

Simulating urban development scenarios for Wuhan

武汉城市发展情景模拟

Yu-e Shi et al.

RIKS

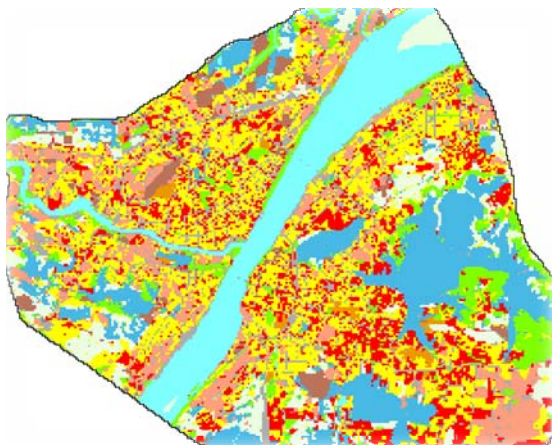
The Netherlands

yshi@riks.nl

www.riks.nl



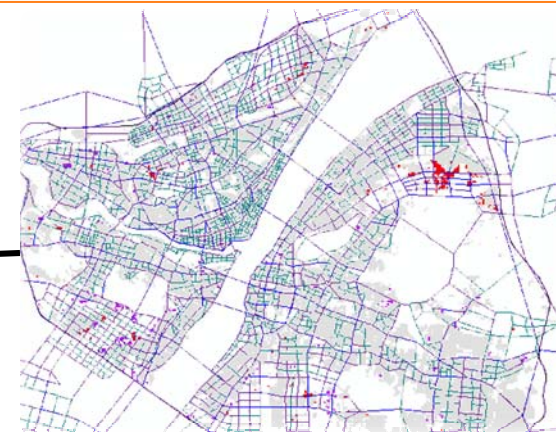
Background 背景



Fast urban growth 城市发展



Strong interaction, dynamic, complex
动态和复杂的交互作用



Transport infrastructure 交通道路

**Integrated urban and
transportation planning**
综合交通和城市规划



Harmonious city 和谐城市



Sustainable development 可持续发展

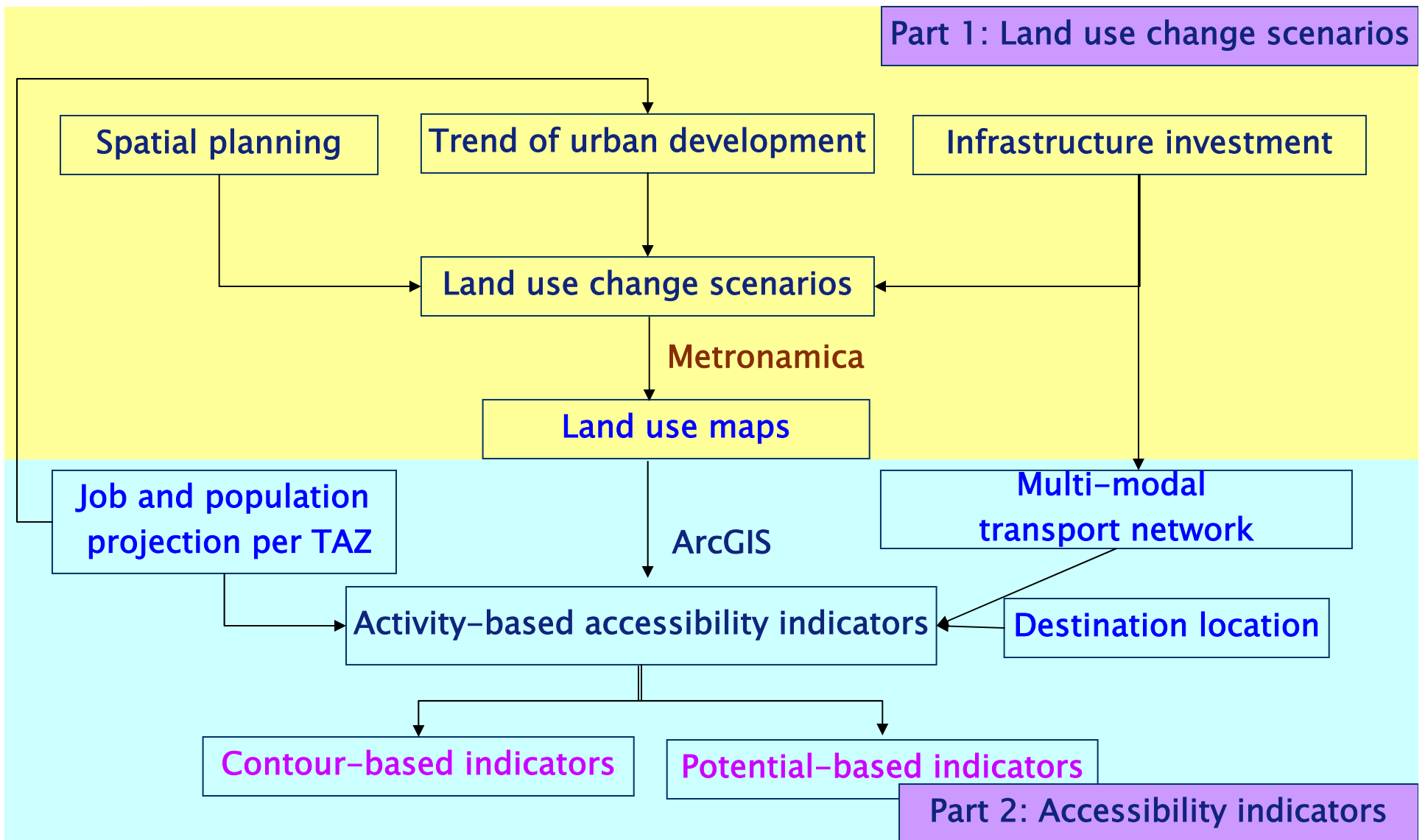


The World Bank Project: Wuhan urban accessibility planning support systems 世行项目：武汉城市可达性规划支持系统项目

- ◆ **Aim: to demonstrate methods for integrated land use and transport planning.** 土地利用与交通综合规划的可行性研究示范
- 1. **A dynamic land use model for Wuhan (the Metronamica application for Wuhan): exploring the effects of alternative policy options for land use change in Wuhan .** 基于Metronamica的武汉市动态土地利用模型：探索政策对于土地变化的影响
- 2. **Activity-based accessibility indicators for Wuhan in a GIS environment: e.g. how alternatives for land use and transport policy affect accessibility to jobs.** 基于活动性的可达性指标：不同的土地和交通政策对于就与可达性的影响
- 3. **Showcase the use of Metronamica and GIS techniques (Spatiotemporal simulation models) for urban development modelling, analyses and assessment.** 列举Metronamica和GIS技术在城市发展建模、分析和评估中的应用



