

Standardized Analysis of Urban Form

May 16, 2011 - ISSST
Urban Systems & Infrastructure

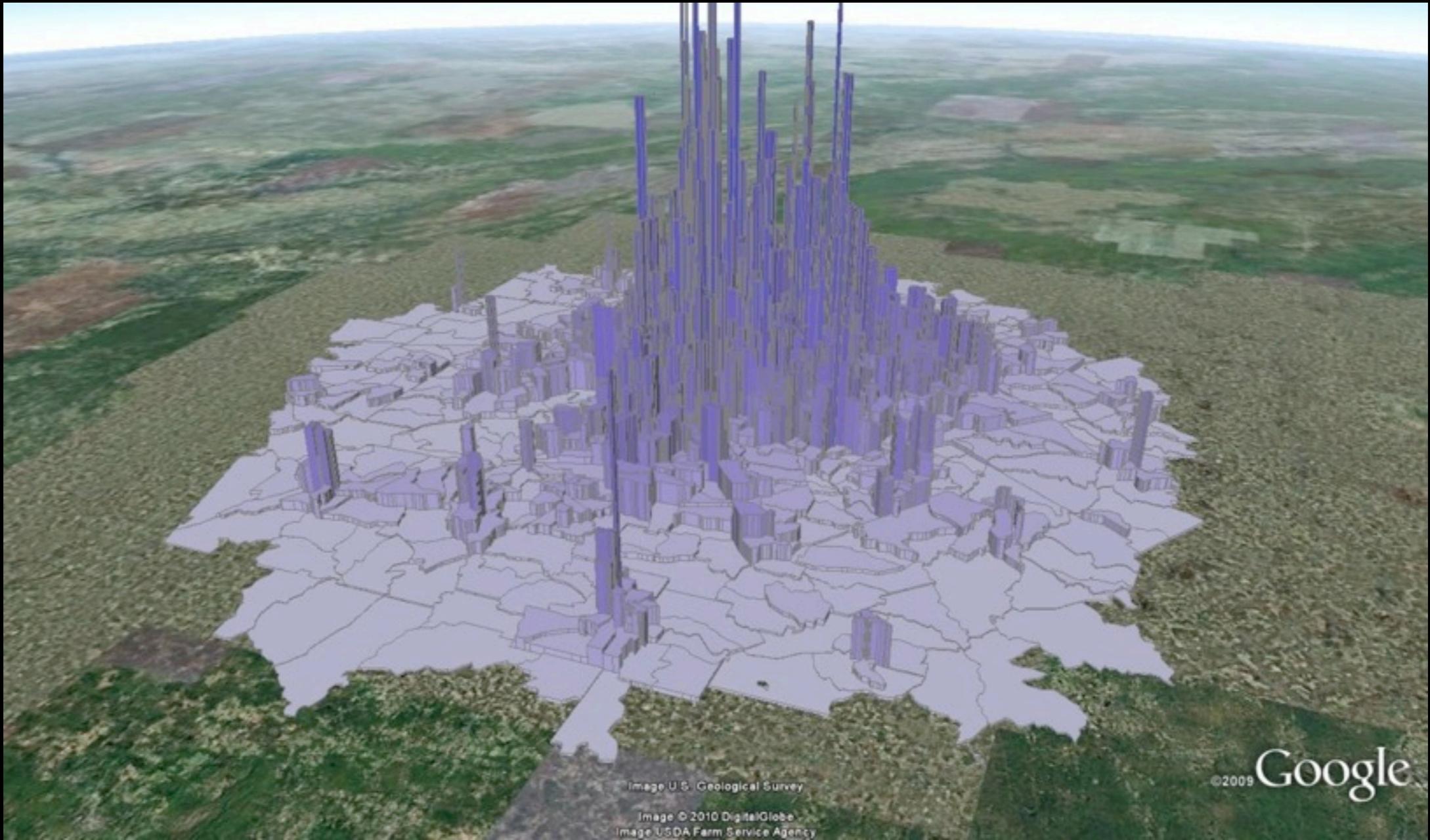
David Quinn & John E. Fernández
Department of Building Technology
School of Architecture and Planning
Massachusetts Institute of Technology
Cambridge, MA, USA

Background: Cities and complexity

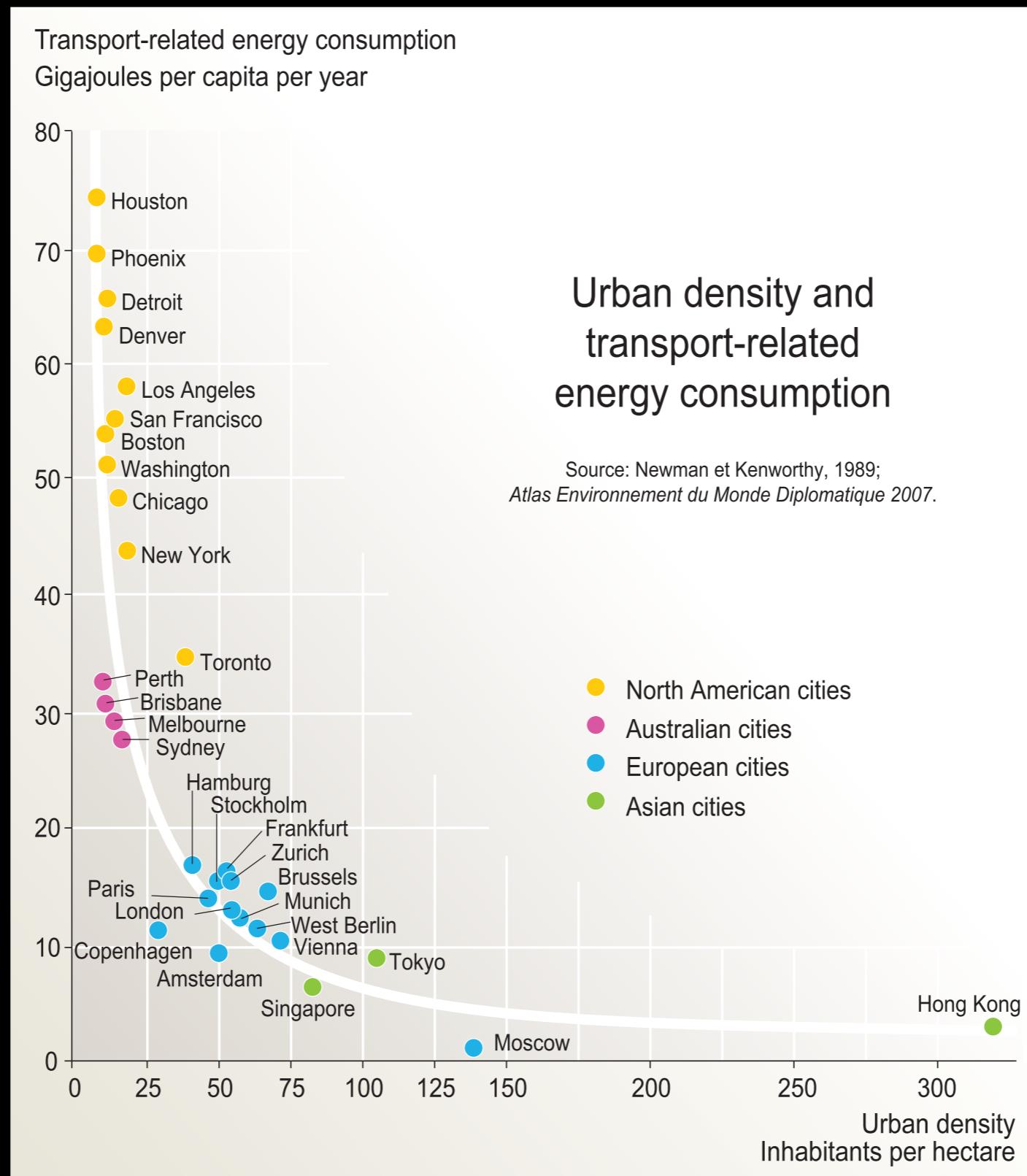


Image source: <http://earthobservatory.nasa.gov/>

Background: Cities and complexity



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Motivation: Standardized analysis of urban form

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Resource consumption data gathered at a national level

