

Multi-scale and multi-sensor analysis of urban cluster development and agricultural land loss in China and India

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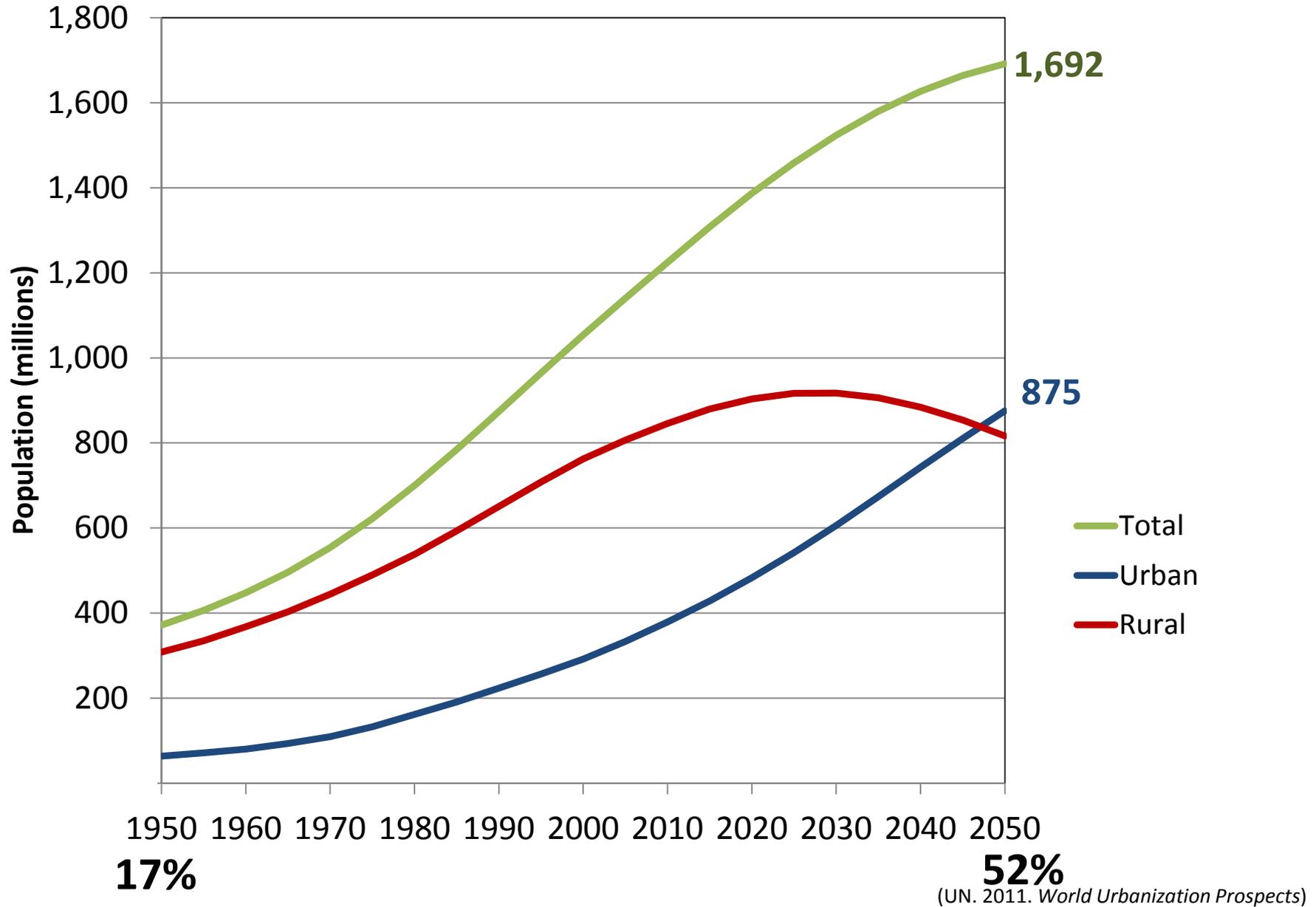


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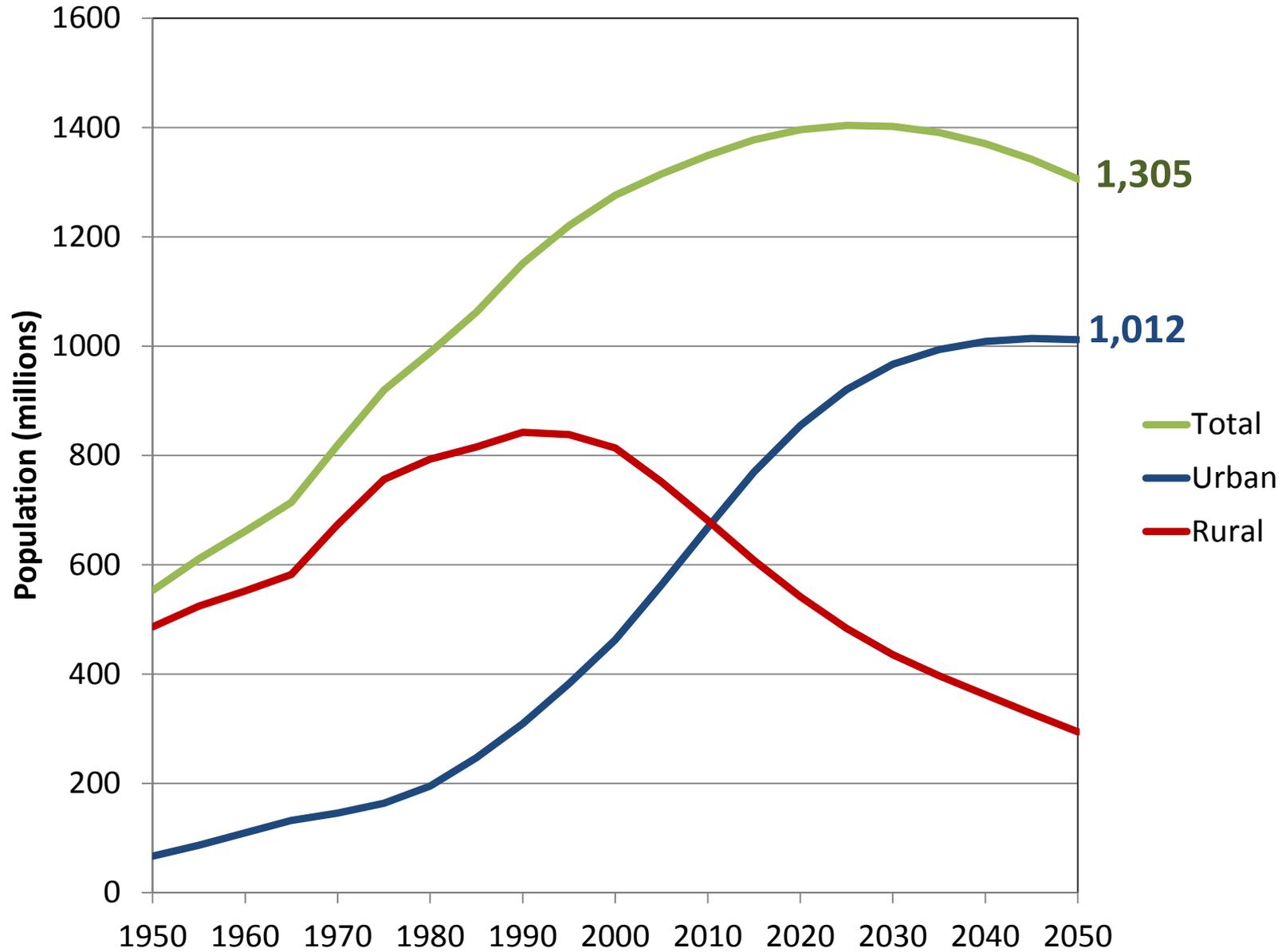
Project Goals

1. Detect and quantify the growth of **urban cluster hot spots** in China and India.
2. Identify **agricultural land loss** in urban cluster hot spots and when they occurred.
3. Explain the **drivers of the growth of urban clusters** and urban land conversion within them.

India's urban population: Peaking in second half of 21 C



China's urban population: Peaking in first half of 21 C

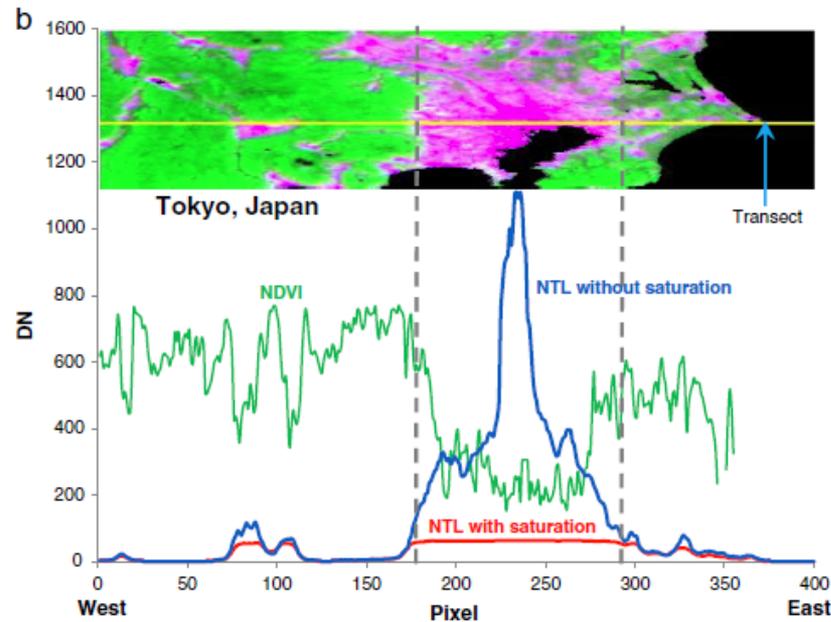


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77%
(UN. 2011. *World Urbanization Prospects*)