Chart flow 流程图





Metronamica : Modeling land use dynamics for Wuhan

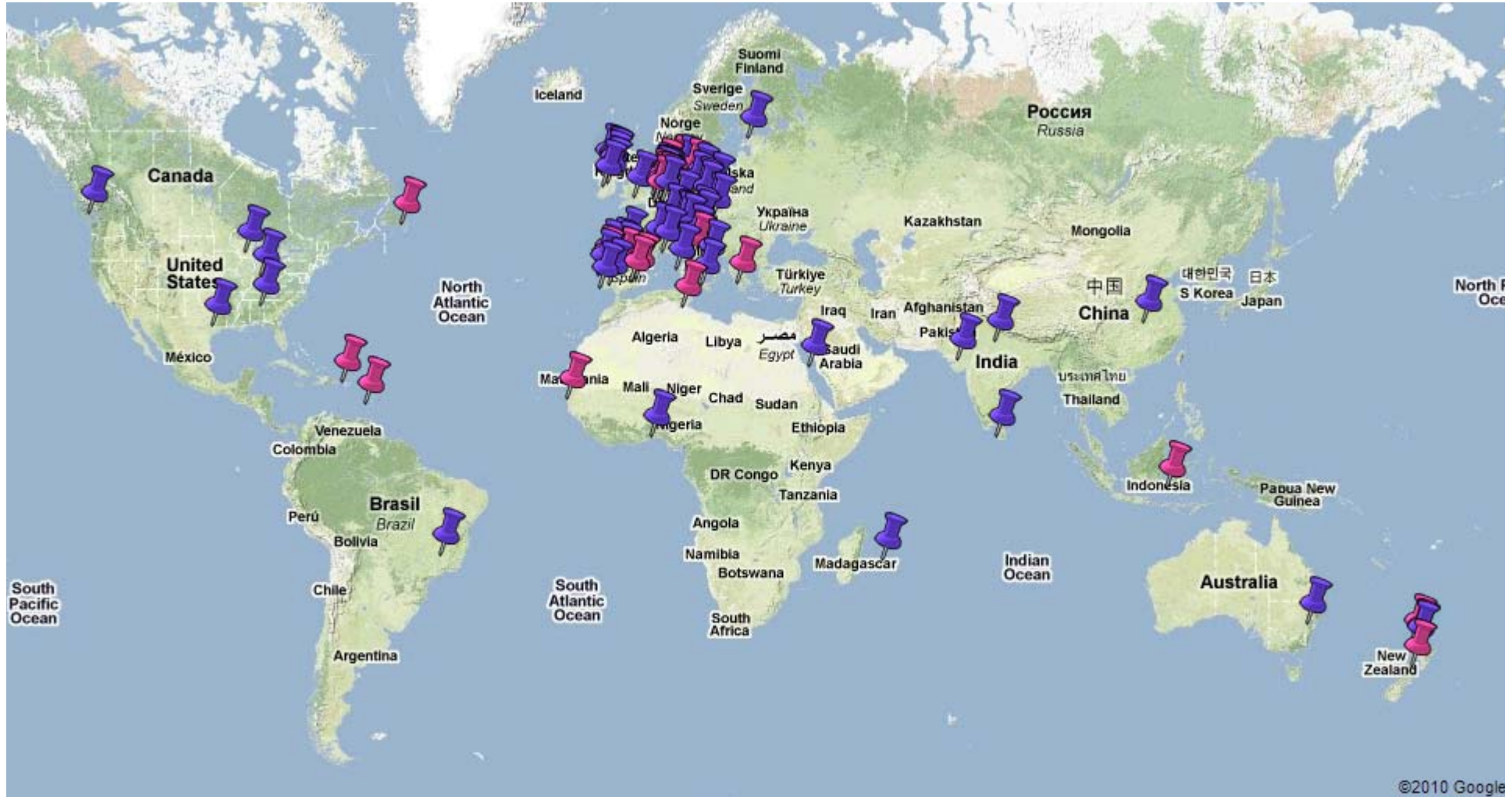
基于METRONAMICA 建立武汉市动态土地利用模型





Metronamica: a SDSS tool for spatial planning

空间规划决策系统支持工具



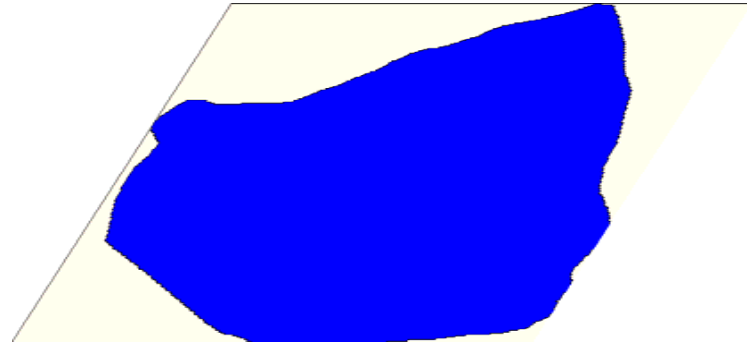


Metronamica: coupled spatial scales

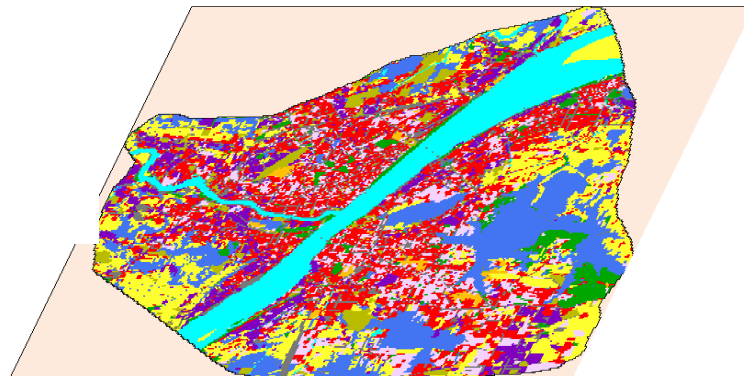
集成多个空间尺度

Wuhan application: 2 coupled spatial scales 武汉模型：集成2个空间尺度

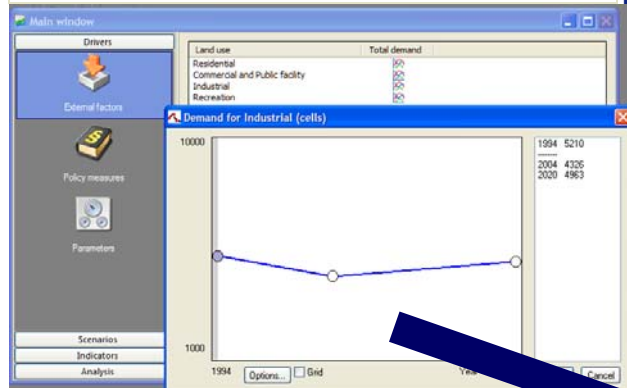
Global level 全局
Wuhan core city
(武汉三环线内)



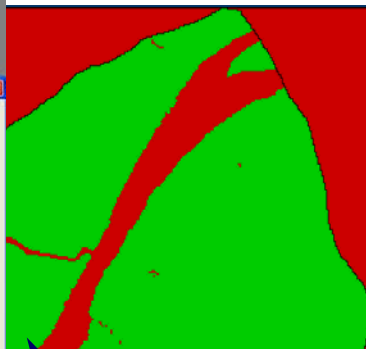
Local level 局部
Cells of 100x100m
(1公顷的栅格)