Urban analyses typically focus on political boundaries

Difficult to repeat urban analyses

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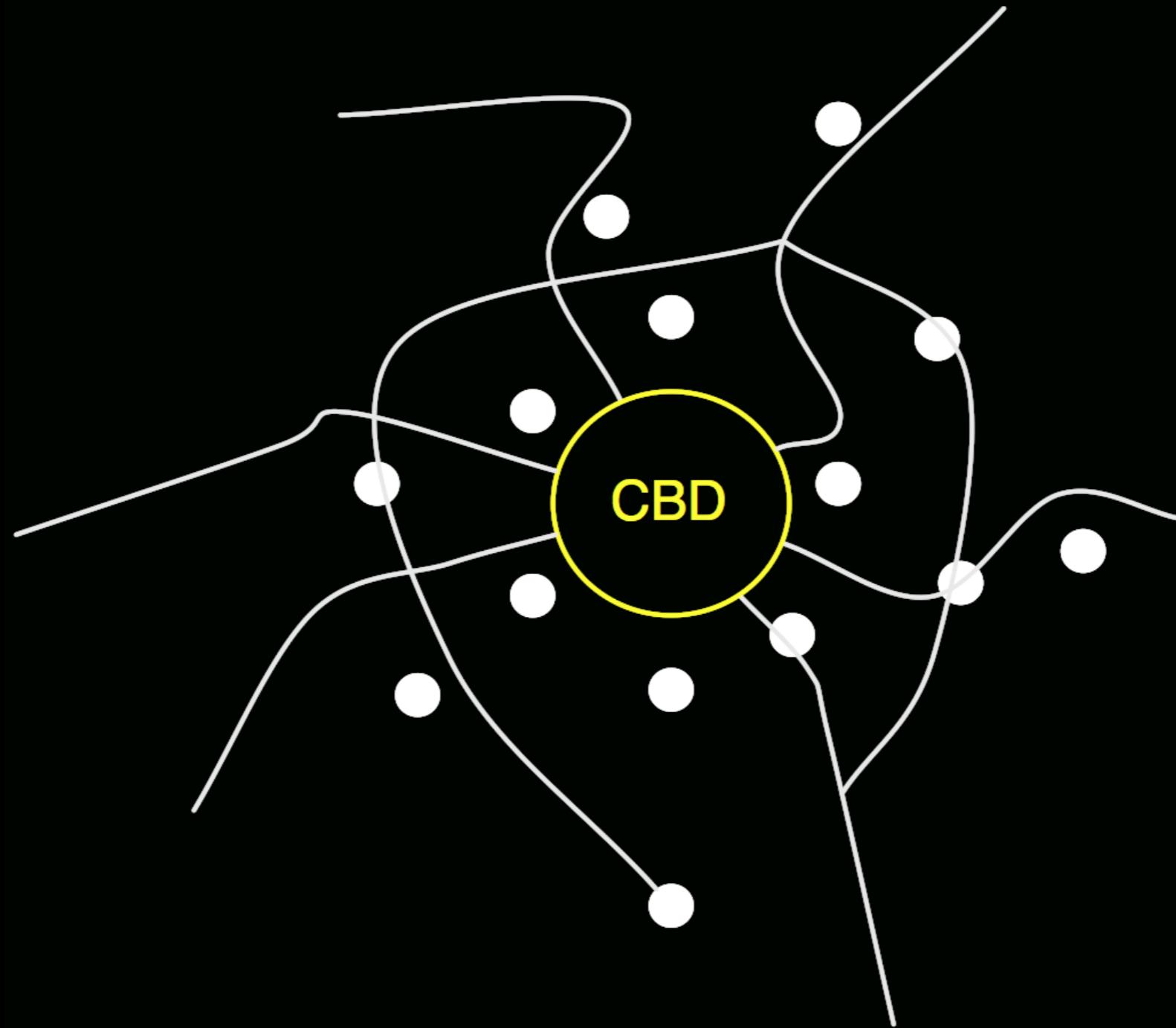
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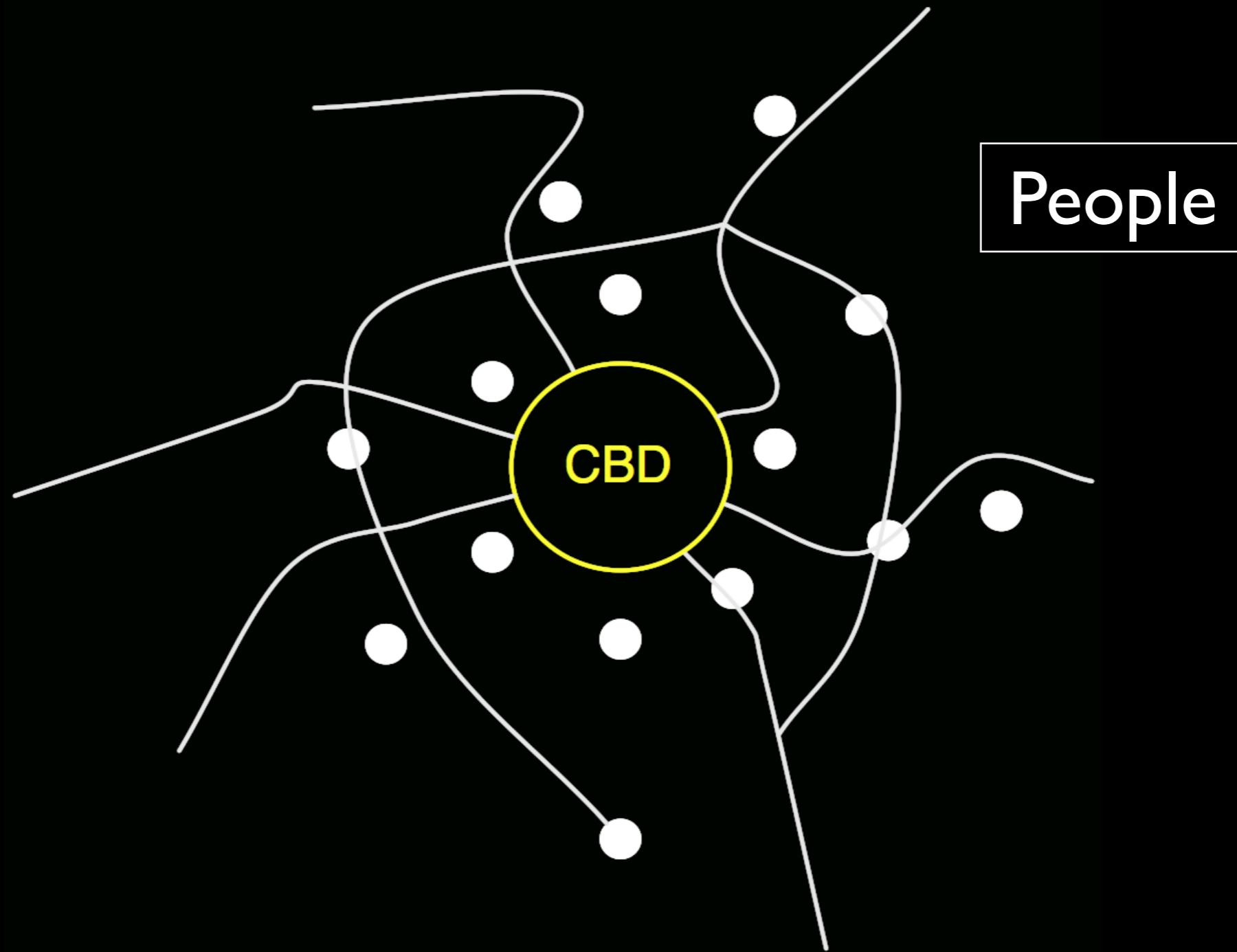
Difficult to repeat urban analyses