Vegetation Adjusted NTL Urban Index to identify urban clusters

$$\text{VANUI} = (1 - \text{NDVI}) * \text{NTL}$$



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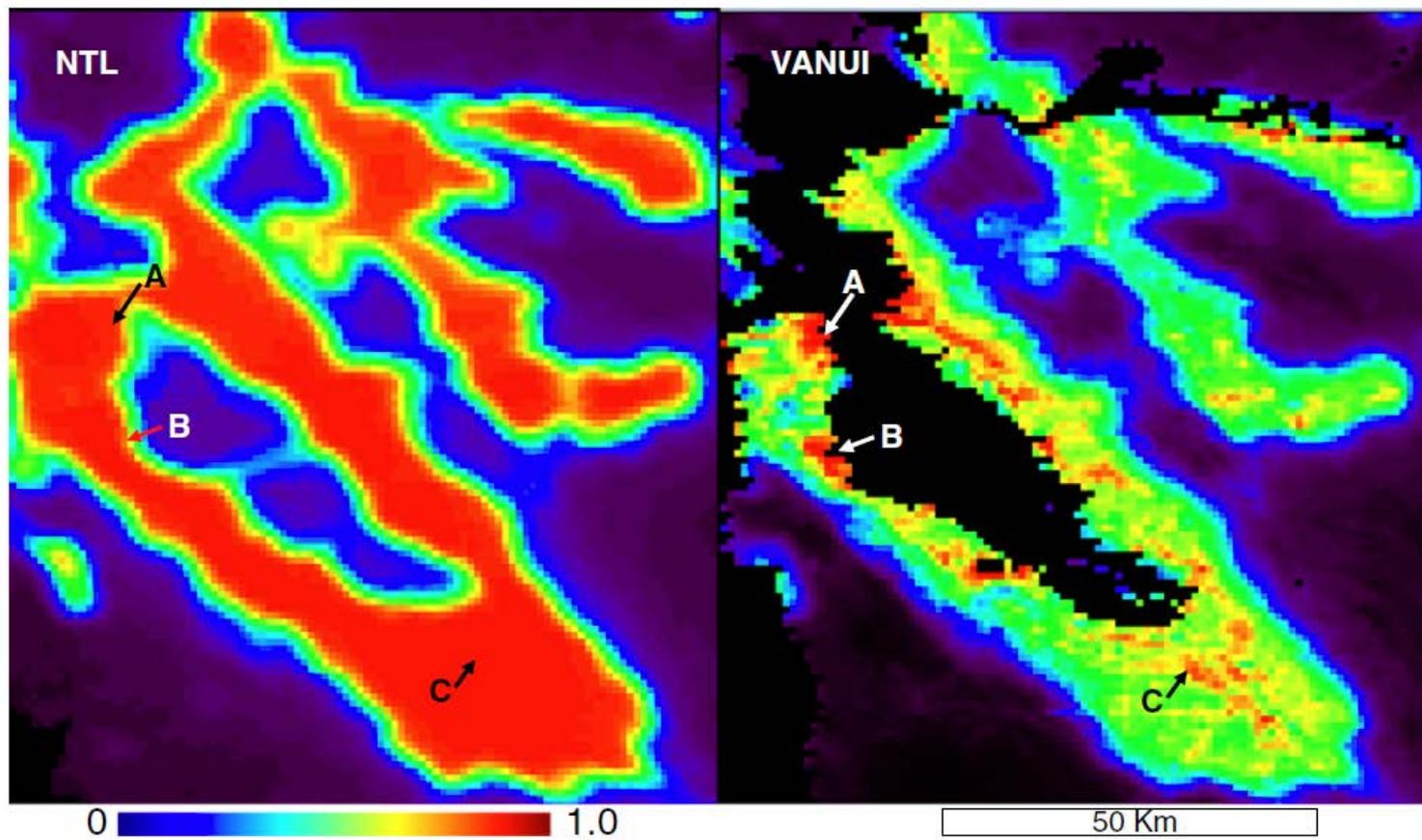


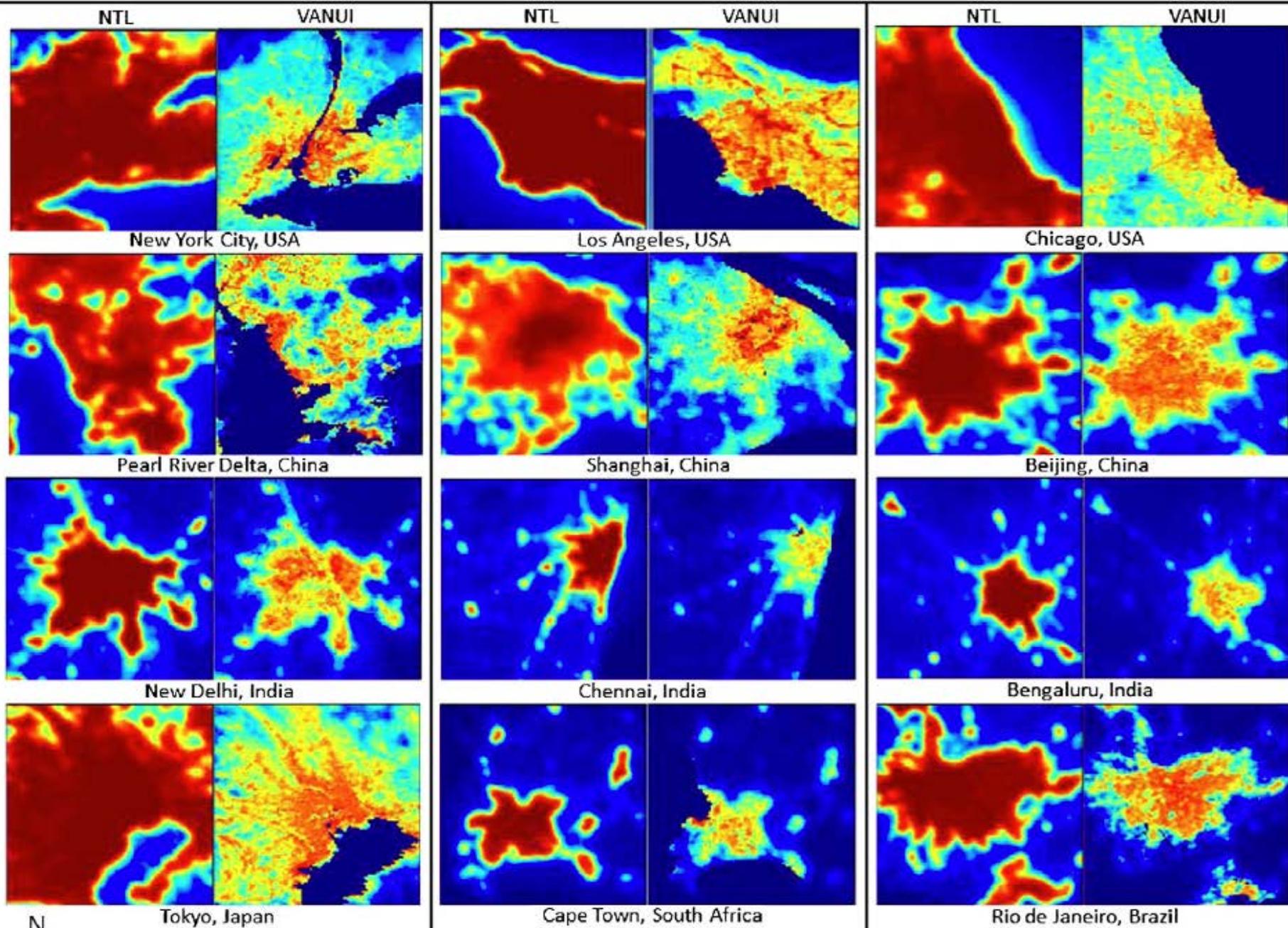
The Vegetation Adjusted NTL Urban Index: A new approach to reduce saturation and increase variation in nighttime luminosity

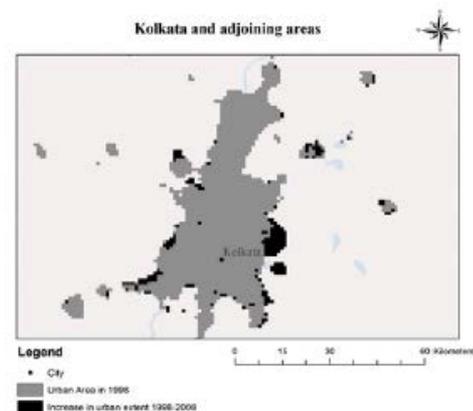
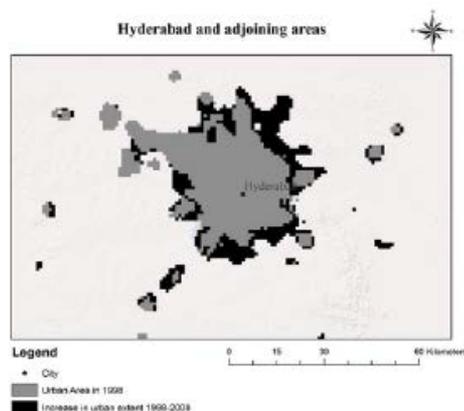
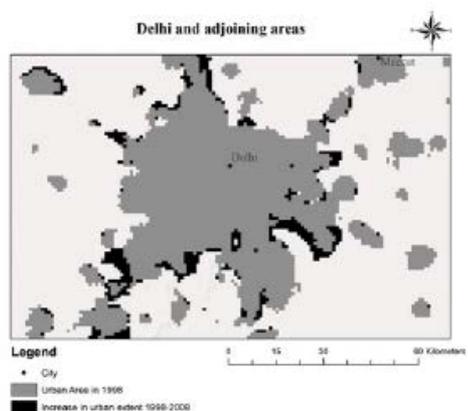
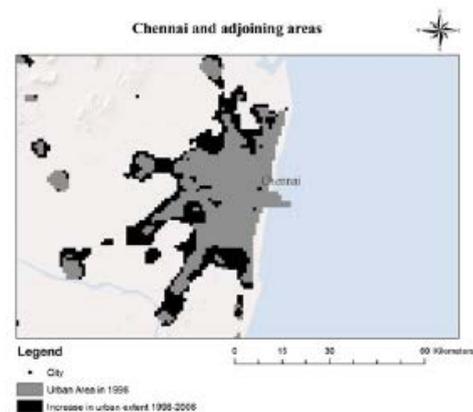
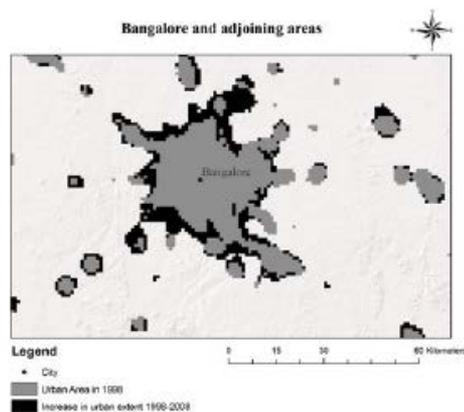
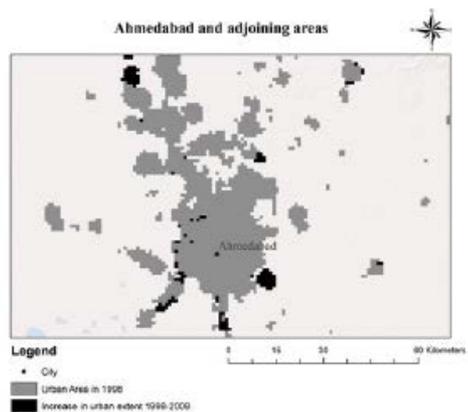
Qingling Zhang ^{a,*}, Crystal Schaaf ^b, Karen C. Seto ^a