Regional demands 需求

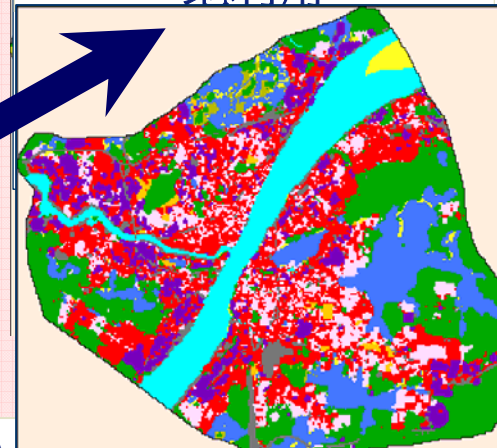


Suitability 适宜性

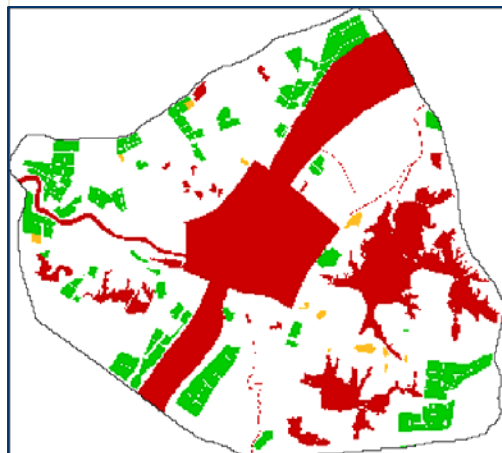


Land use & Interaction weights
土地现状和交互作用

Land use T+1 新土地利用



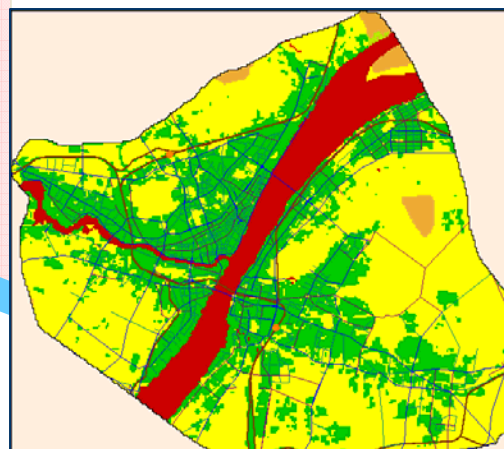
Zoning 空间管制



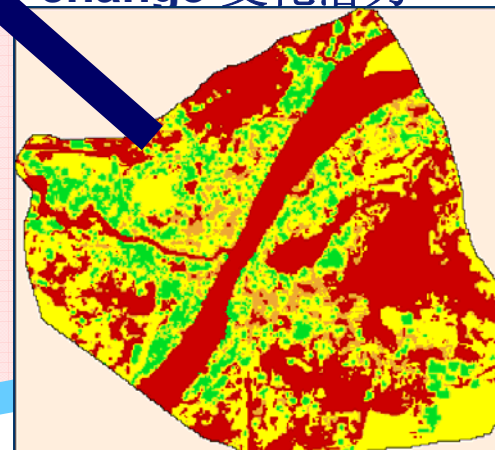
Transition Rule 演化规则

Cells change to land-use with highest potential until regional demands are met. 高潜力栅格演化

Accessibility 可达性



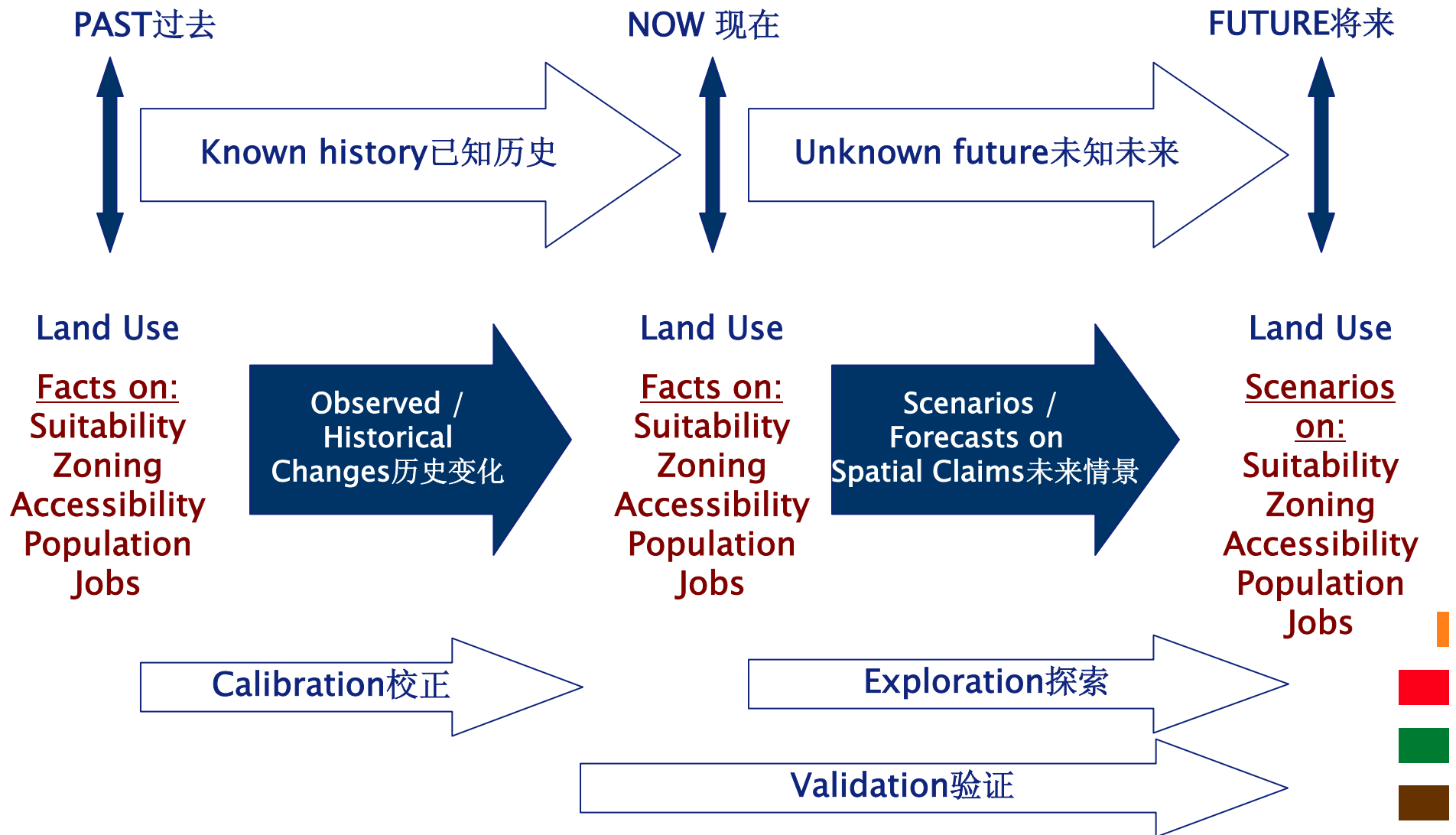
Potential for change 变化潜力





Developing and using the model

模型发展和应用





Policy-relevant land use scenarios 政策相关土地利用情景方案

- ◆ **Design policy-relevant scenarios “what-if” and assess future urban dynamics and its linkage with transport** 设计与政策相关的情景方案，评价城市动态发展与交通的联系
- ◆ **Provide information for policy maker to analysis spatial policies and support spatial planning** 为决策者政策分析和规划支持的信息
- ◆ **Business-as-Usual (BAU) scenario assuming a continuation of historic land use dynamics combined with current land use and transport policies** 常规发展情景是基于当前土地利用和交通政策的延续历史动态发展的情景
- ◆ **Based on workshops definition of land use change scenarios varying in terms of** 情景类别
 - **Spatial planning** 空间规划
 - **Trends of urban development** 城市开发趋势
 - **Infrastructure investment** 基础设施建设