Methodology: Tool description

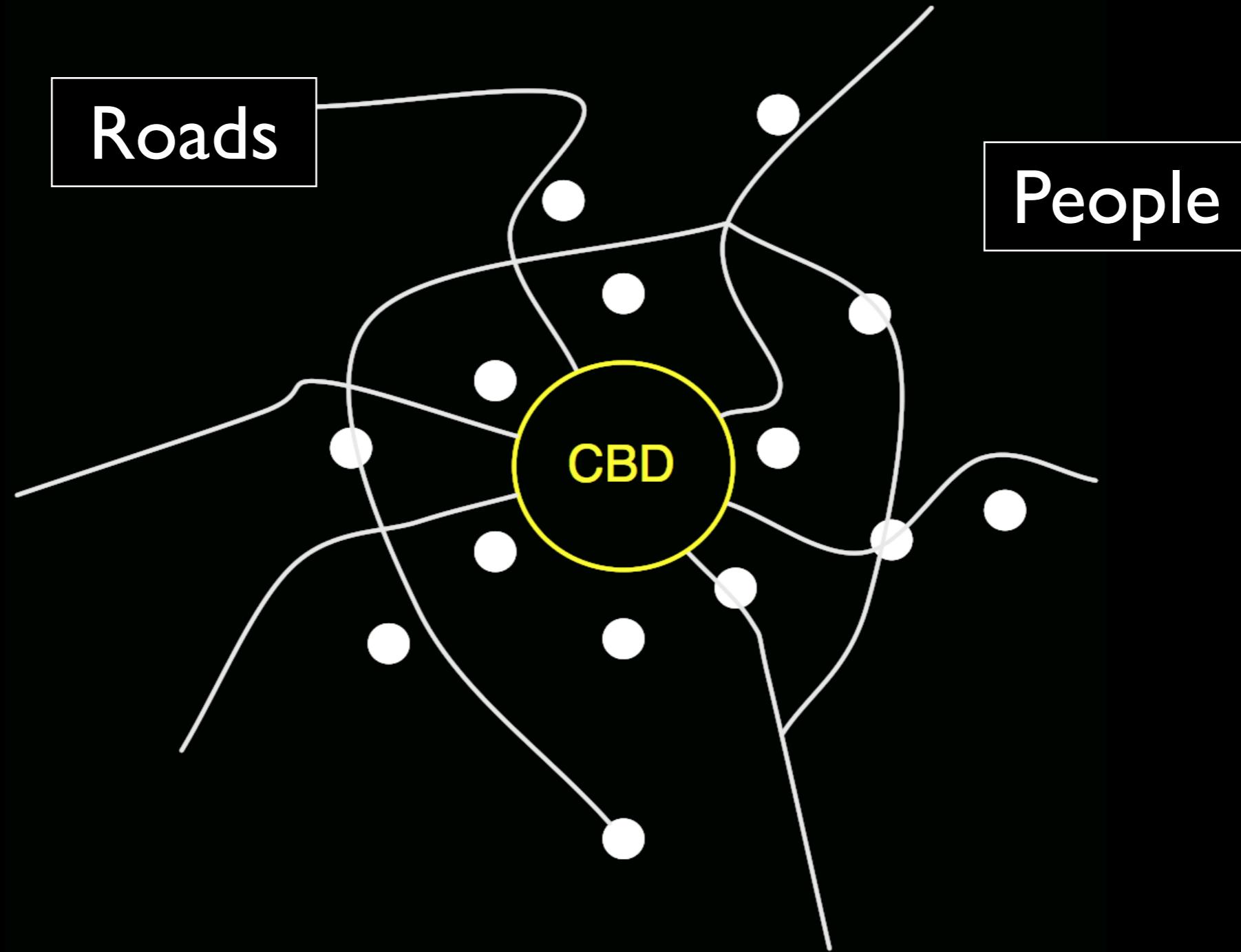
Methodology: Tool description



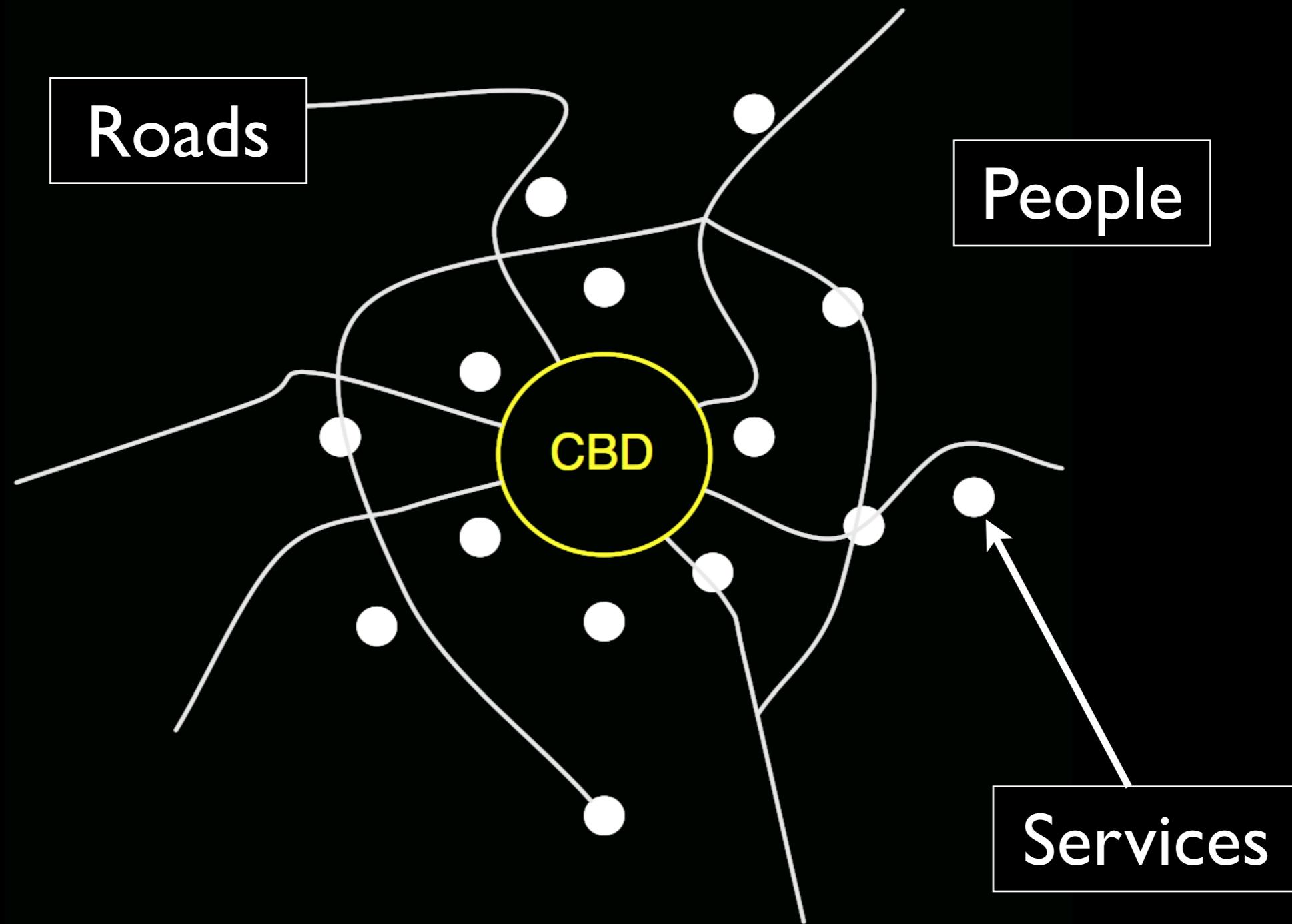
Methodology: Tool description



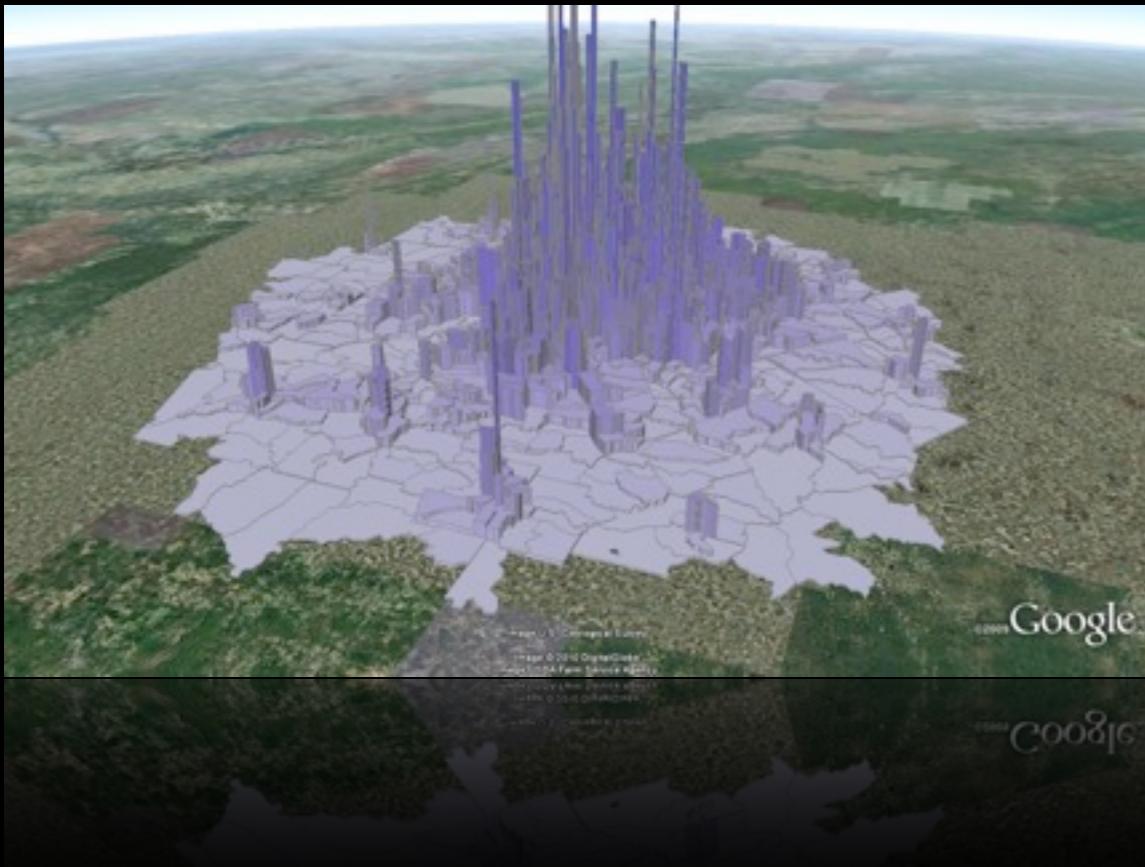
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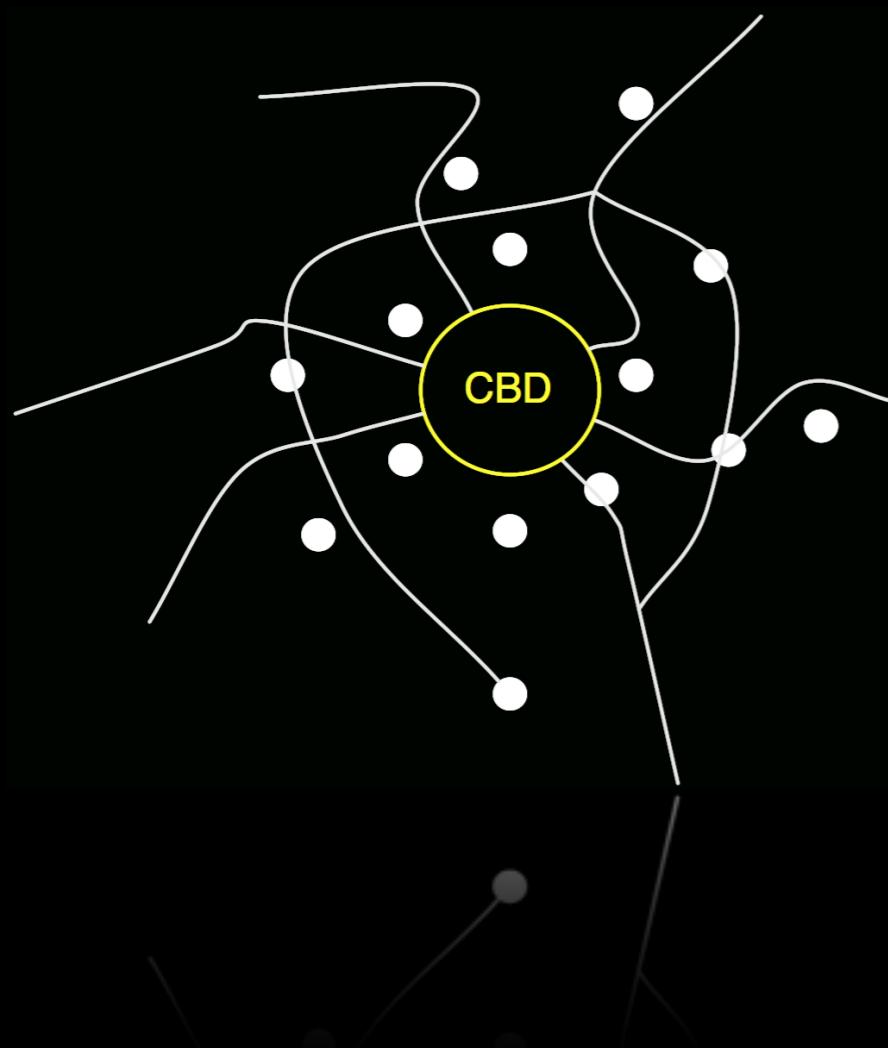