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^b University of Massachusetts, Boston, 100 Morrissey Blvd, Boston, MA 02125, United States







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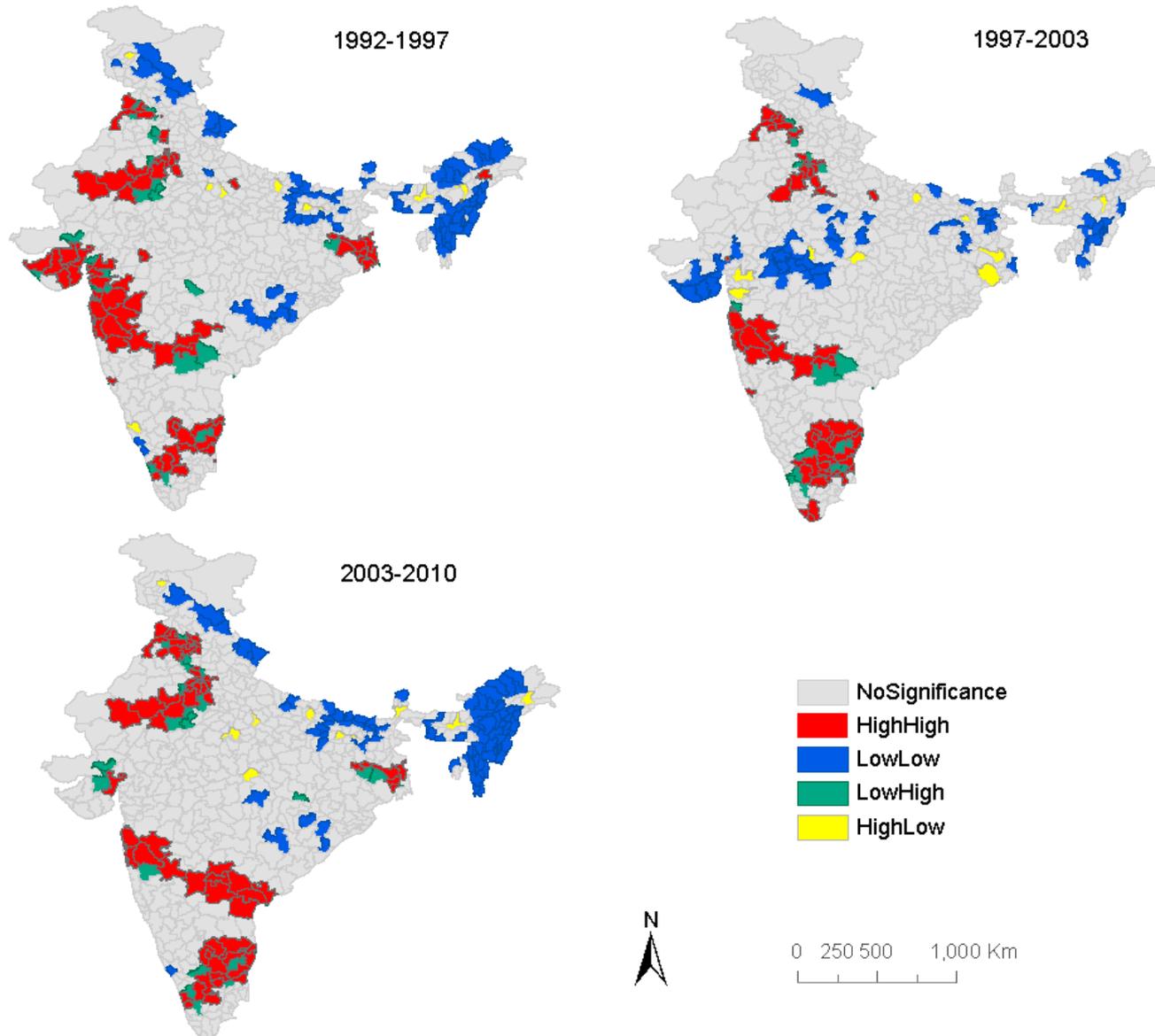
Monitoring urbanization dynamics in India using DMSP/OLS night time lights and SPOT-VGT data

Bhartendu Pandey^a, P.K. Joshi^{a,*}, Karen C. Seto^b

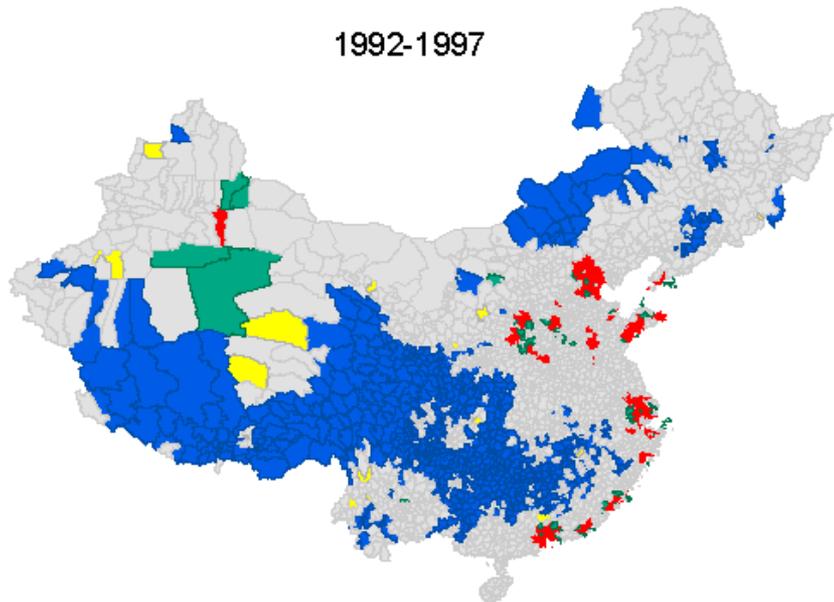
^a Department of Natural Resources, TERI University, New Delhi, India

^b Yale School of Forestry & Environmental Studies, Yale University, New Haven, CT, United States

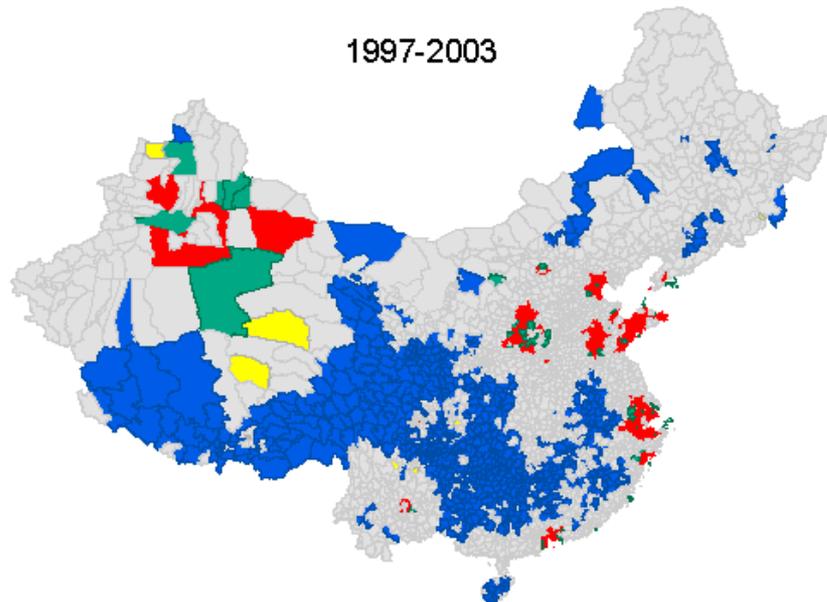
Goal 1: MODIS and DMSP OLS to identify urban cluster hot spots