Overview of land use change scenarios

土地利用情景方案描述

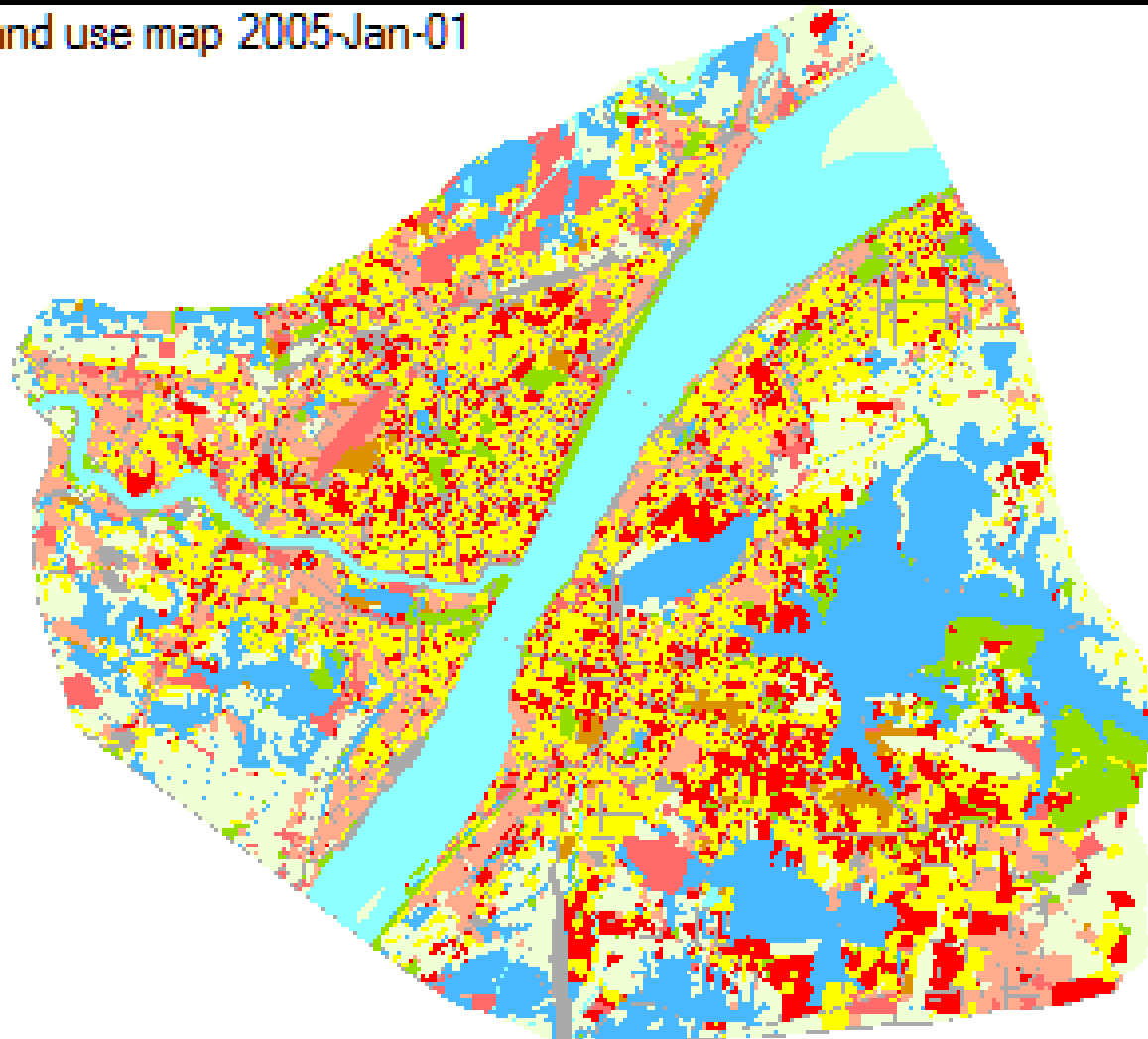
Components LU scenarios	Land use demand in 2020 土地需求	Transport networks 交通网络	Master plan 1996–2020 综合规划	Sub-centre zones 附中心	Policy intervention 政策干预
BAU 常规发展	BAU: master plan 1996–2020 for urban land uses and buffered lake and rivers for recreation	BAU	BAU: zoning	BAU	Policy is pursued as business as usual
BAU without sub-centres	BAU	BAU	BAU	Excluded	Subzone policy is not pursued
Relaxed zoning 松散控制	BAU	BAU	Excluded	Excluded	No zoning regulation is pursued
Compact urban development 紧凑发展	High density residential (26.7m ² /p) : 1/3 of the lowest bound of the national standard (80 m ² /p)	BAU	BAU	BAU	High-rise buildings are facilitated, allowing for more development of green space
Urban sprawl 快速扩张	Low density residential (43.3m ² /p): 1/3 of the highest bound of the national standard (130 m ² /p)	BAU	BAU	BAU	Less high-rise buildings are allowed in the city centre causing the development of urban sprawl
Metro focus 聚焦地铁	BAU	No roads built after 2010; metro construction continues on schedule	BAU	BAU	After 2010 construction of infrastructure focuses on metro instead of metro and roads
Metro focus extra 聚焦地铁+	BAU	No roads built after 2010; metro construction continues on schedule; metro becomes more attractive	BAU	BAU	After 2010 construction of infrastructure focuses on metro instead of metro and roads. The metro is more attractive, e.g. due to price policy. Metro is more attractive for urban development



Land use change for LU1 BAU scenario 常规情景中的土地利用变化

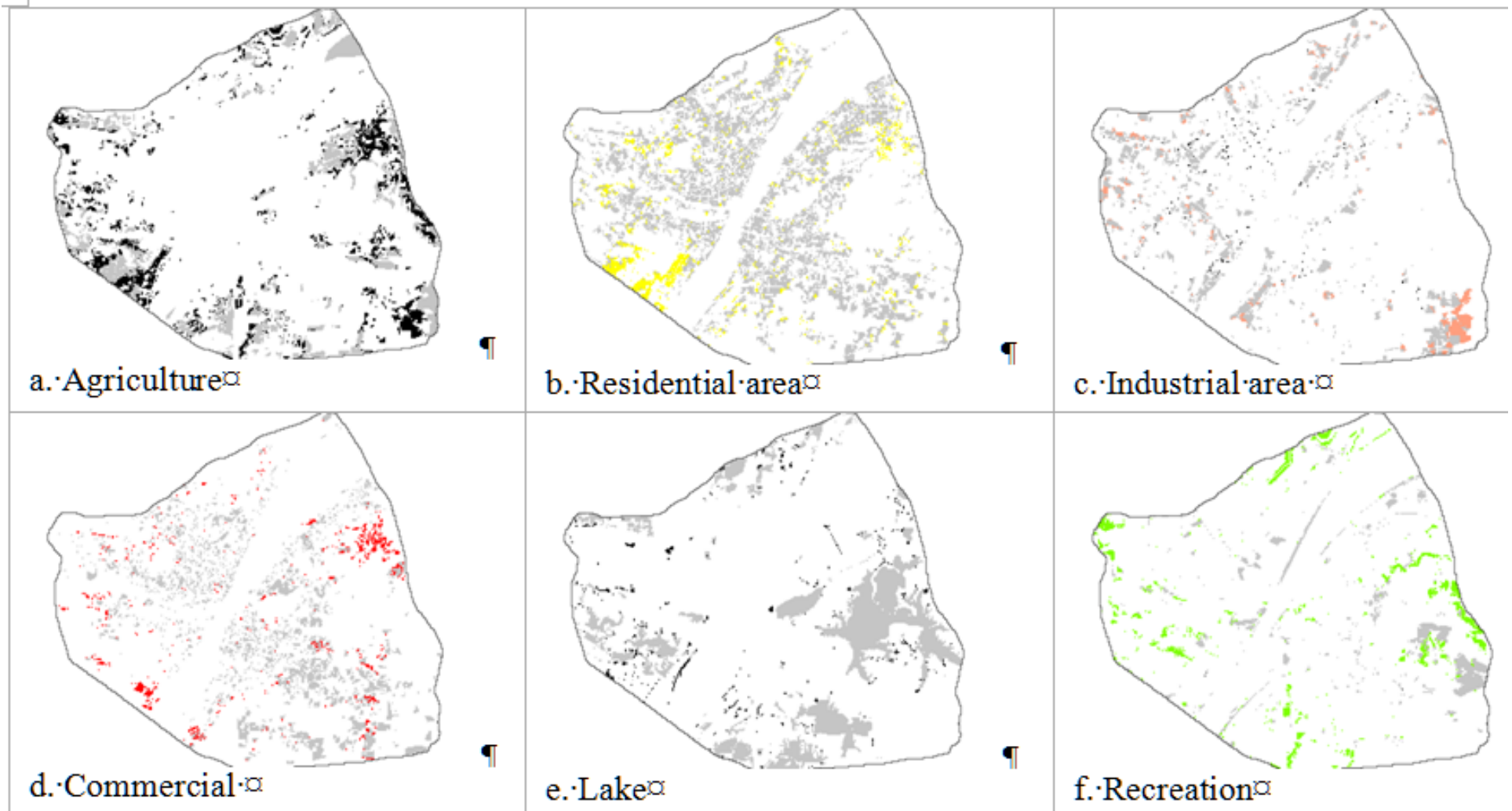
Land use map 2005-Jan-01

-  Agriculture
-  Unused
-  Special use
-  Lakes
-  Residential area
-  Commercial area and Public
-  Industrial area
-  Recreation
-  Transportation and associa
-  Rivers
-  Out of modelling area