Identify Population Density gradient

Identify Road Density gradient

Identify ‘Distance to Service’ gradient

Methodology: Tool description

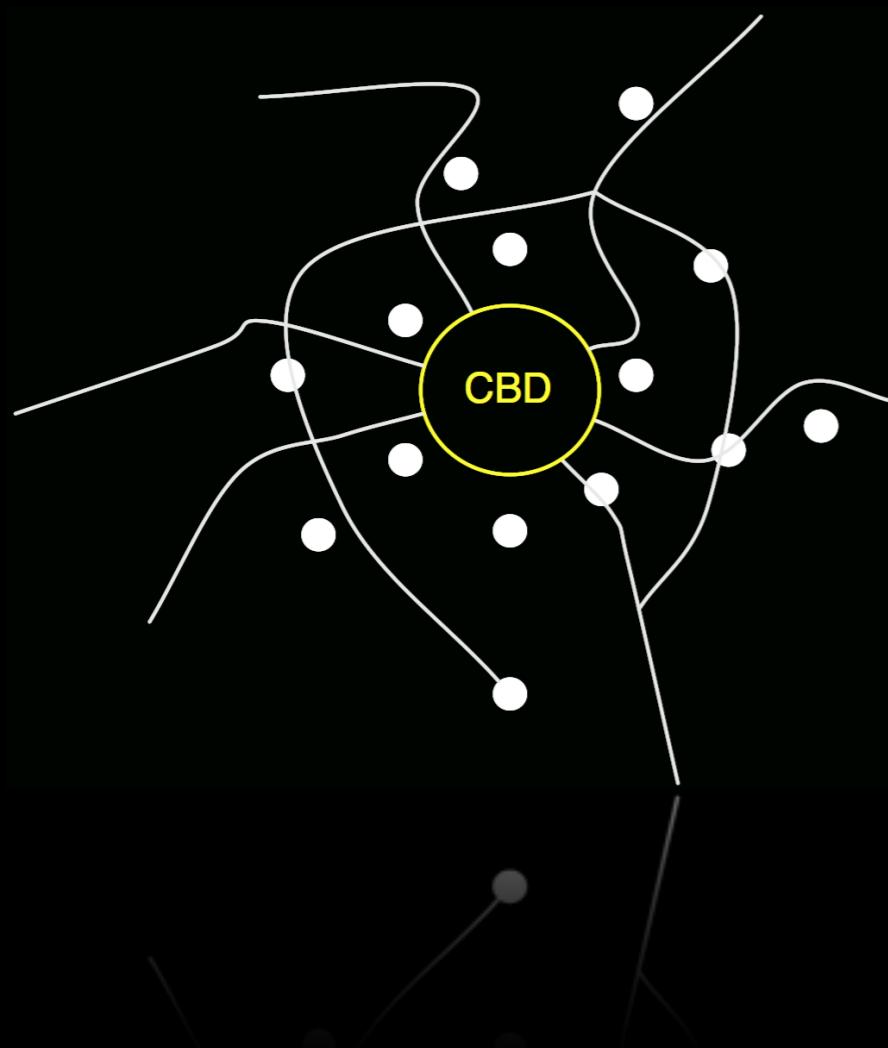


Identify Population Density gradient

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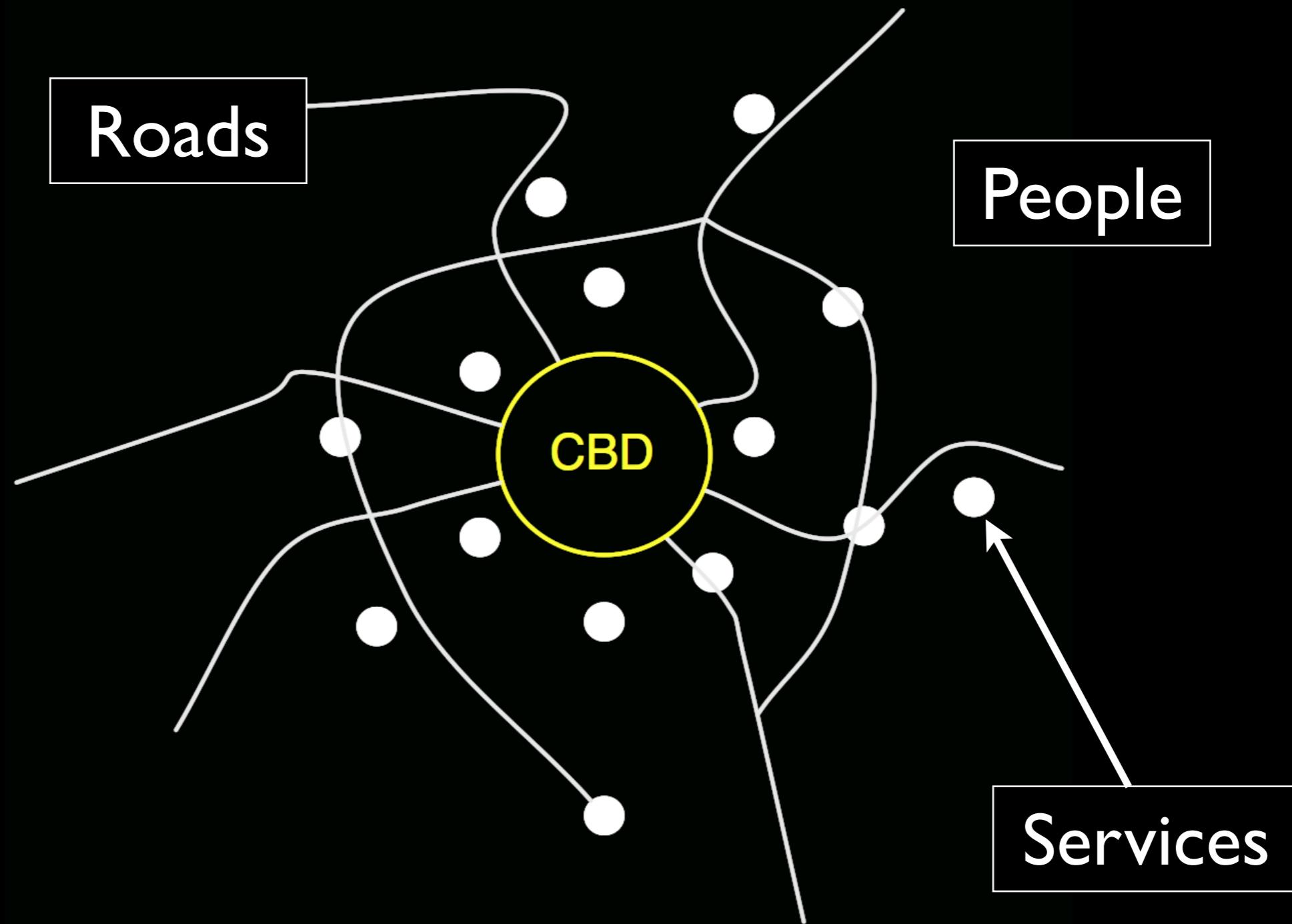