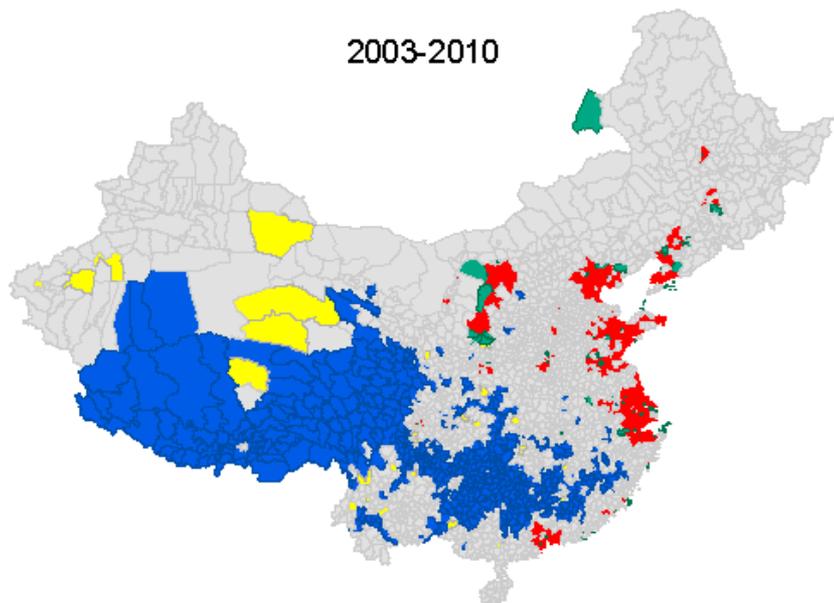
1992-1997



1997-2003



2003-2010



A global fingerprint of macro-scale changes in urban structure from 1999 to 2009

Steve Frohking^{1,2,5}, Tom Milliman¹, Karen C Seto³ and Mark A Friedl⁴

¹ Institute for the Study of Earth, Oceans, and Space, University of New Hampshire, Durham, NH 03824, USA

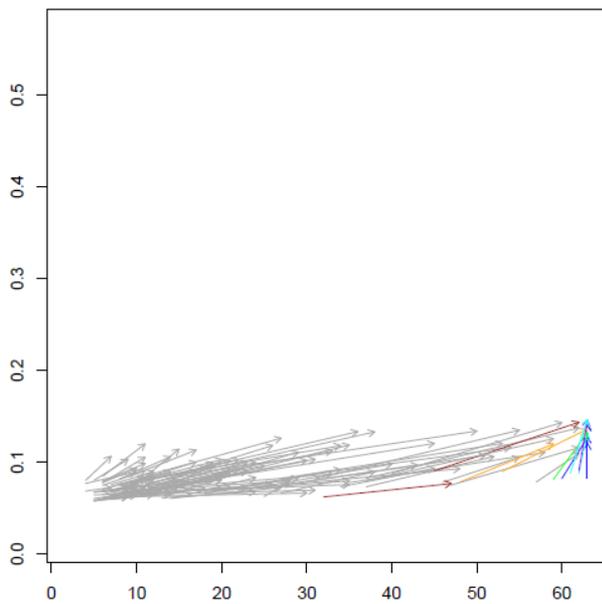
² Department of Earth Sciences, University of New Hampshire, Durham, NH 03824, USA

³ School of Forestry and Environmental Studies, Yale University, New Haven, CT 06511, USA

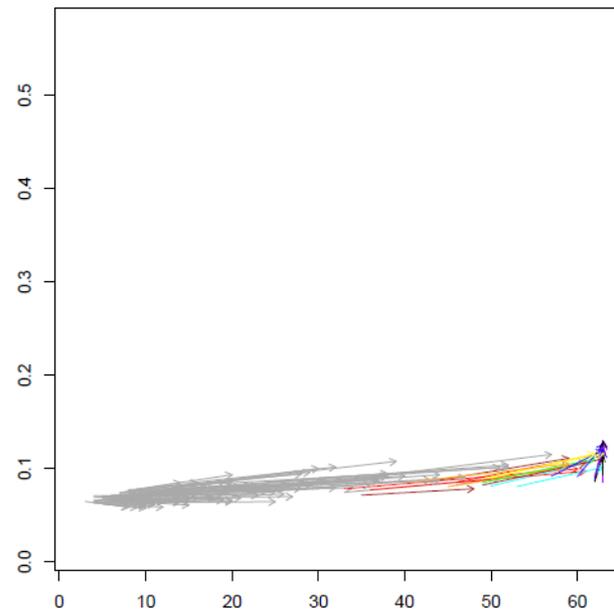
⁴ Department of Earth and Environment, Boston University, Boston, MA 02215, USA

E-mail: steve.frohking@unh.edu, thomas.milliman@unh.edu, karen.seto@yale.edu
and friedl@bu.edu

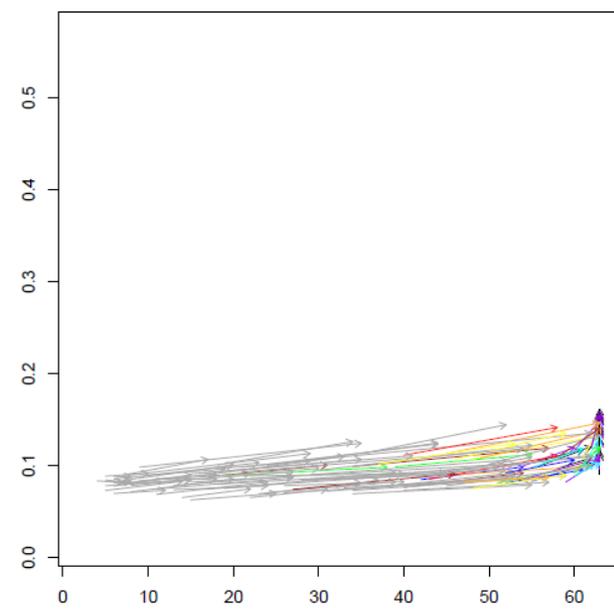
Bangalore



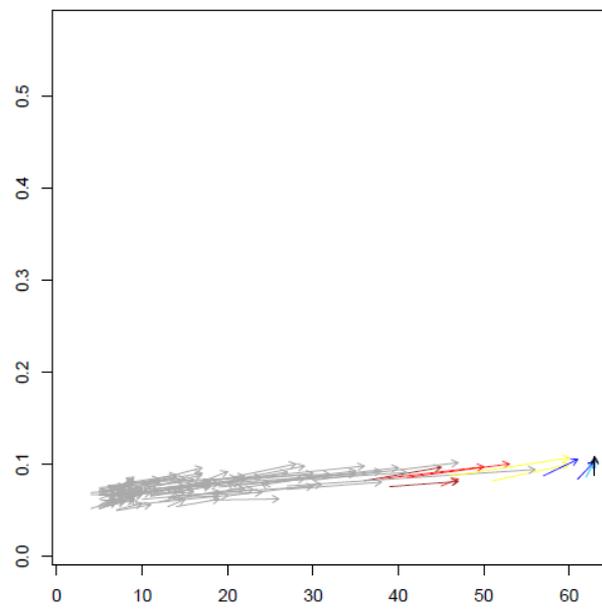
Hyderabad



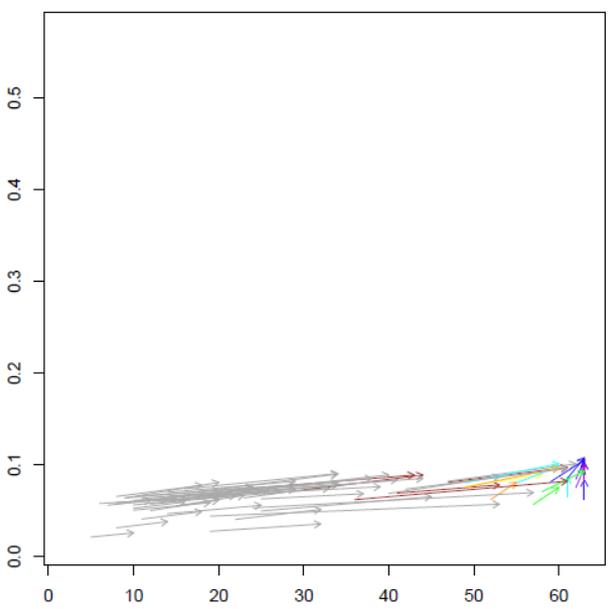
Delhi_(National_Capital_Region)



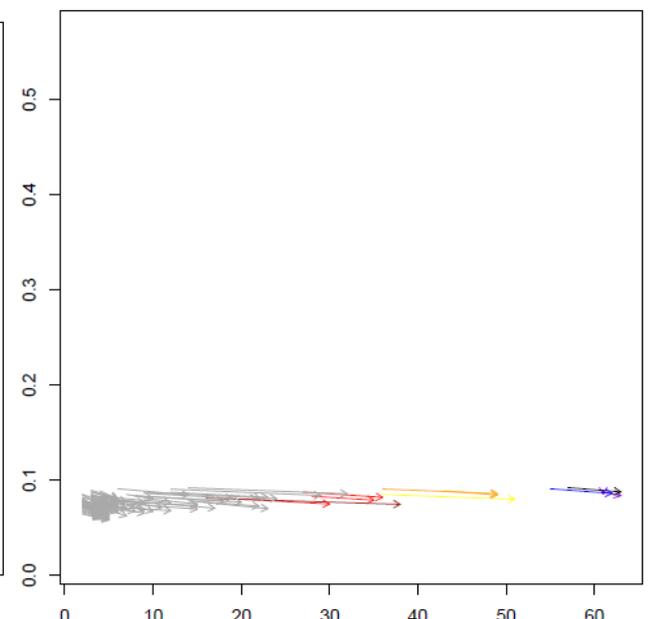
Ahmedabad



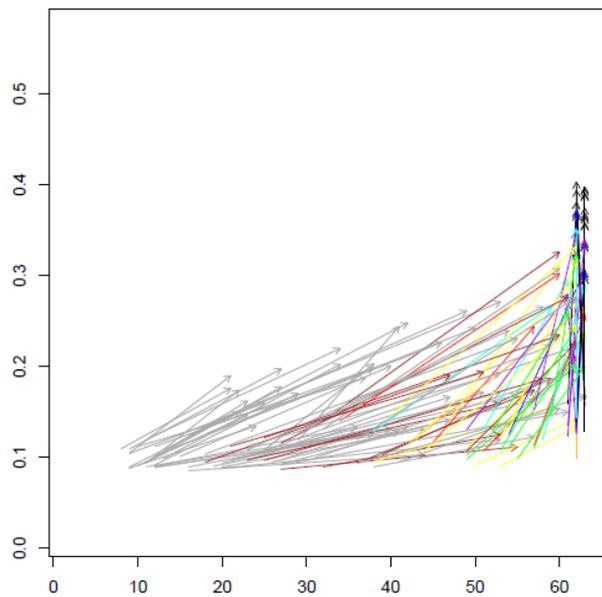
Chennai_(Madras)