Land use change 2004–2020 for LU1 BAU scenario 常规情景中的土地利用变化2004–2020

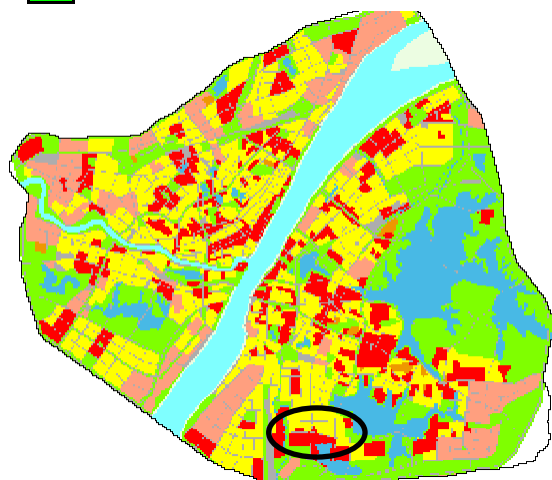


Grey: appear in both year; Black: disappear in 2020; Other colour: appear in 2020

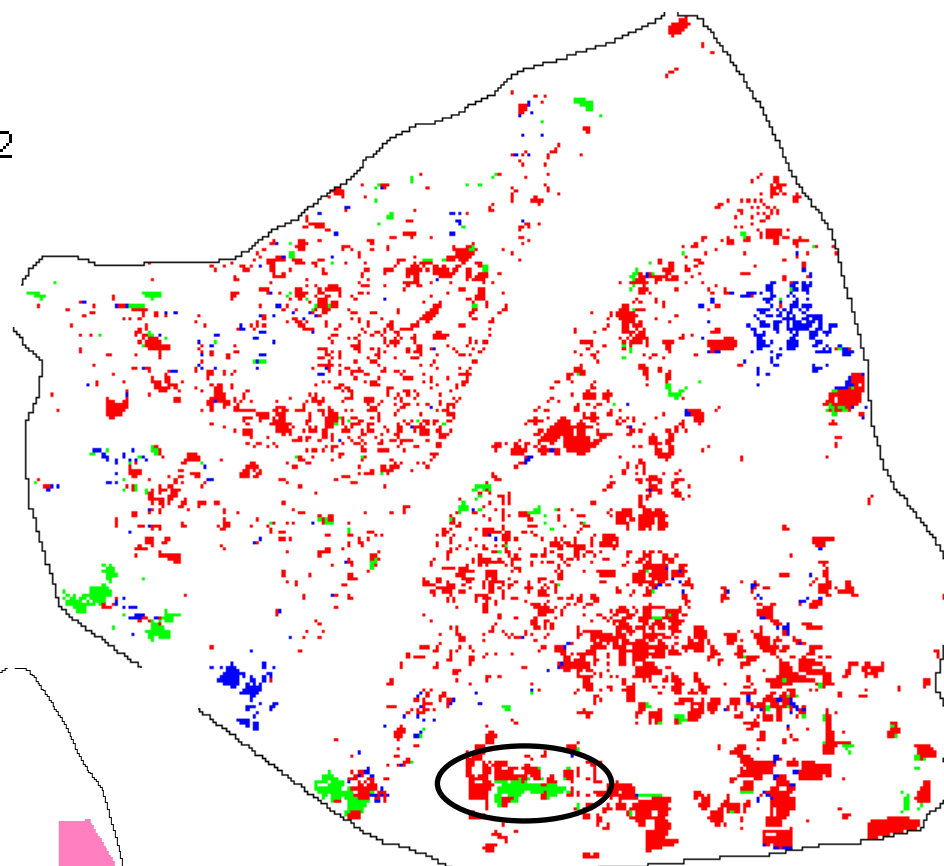


Commercial land 2020 in LU 1 BAU scenario vs LU 2 BAU without sub-centres scenario 2020年商业用地比较

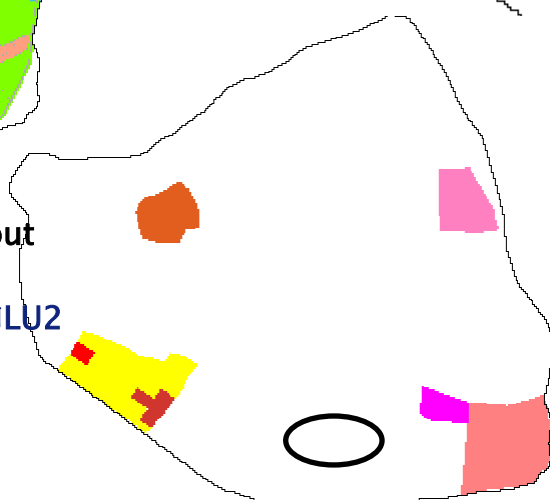
- Not commercial area and public facility
- Commercial area and public facility in both LU 1 and LU 2
- Commercial area and public facility only in LU 1
- Commercial area and public facility only in LU 2



Master plan 1996-2020;
Used in LU1 BAU & LU2 BAU without
sub-centers
1996-2020综合规划图，用于LU1和LU2



Sub-centers: tenth five-year plan
Used only in both LU1 BAU
附中心（第十个五年计划），用于LU1

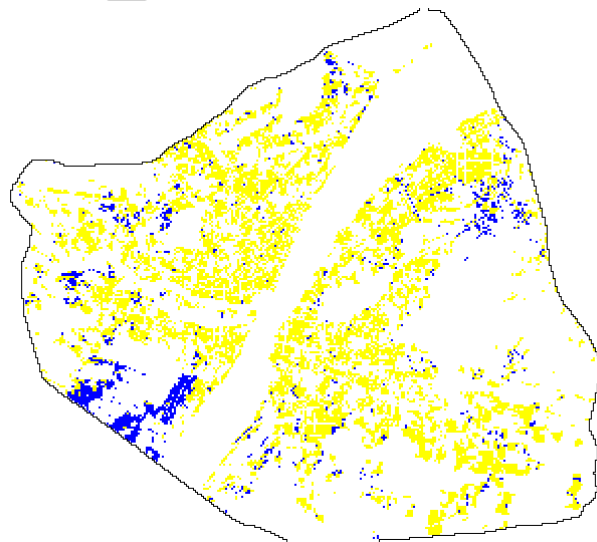




Land use map 2020 LU1 vs LU4 and LU5

2020年土地利用变化比较：常规、紧凑发展、快速扩张情景

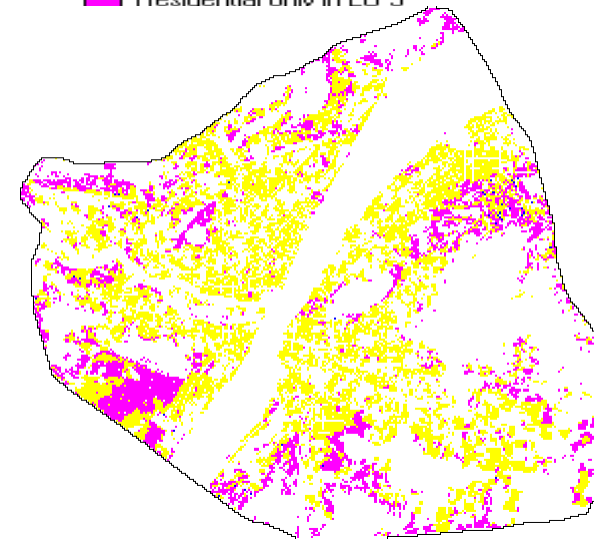
- ☐ Not residential
- ☒ Residential in both LU 1 and LU 4
- ☒ Residential only in LU 1
- ☒ Residential only in LU 4