Identify Population Density gradient

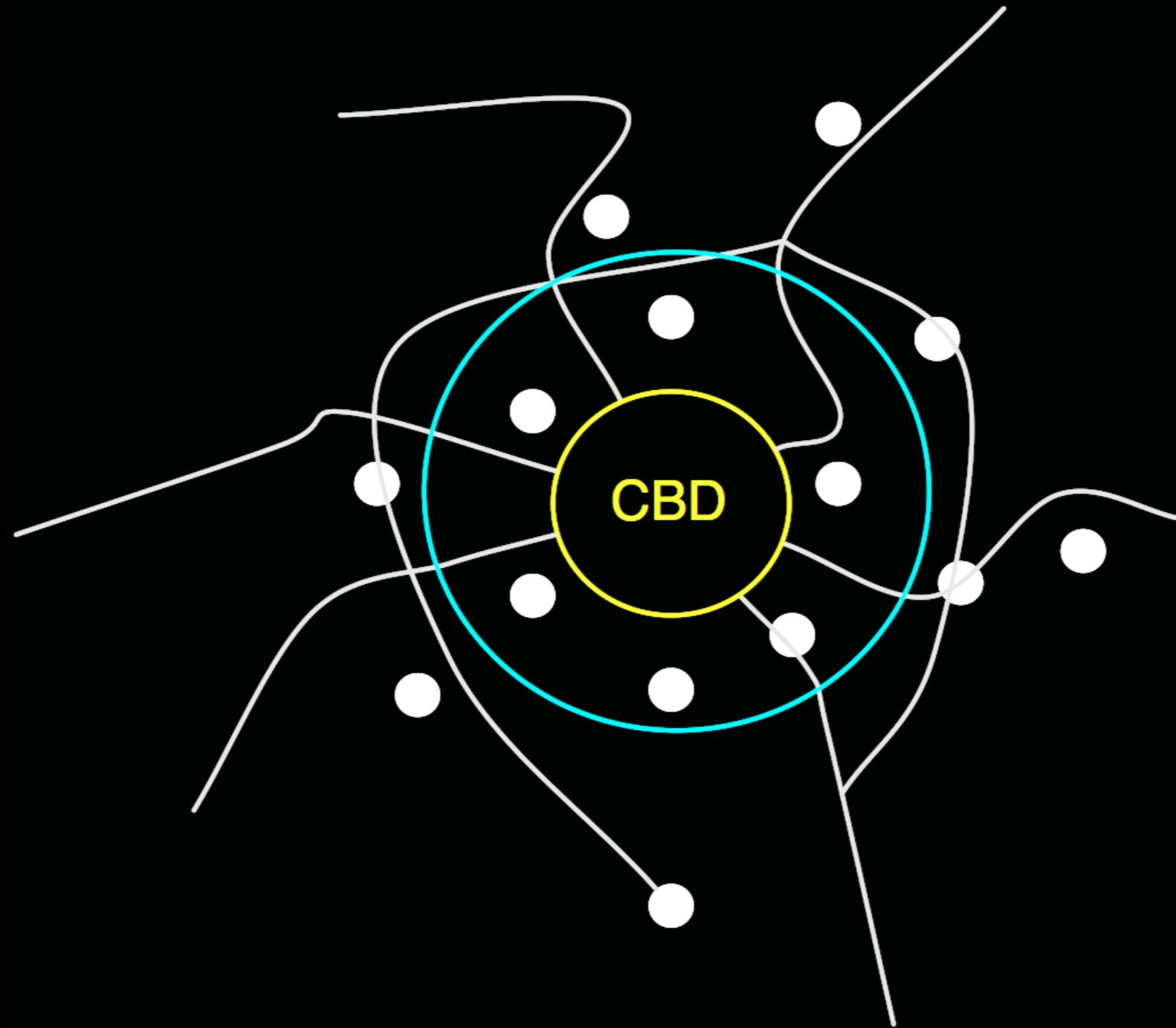
Identify Road Density gradient

Identify 'Distance to Service' gradient

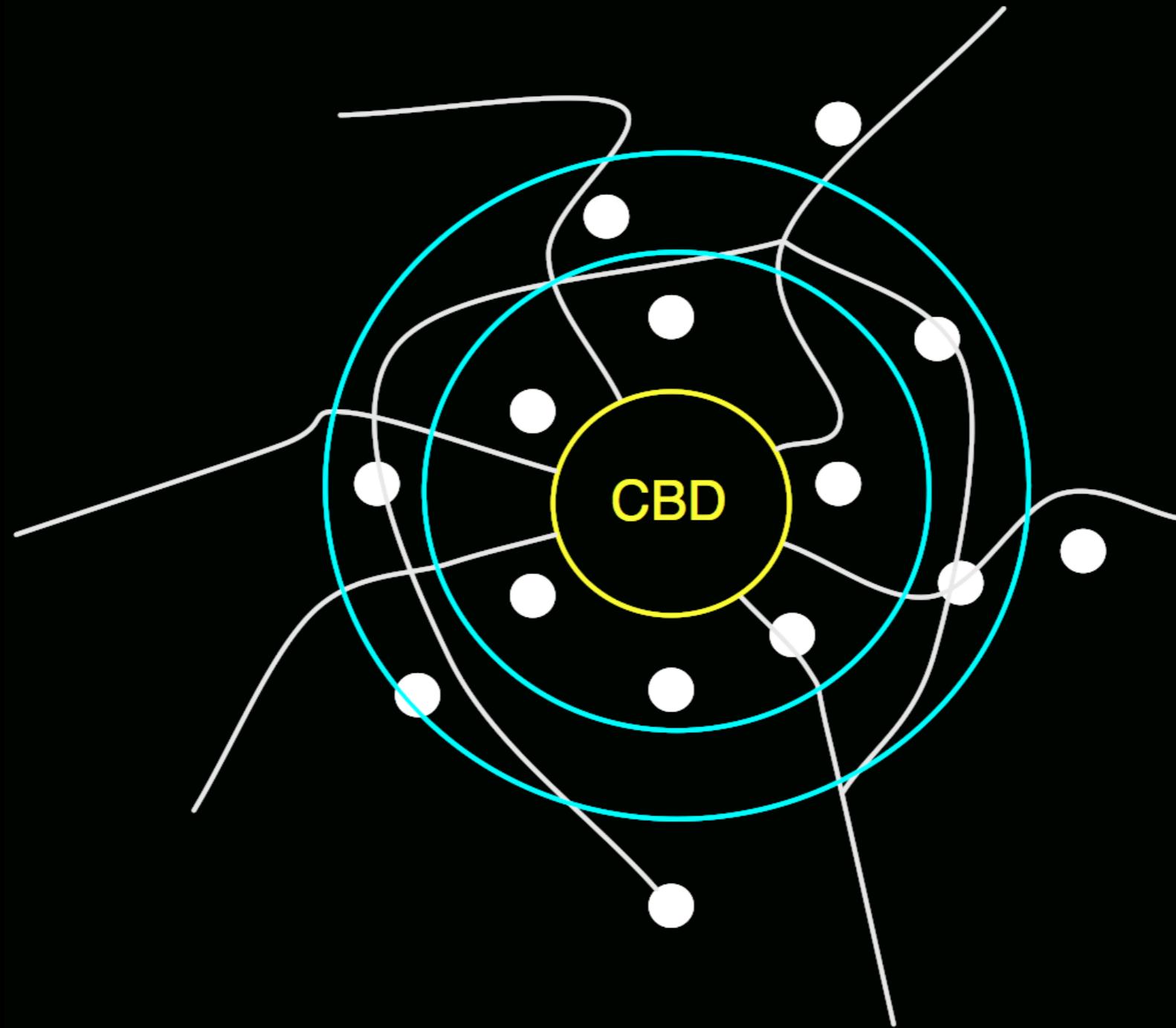
Methodology: Tool description