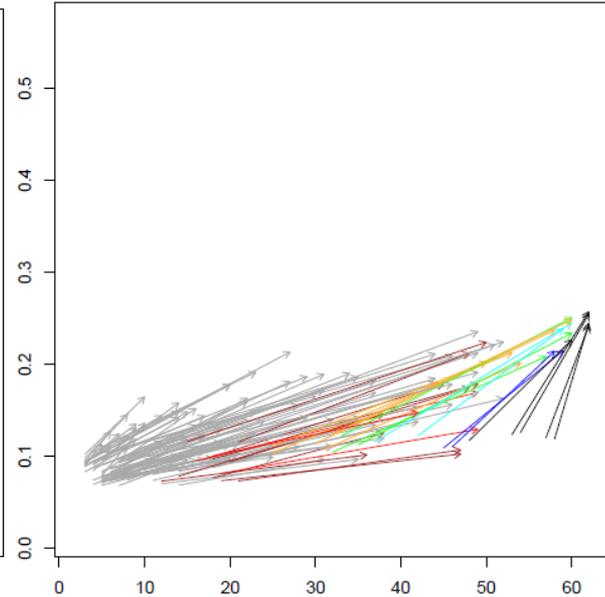
Kanpur_(Cawnpore)



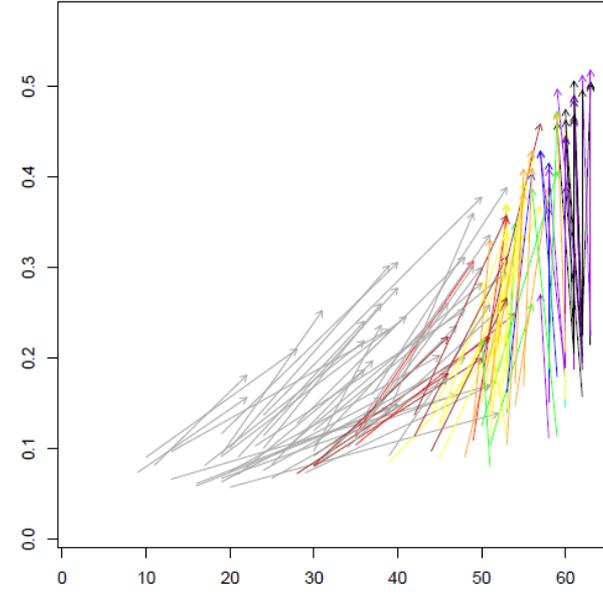
Beijing



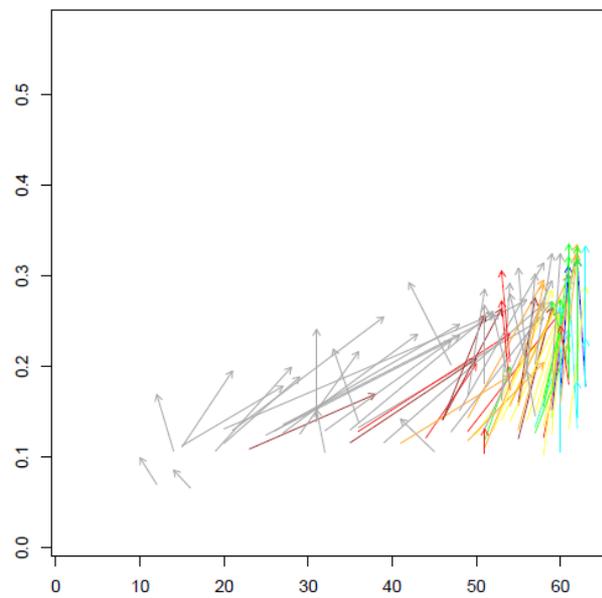
Chengdu



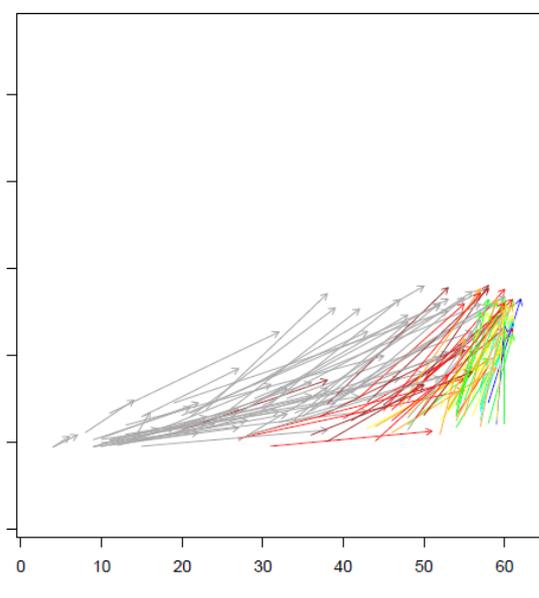
Shanghai



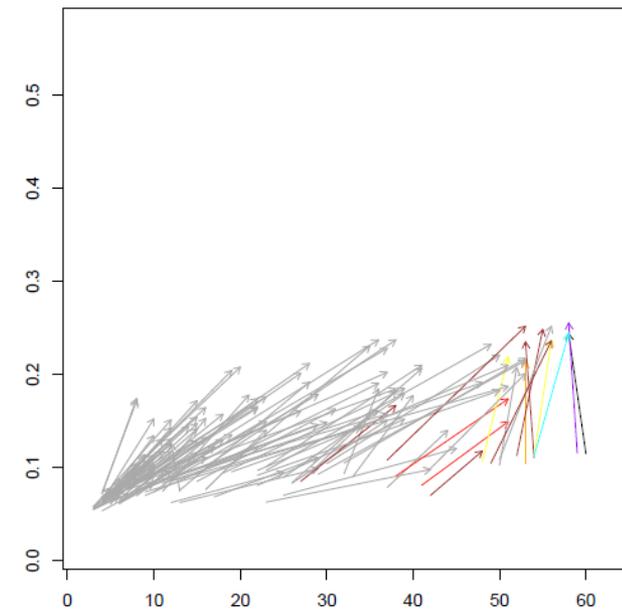
Shenzhen



Dongguan



Nanjing



Urban centers are dense but buildings often do not rise above 3-4 stories



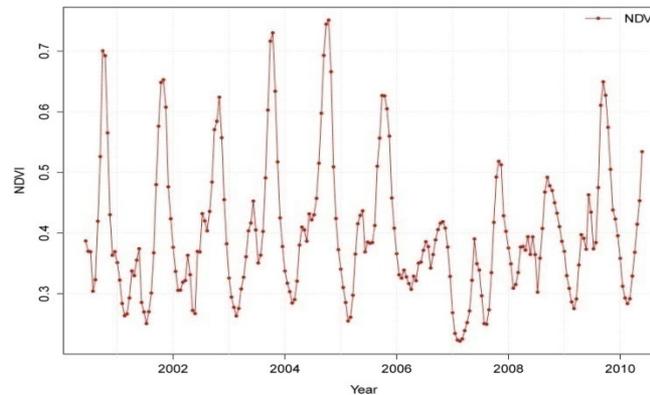


High rise residences are common in peri-urban areas

KEY MESSAGES FROM GOAL 1

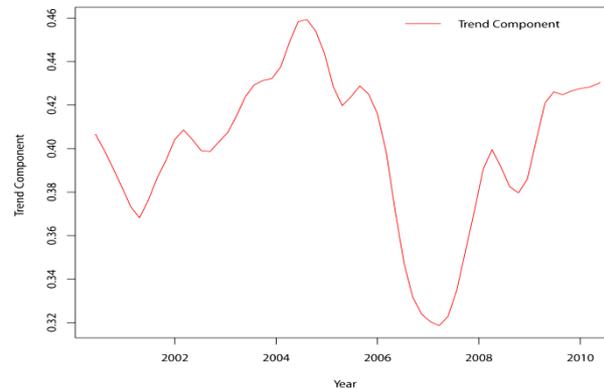
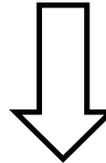
- Chinese cities are building up and out
- Indian cities are primarily building out
- Urban hot spots do not change significantly due to inertia and agglomeration economies
- Growing concentration of activities and resources in urban hot spots
- Little urban growth spillover around Indian cities
- Different magnitudes and rates of growth

Goal 2: Identify agricultural land loss in urban cluster hot spots



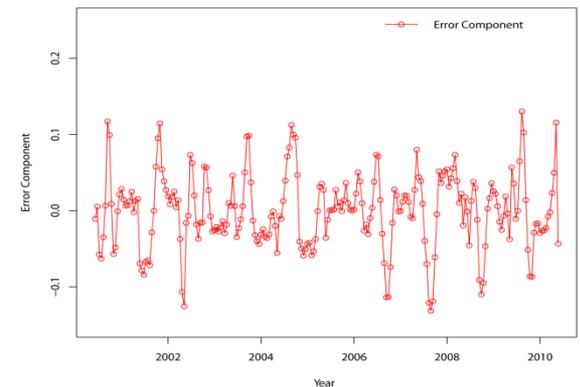
Filtered Time Series

Additive Decomposition using LOESS method (Cleveland et al. 1990)