LU1 BAU vs LU4 Compact urban

LU4: High density residential (27 m²/p) - the lowest bound of the national construction standard
常规情景 vs 紧凑发展情景, 高密度人口居住

- ☐ Not residential
- ☒ Residential in both LU 1 and LU 5
- ☒ Residential only in LU 1
- ☒ Residential only in LU 5



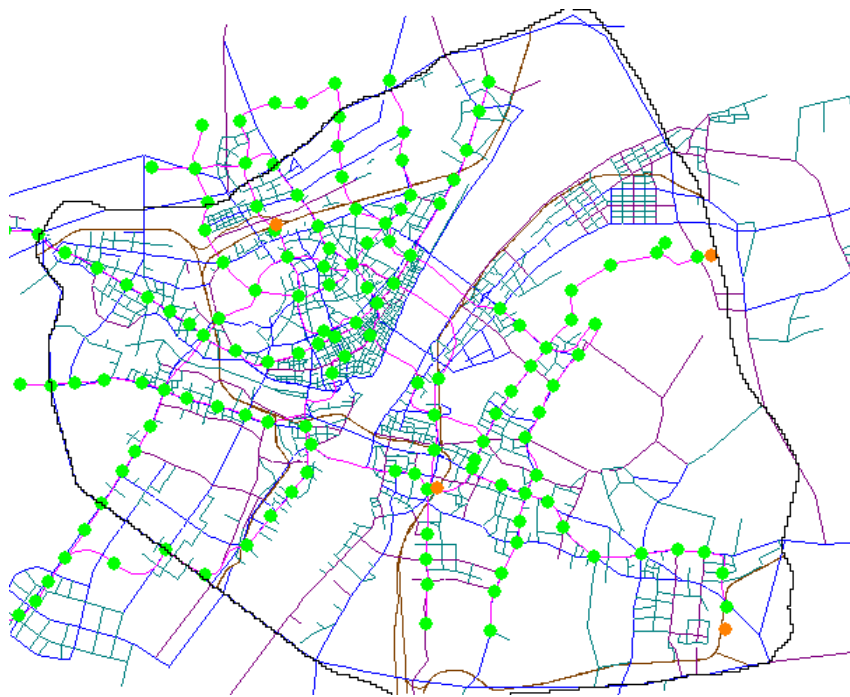
LU1 BAU vs LU5 Urban sprawl

Low density residential (43m²/p) - the highest bound of the national construction standard
常规情景 vs 快速扩张情景, 低密度人口居住

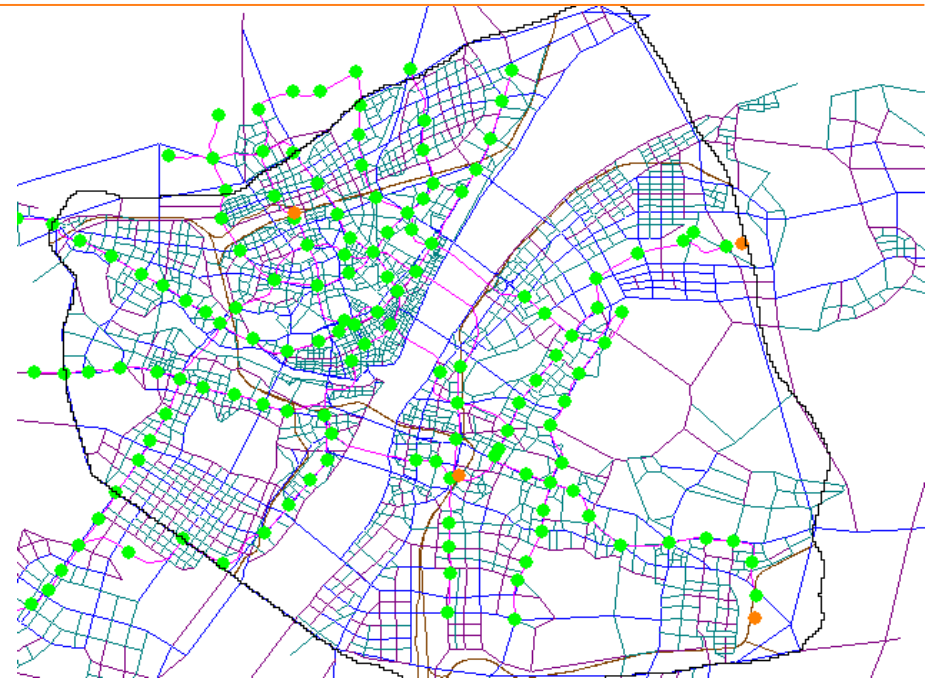


Transport networks in 2020 LU1 BAU vs LU7 Metro focus + 2020年交通道路设施比较

LU7 Metro focus +
聚焦地铁+



- Major road
- Secondary road
- Minor road
- Railway
- Train station
- Subway
- Subway station

