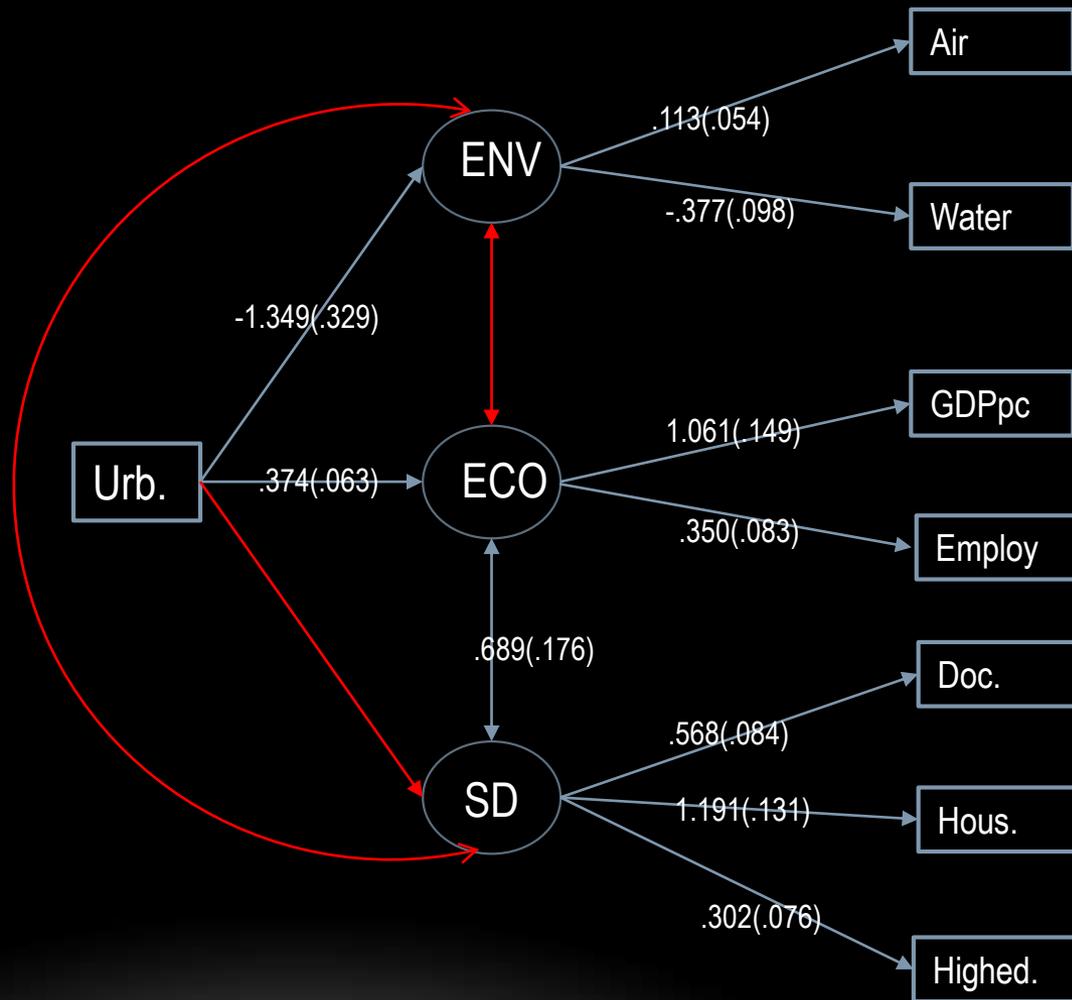


- The SEM model reflects the relationship between urbanization, economic development, environment, and social development.
- The latent variables are labeled in circles and the measured variables are in squares. The path coefficients, describing the relationship between variables, are located on the path
- Note: the numbers on the arrows are loading coefficient (not correlation) and its standard error (in parentheses). Only significant relationships are shown. Red arrow means there is no significant relationships between.

For Siberia



# For Far East



# SUMMERY

- **Urban built-up land change is more dramatic**
  - Significant amount of conversion in the reverse **direction at regional level (i.e., de-urbanization)** Urban built-up land: first decreased then increased but not to recovered to its level of 1992.
  - Nevertheless, **major cities have experienced an overall urban built-up area expansion** despite the regional trend.
- **Sustainability index and its sub-index for the region (RSI, ECI, EVI, SDI)**
  - Mostly closely follow the national trend; decreasing value till 2000, then increasing for RSI and ECI , EVI continuously decreasing, SDI continuously increasing
  - Divergence at the (federal subject) level
- SEM analysis:
  - strong relationships between EC and SD, EV and SD
  - urbanization as main driver for environment pressure and economic development



City Center of Novosibirsk, May 2015, photo by Peilei Fan

Comments & questions?

THANK YOU!  
БОЛЬШОЕ СПАСИБО!