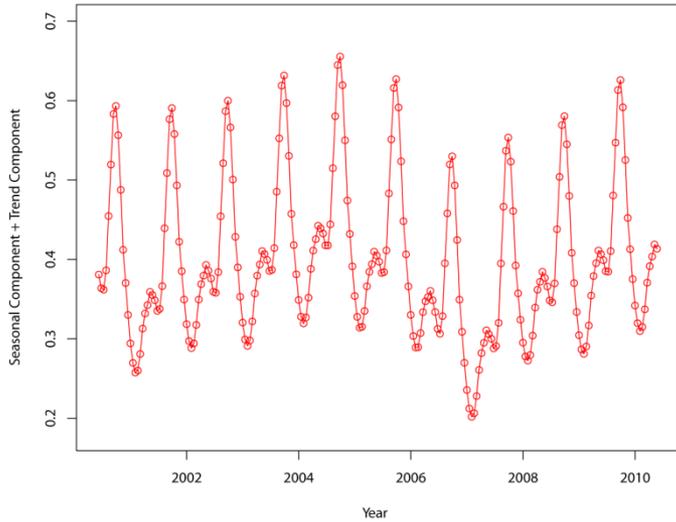


Seasonal Component

Trend Component



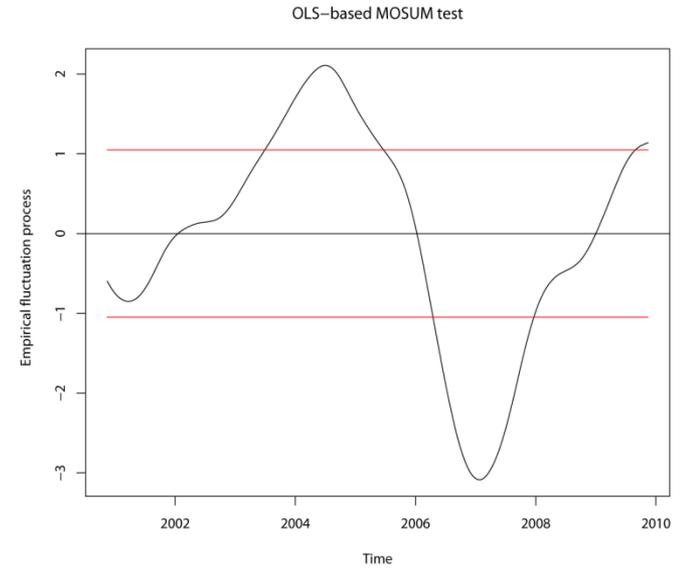
Error Component



Seasonal + Trend Component

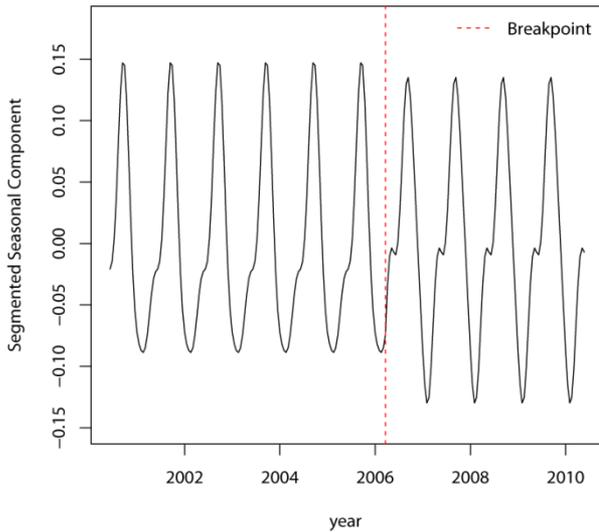
OLS- MOSUM Test

$H_0 = \text{No structural change}$



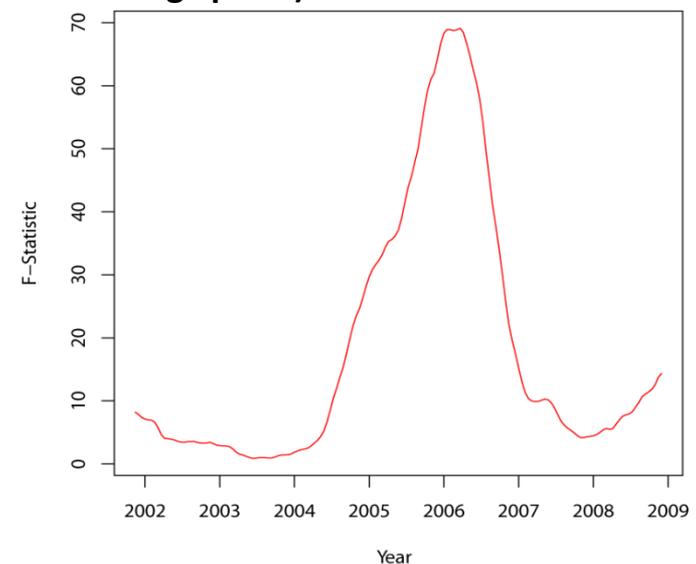
Structural Break Present
 $\alpha = 0.05$ ($p = 0.01$)

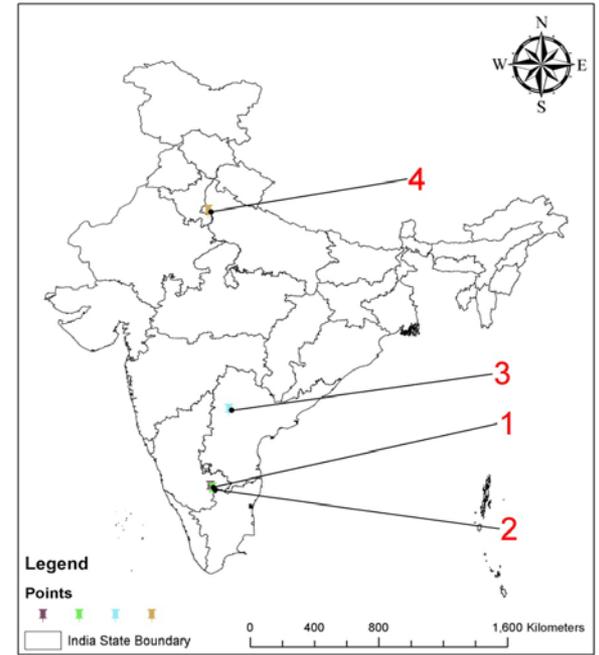
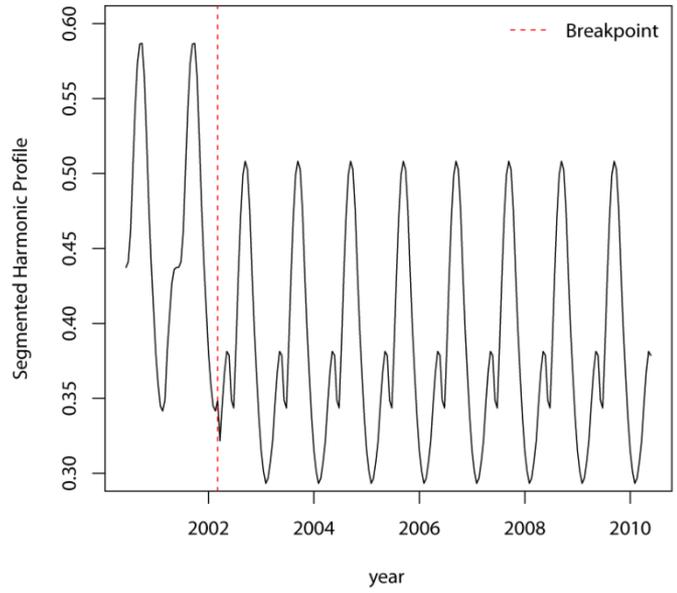
Compute F-Statistic to identify change point (Chow Test for statistical significance of change point)



Change estimated in 2006

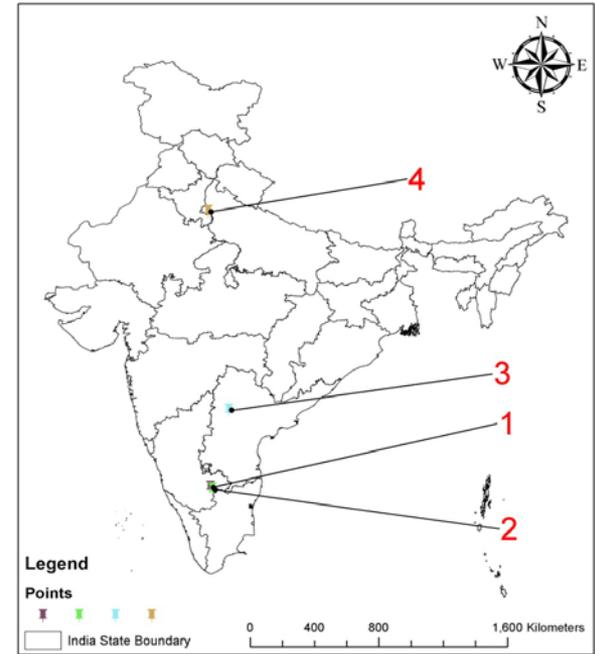
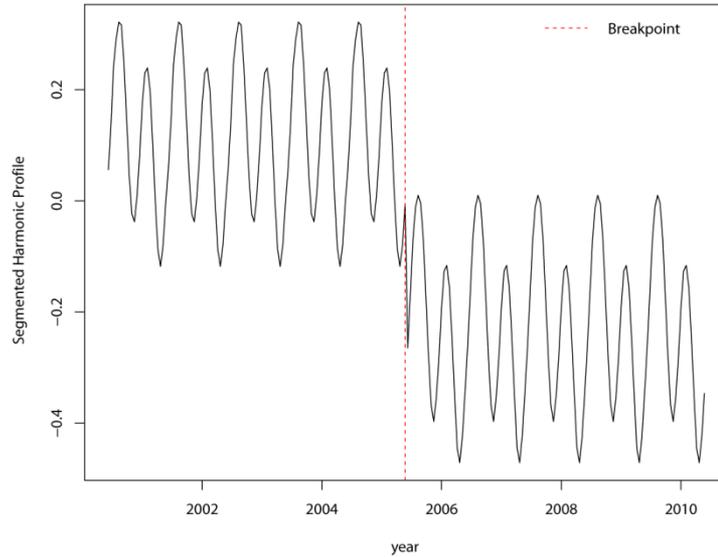
Segmented Seasonal Component