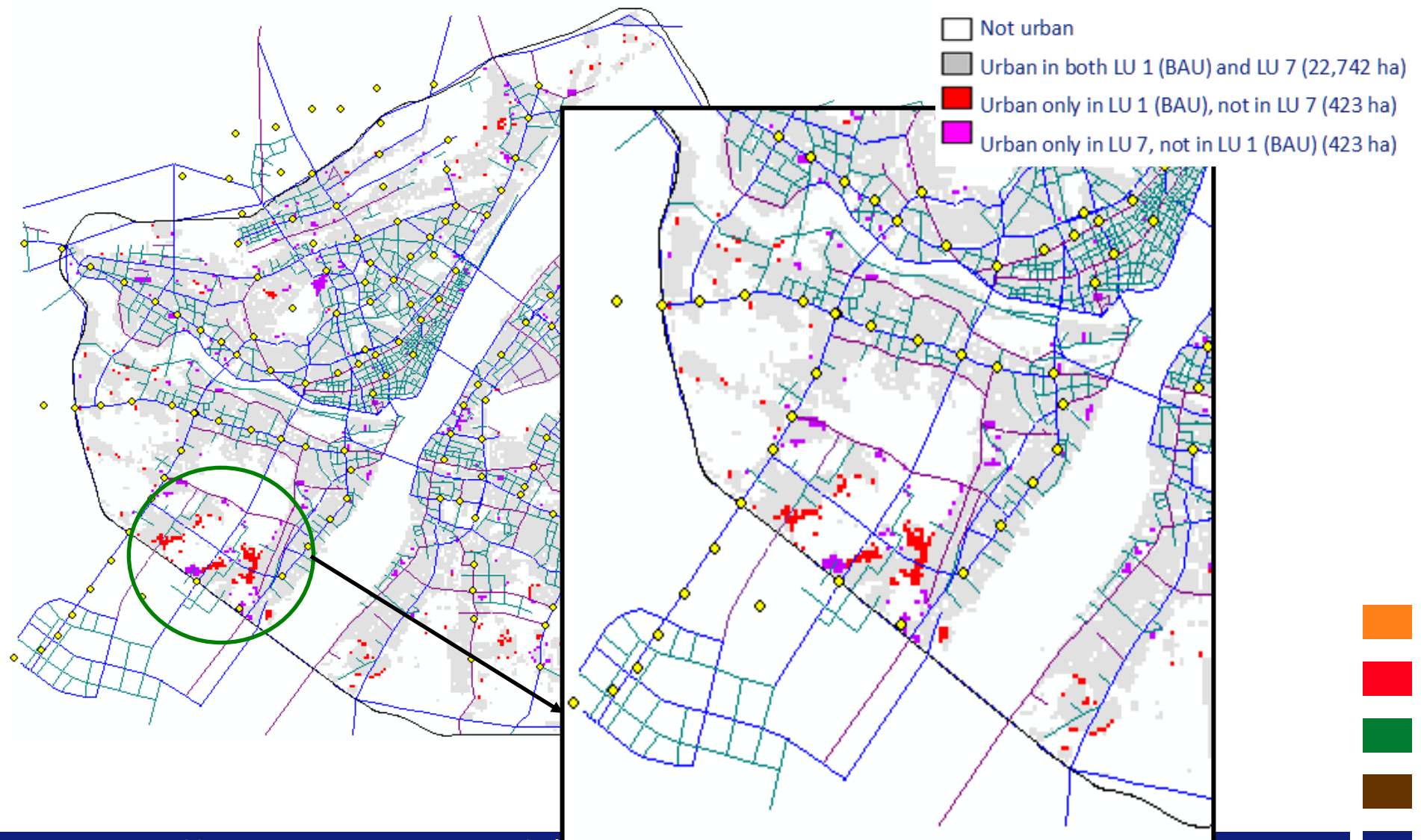


LU1 Business-as-usual
常规情景





Urban 2020 in LU1 BAU vs LU7 Metro focus + 2020年城市用地比较：常规情景和聚焦地铁+情景





Impacts of urban and transport development on accessibility

城市开发和交通发展对于可达性的影响





Accessibility indicators

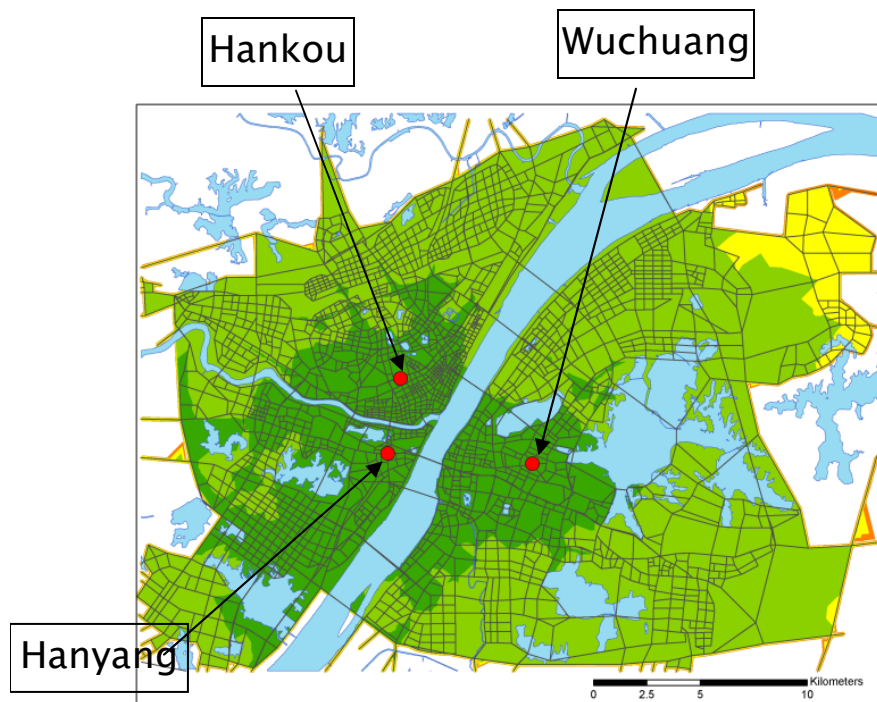
可达性指标

- ◆ Aim to analyze impacts of future trends and developments (both land use and infrastructure) on accessibility in a spatially explicit manner. 从空间变化的角度探索未来发展对可达性的影响
- ◆ Contour-based indicator 等值线指标:
 - The number of opportunities (jobs or people) reachable within a given travel time. 给定出行时间的可达机会（工作和人口）
- ◆ Potential-based indicator 潜在可达性指标:
 - The potential of opportunities for interaction (e.g. residents in location A finding a job in location B) 潜在可达机会的交互作用
 - Discounts the number of opportunities (jobs or people) over distance. 基于距离衰减函数计算
- ◆ An increase in accessibility can be because of 交通改善和土地利用 均有影响
 - Transport improvement 交通改善
 - Land use change (and its effect on distribution of activities in space) 用地变化

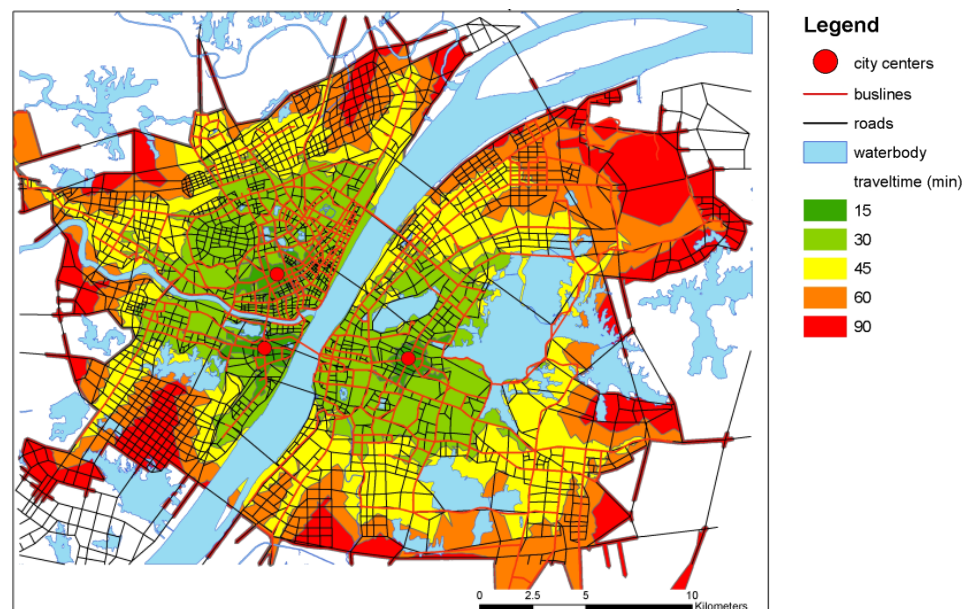


Contour-based indicators 2020

汽车与公交等时线描述



Car 汽车



Bus & walk 公交车 和 步行

2020 travel time contours to the nearest city centres in Hankou, Wuchang and Hanyang