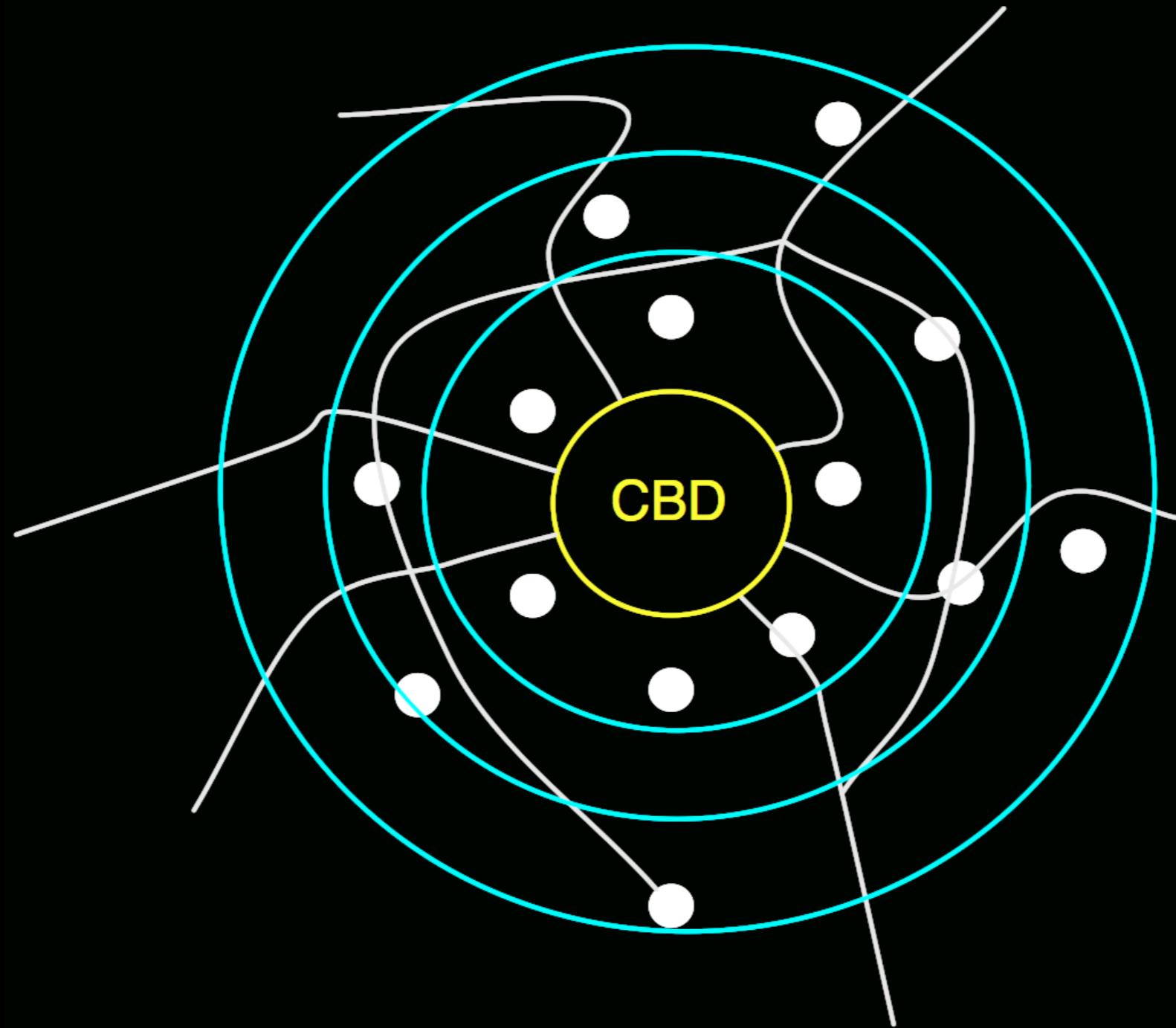
Methodology: Tool description



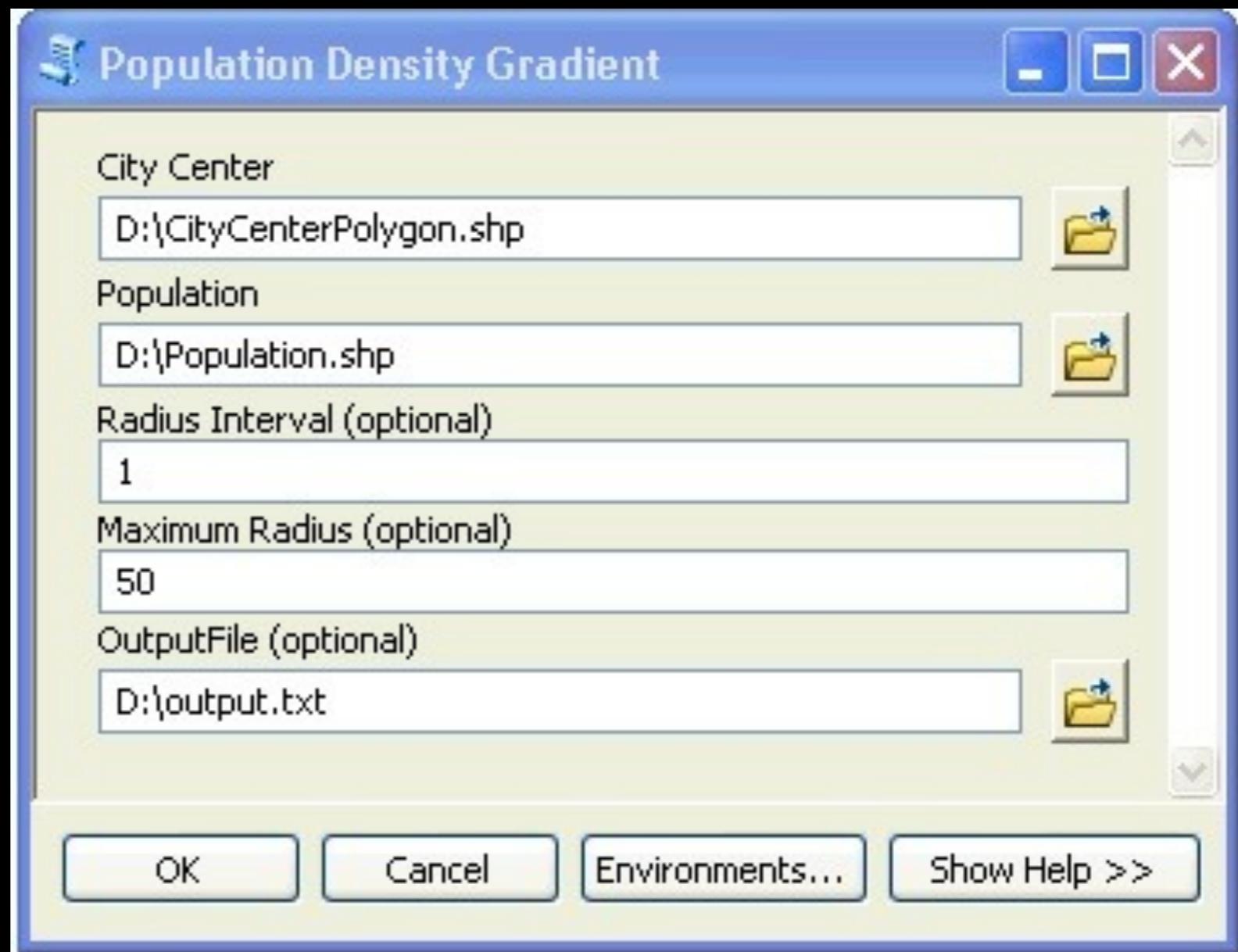
Methodology: Tool description



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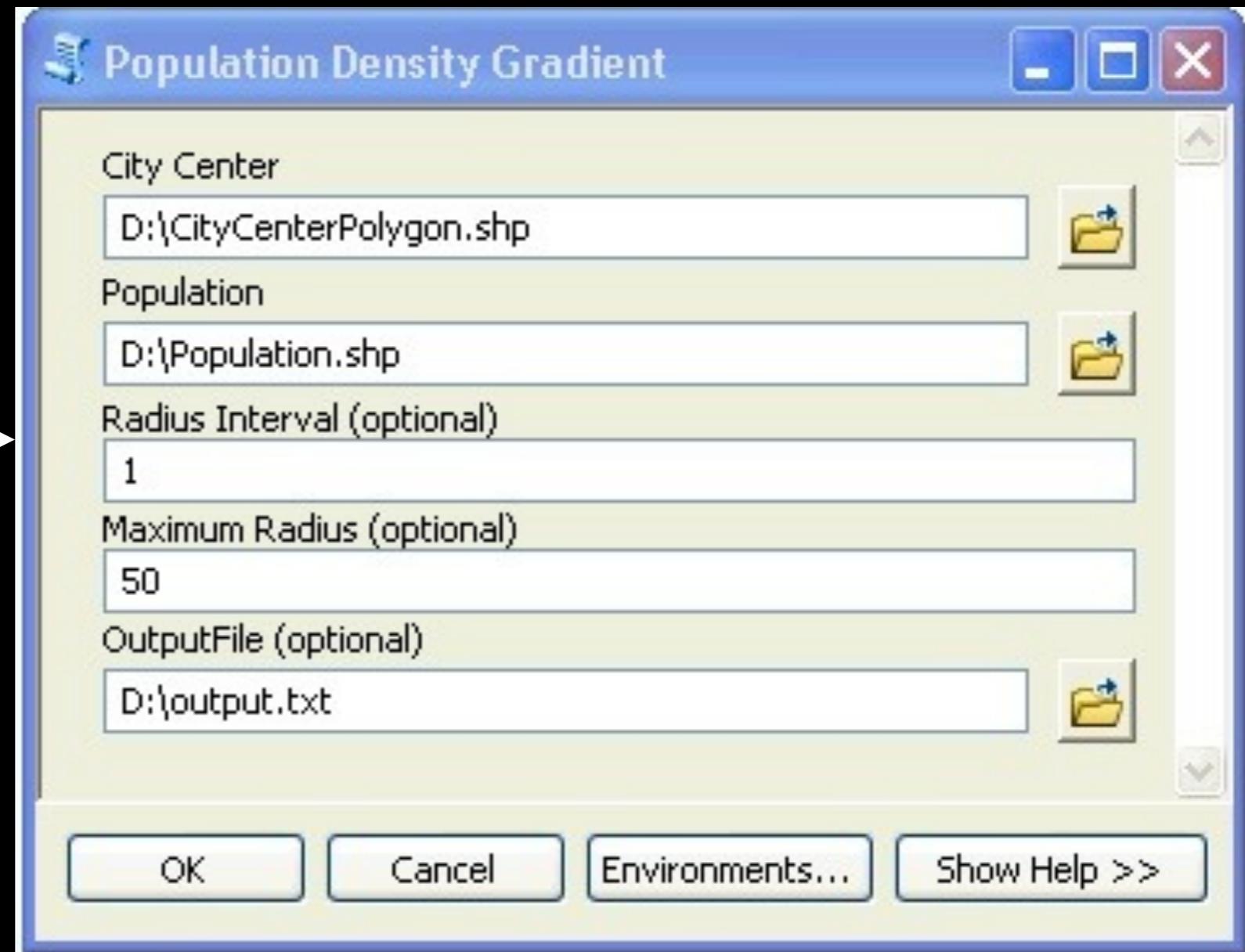