Change estimated in 2002



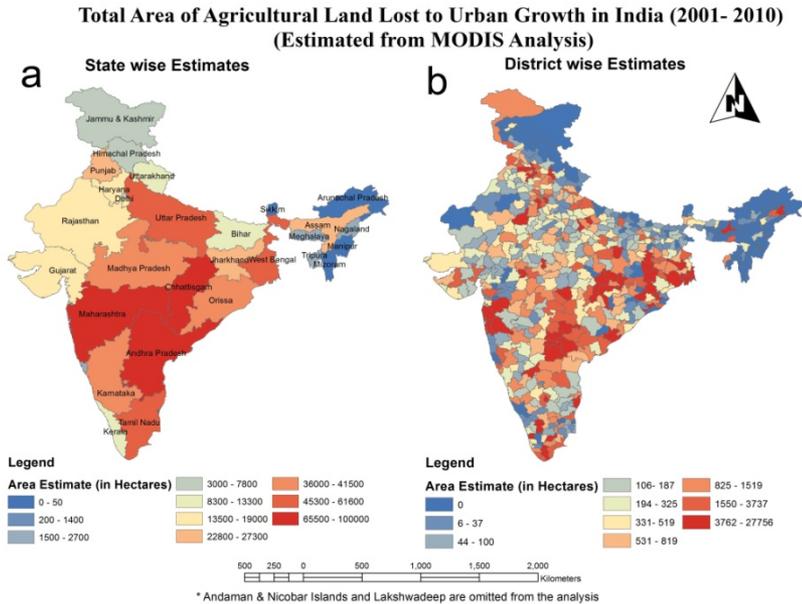


Change estimated in 2005



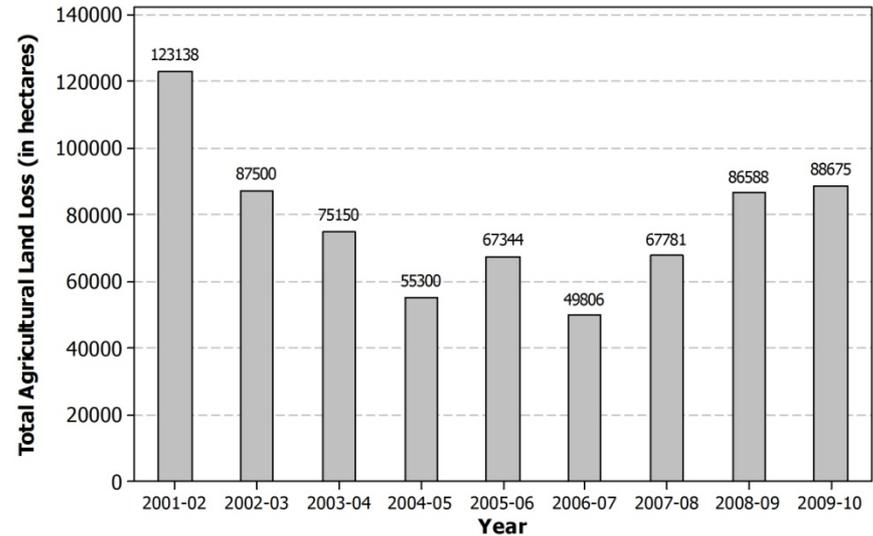
Key Findings

Amount of agricultural land loss



- During 2001 – 2010, India lost 0.7 million hectares (roughly five times the size of Delhi) of its agricultural land to urban growth.
- Agricultural land loss in each state is less than 1% of its total geographical area
- Agricultural land loss is lower in the northeastern states compared to other states.

Trends in agricultural land loss



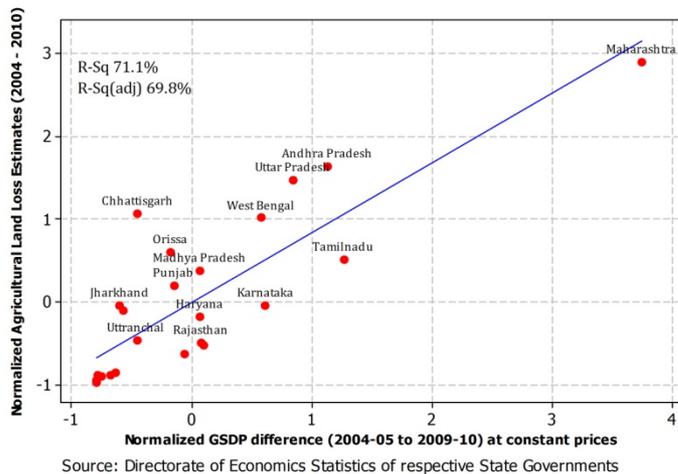
- The total amount of agricultural land lost to urban growth was highest (0.12 million hectares) in the one year period from June 2001 to May 2002.
- Since 2006, the amount of agricultural land converted has been increasing steadily.

Key Findings

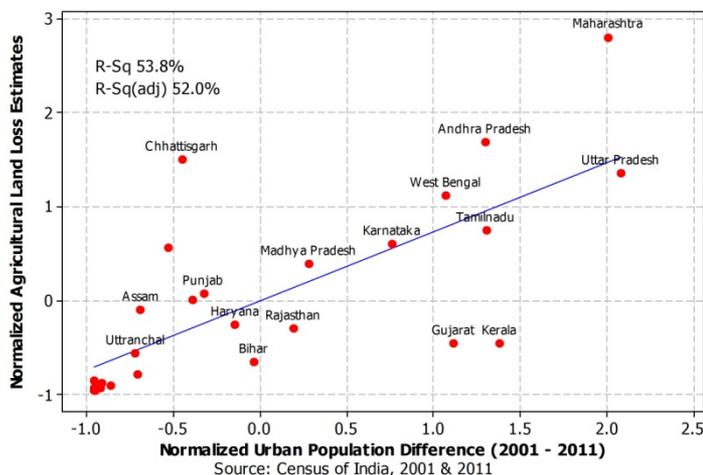
Location attributes of agricultural land loss

- Agricultural land loss is largely in states and districts which have a larger number of operational or approved special economic zones (SEZs).
- Agricultural land loss is occurring around smaller cities more than around bigger cities.
- Agricultural land loss is concentrated in a few districts and states with:
 - I. High rates of urbanization
 - II. High rates of economic growth
 - III. Higher agricultural land suitability compared to other states

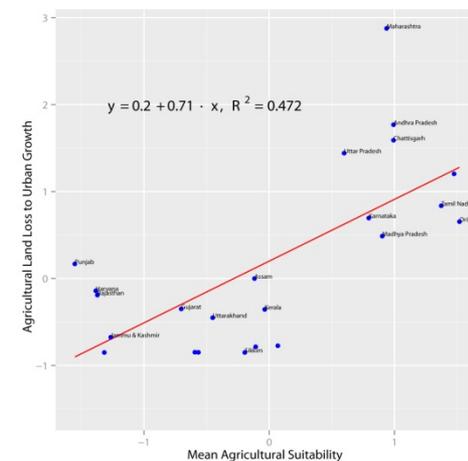
I.



II.



III.



Agricultural land conversion is slow



Agricultural land uses often conflict with converted urban land



Goal 3: Explain the drivers of the growth of urban clusters and agricultural land conversion

- In China, urban expansion is associated with decline in agricultural land use intensity
- Growth in the industrial sector negatively affects agricultural land use intensity

Land Use Policy 35 (2013) 33–39

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Landscape and Urban Planning 108 (2012) 131–139

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Research paper

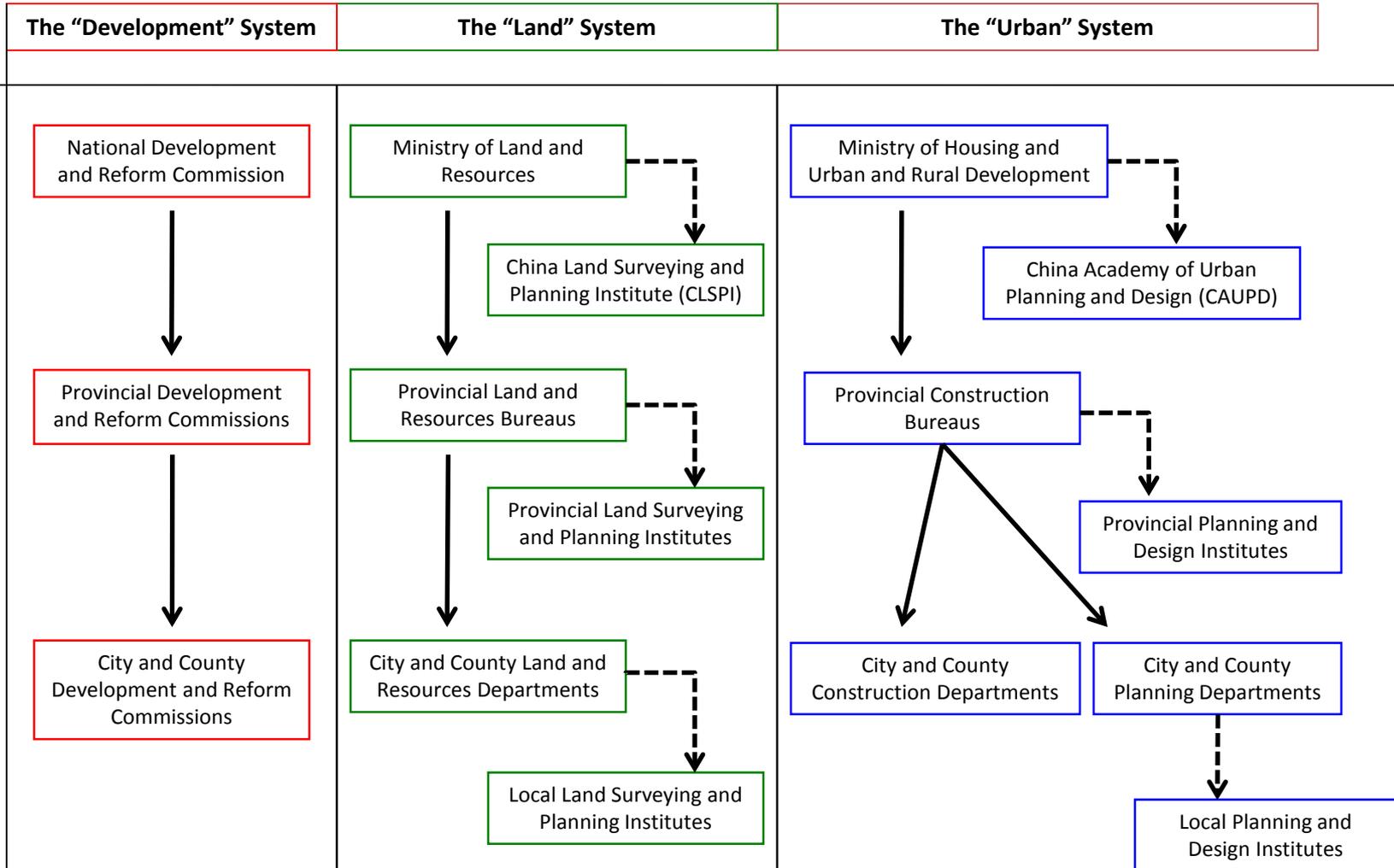
Multi-level modeling of urban expansion and cultivated land conversion for urban hotspot counties in China