2020 年距汉口、武昌及汉阳中心的交通时间等值线

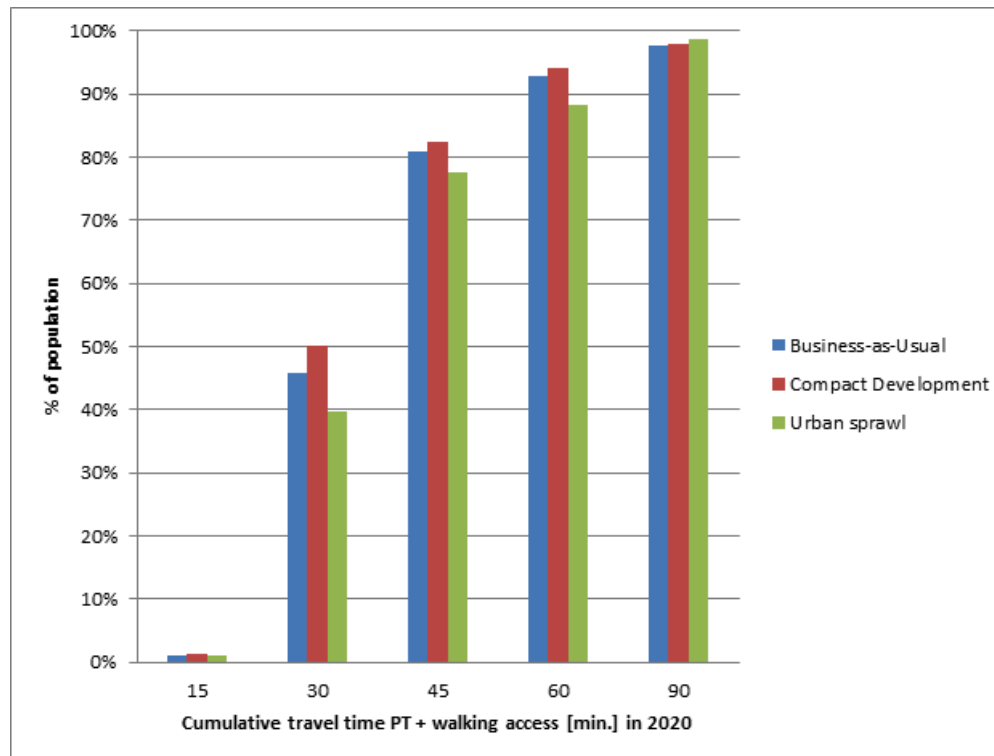


Impact of urban development scenarios on accessibility 土地利用发展情景模式对可达性的影响

Contour-based indicators: 等值线指标

Cumulative percentage of population within travel time contours for public transport (PT) with walking access

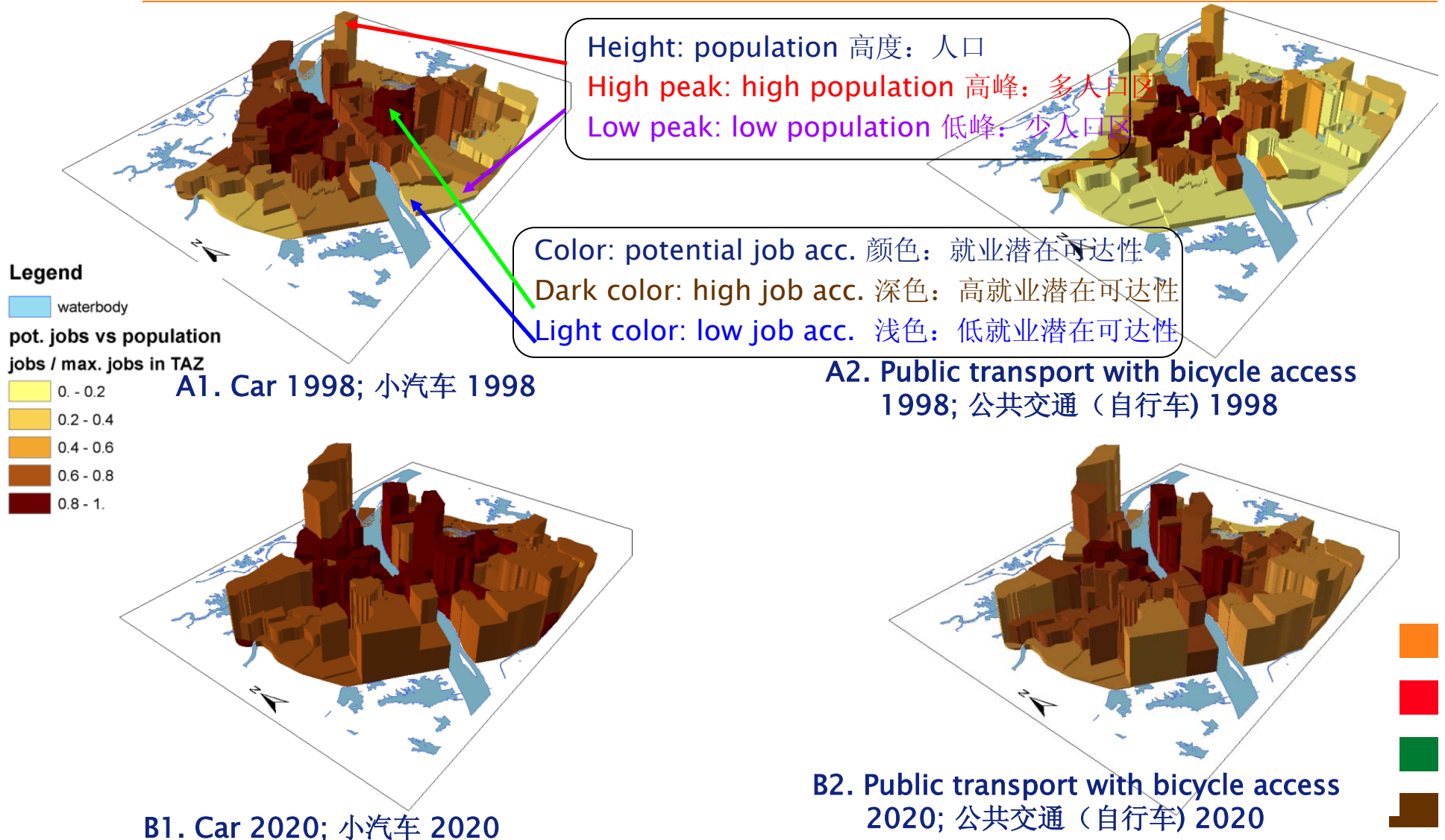
等值出行时间的累计人口百分比-公交和步行





Potential job accessibility vs TAZ population

就业潜在可达性在TAZ层面（人口）的三维描述





Conclusions

结论

- ◆ Transport is not the only factor that drives urban development, as more factors such as zoning regulations and other development policies should be considered in interaction with transport. 交通和其他政策措施交互作用对城市发展都有重要影响
- ◆ There is a clear ‘cause–effect’ between planning policy (zoning regulation, infrastructure and urban/city development) and future land developments. 规划政策（空间管制、基础设施、城市开发）与未来用地发展的存在必然的因果关系
- ◆ Metronamica is able to be used to support the spatial planning and can help stakeholders to understand of processes, stimulate discussion and facilitate communication. Metronamica能够用来作为一个支持空间规划的工具，促进交流和讨论
- ◆ Current urban development, recent and planned transport infrastructure investments have significant effects on the level of accessibility to most locations in Wuhan for most people. 交通改善措施对提高城市可达性标准具



Recommendation for the future work

对今后工作的建议

- ◆ **Data availability : 数据**
 - Distinguishing built-up area classes, congestion levels and more disaggregated opportunity data will allow for more accurate and more integrated modelling. 更精细的数据有助于获得更好的结果
- ◆ **Wider study area: 更大的研究区域**
 - It would be more interesting to apply this approach to a larger area including the urban-rural fringe. This approach could be applied to any other regions and cities. 该方法可以用于任何地区和城市。更适用于更大的研究区域。
- ◆ **Coupling of transport model and land use model: 模型集成**
 - The calculation of both processes over time as well as their mutual interactions will improve the realism of the simulated future developments. 交通模型和土地利用模型的集成能够更好的模拟未来的发展



Thank you!

yshi@riks.nl