Methodology: Tool description



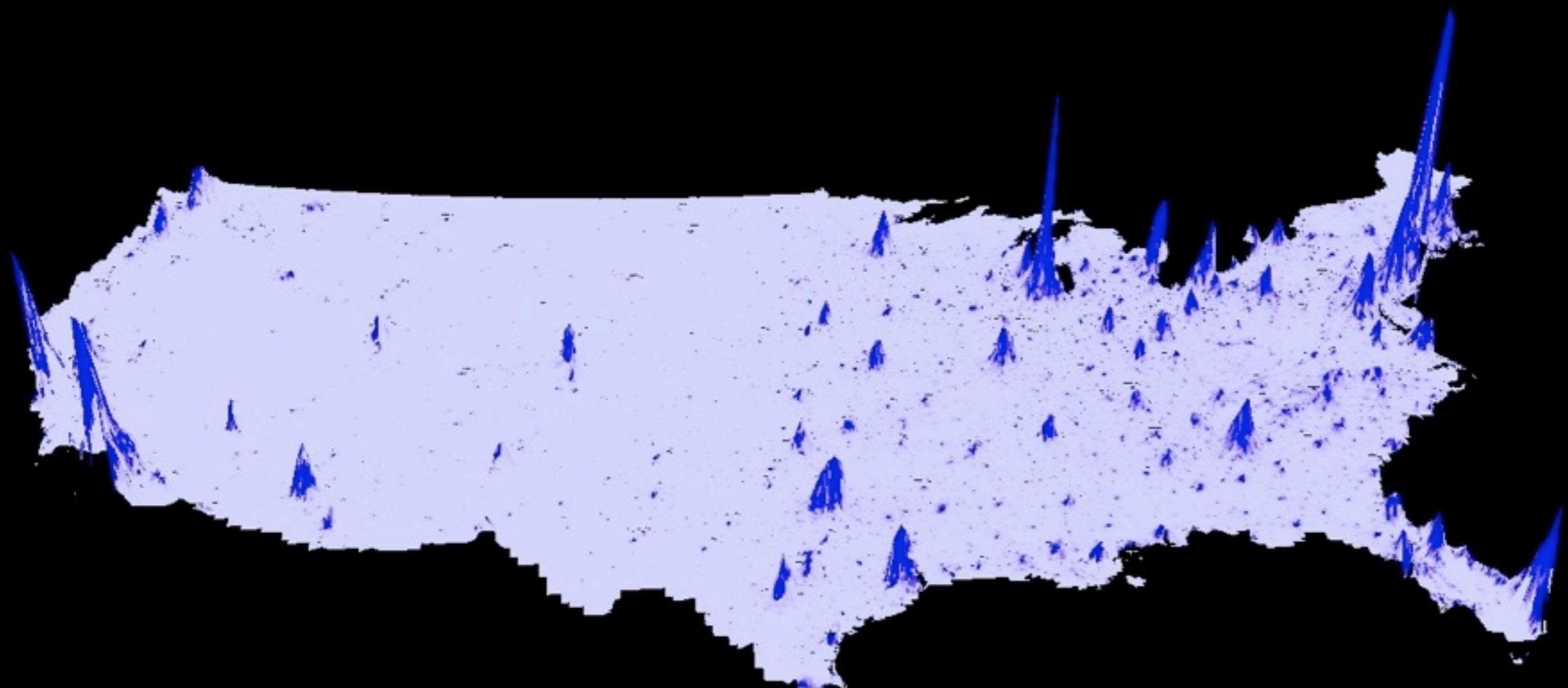
Methodology: Tool description

National
Datasets



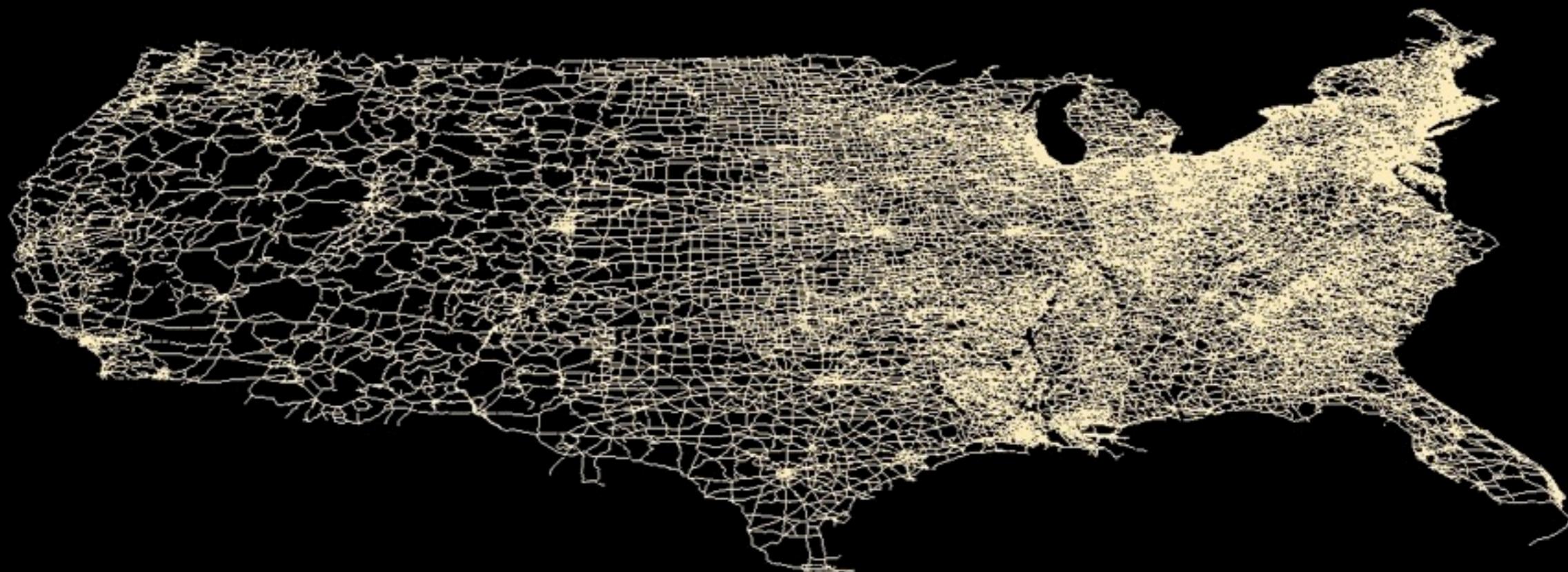
Example of Analysis:

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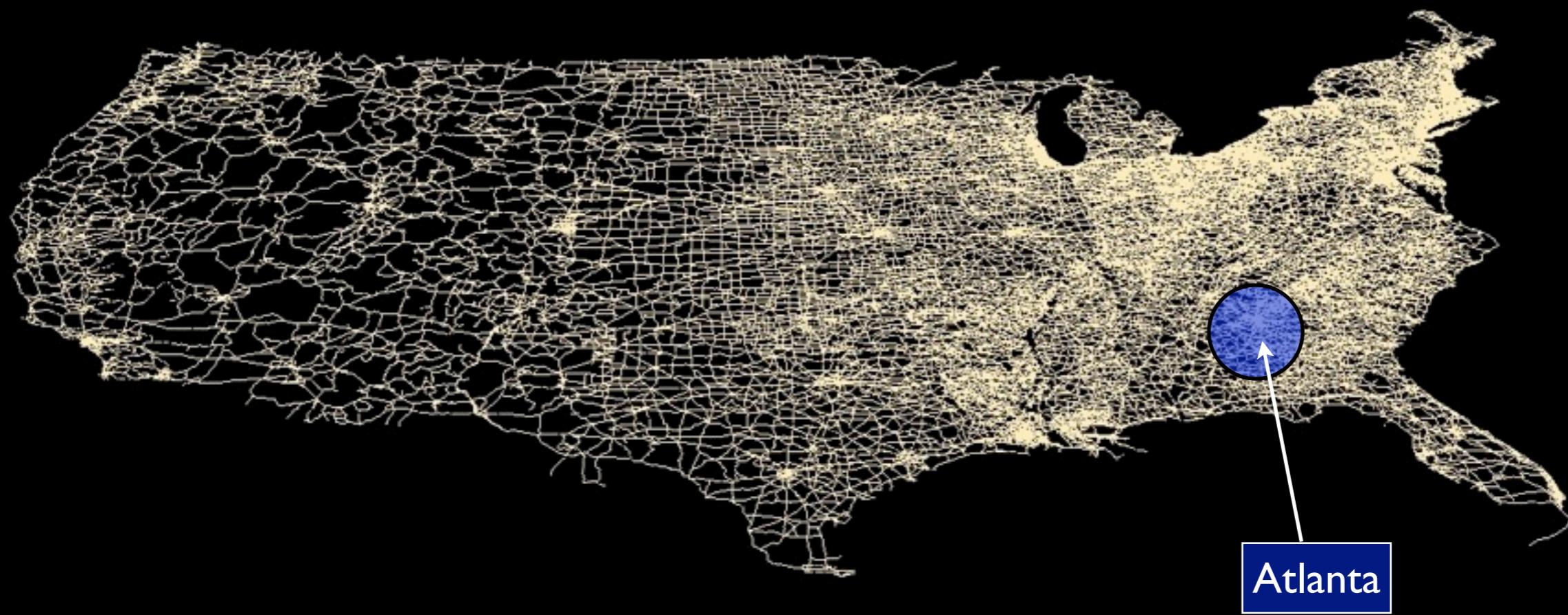
Data Source:
US Census
(2000)

Example of Analysis:



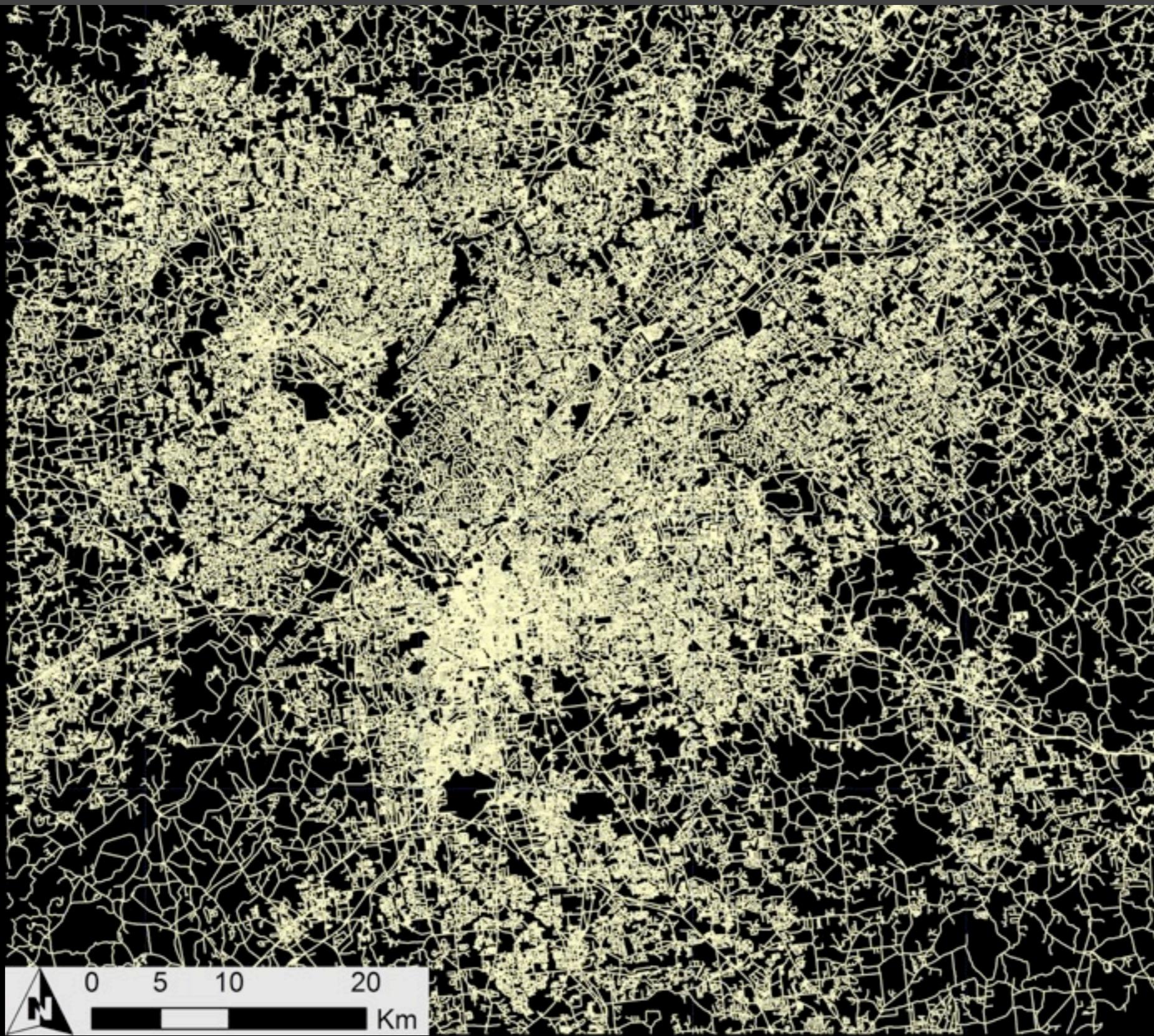
Data Source:
US Tiger Line
Files (2009)