Li Jiang^{a,*}, Xiangzheng Deng^b, Karen C. Seto^a

The impact of urban expansion on agricultural land use intensity in China

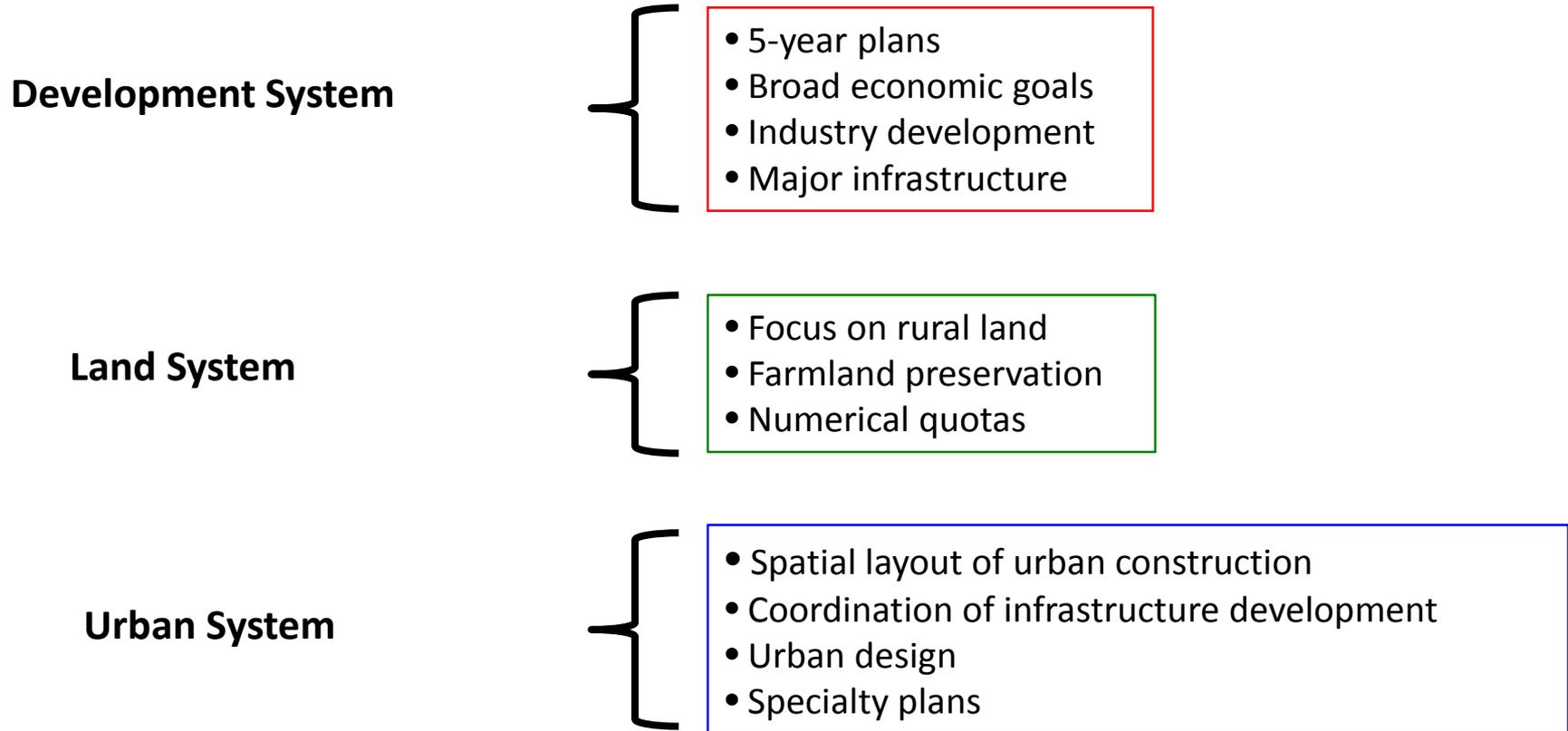
Li Jiang^{a,*}, Xiangzheng Deng^b, Karen C. Seto^c

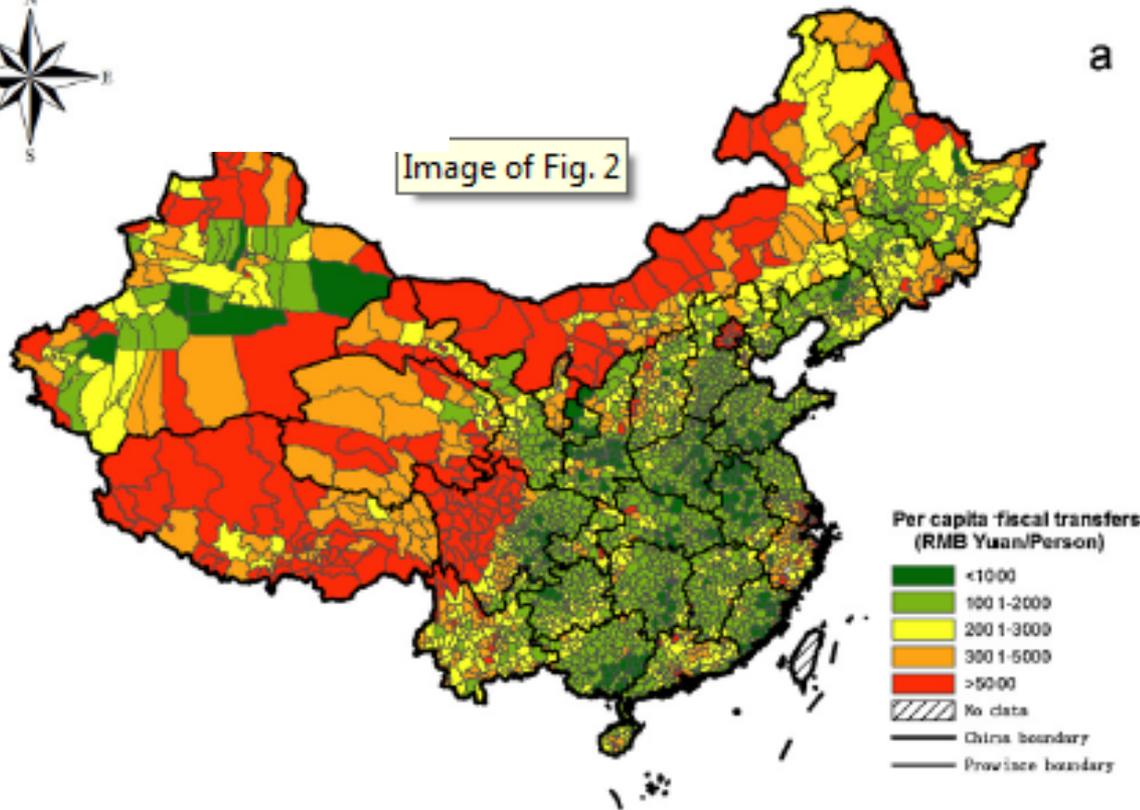
China's Three Major Planning Systems



Source: A. Perlstein, PhD dissertation

Basic features of the 3 major types of plans





Land Use Policy 38 (2014) 487–496



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Land Use Policy

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Central versus local states: Which matters more in affecting China's urban growth?

Qian Zhang^{a,*}, Jeremy Wallace^b, Xiangzheng Deng^c, Karen C. Seto^a

^a Yale School of Forestry and Environmental Studies, Yale University, 195 Prospect Street, New Haven, CT 06511, United States

^b Department of Political Science, The Ohio State University, 2140 Derby Hall, 154 North Oval Mall, Columbus, OH 43210-1373, United States

^c Center for Chinese Agricultural Policy, Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China





Nanchang Planning Exhibition Hall



Wuhan Planning Exhibition Hall

Small agricultural holdings make it difficult for developers to acquire contiguous plots, leading to ribbon development



Small-scale industries lease land temporarily from farmers



KEY MESSAGES FROM GOAL 3

- Growing role of private sector in China's urban development
- Declining role of central government in shaping urban growth in Chinese cities
- Lack of capital hinders infrastructure development in India
- Private provision of infrastructure led urban development in India

Education and Outreach

Yale from Dongguan to Delhi x

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Yale from Dongguan to Delhi

Urbanization and Environment in China and India



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Where we went

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of Our Trip



From China ...



Rethinking Global Land Use
in an Urban Era

EDITED BY
Karen C. Seto and
Anette Reenberg



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Karen C. Seto



Qingling Zhang



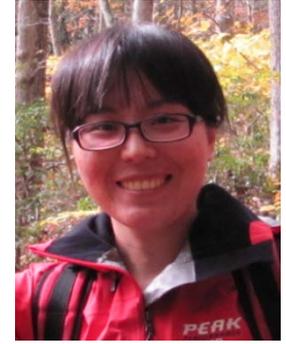
Peter Christensen



Chris Shughrue



Bhartendu Pandey



Qian Zhang



Mahesh
Ramachandran



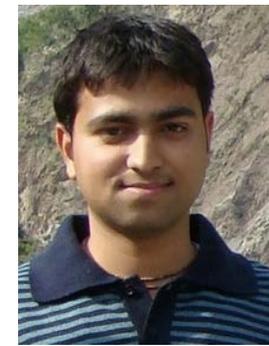
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