Example of Analysis:



Data Source:
US Tiger Line
Files (2009)

Example of Analysis: Atlanta



Example of Analysis: Atlanta

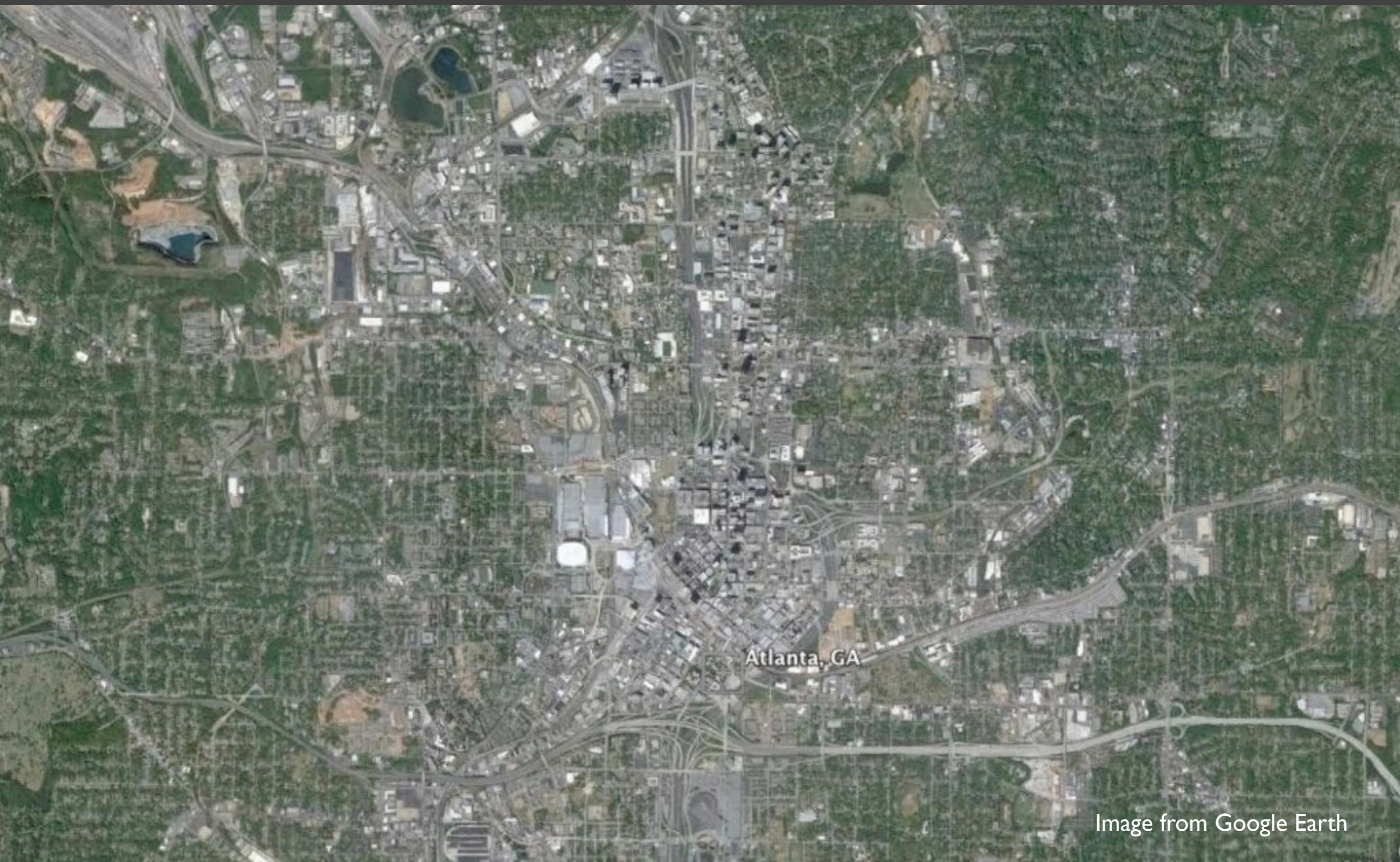
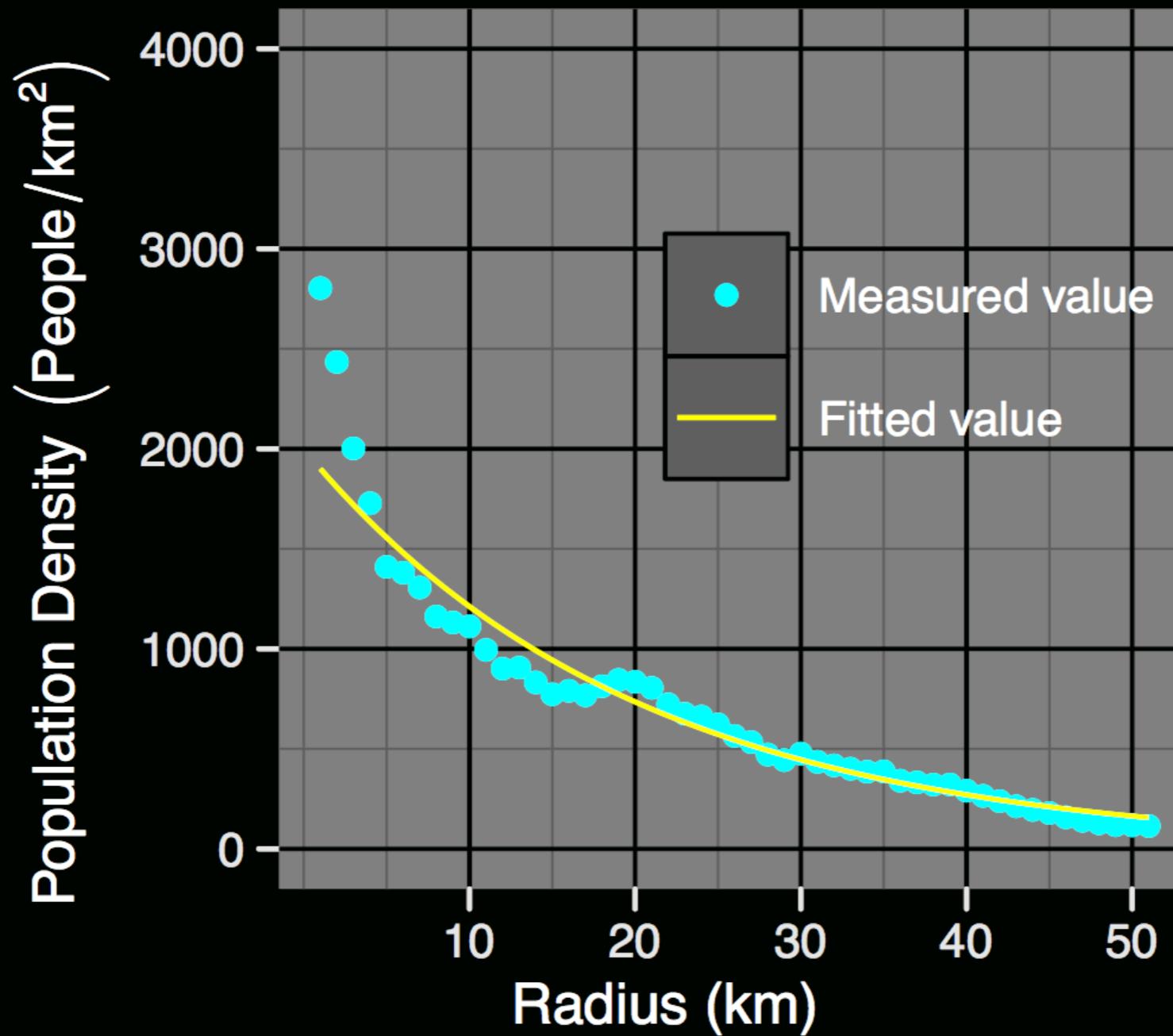


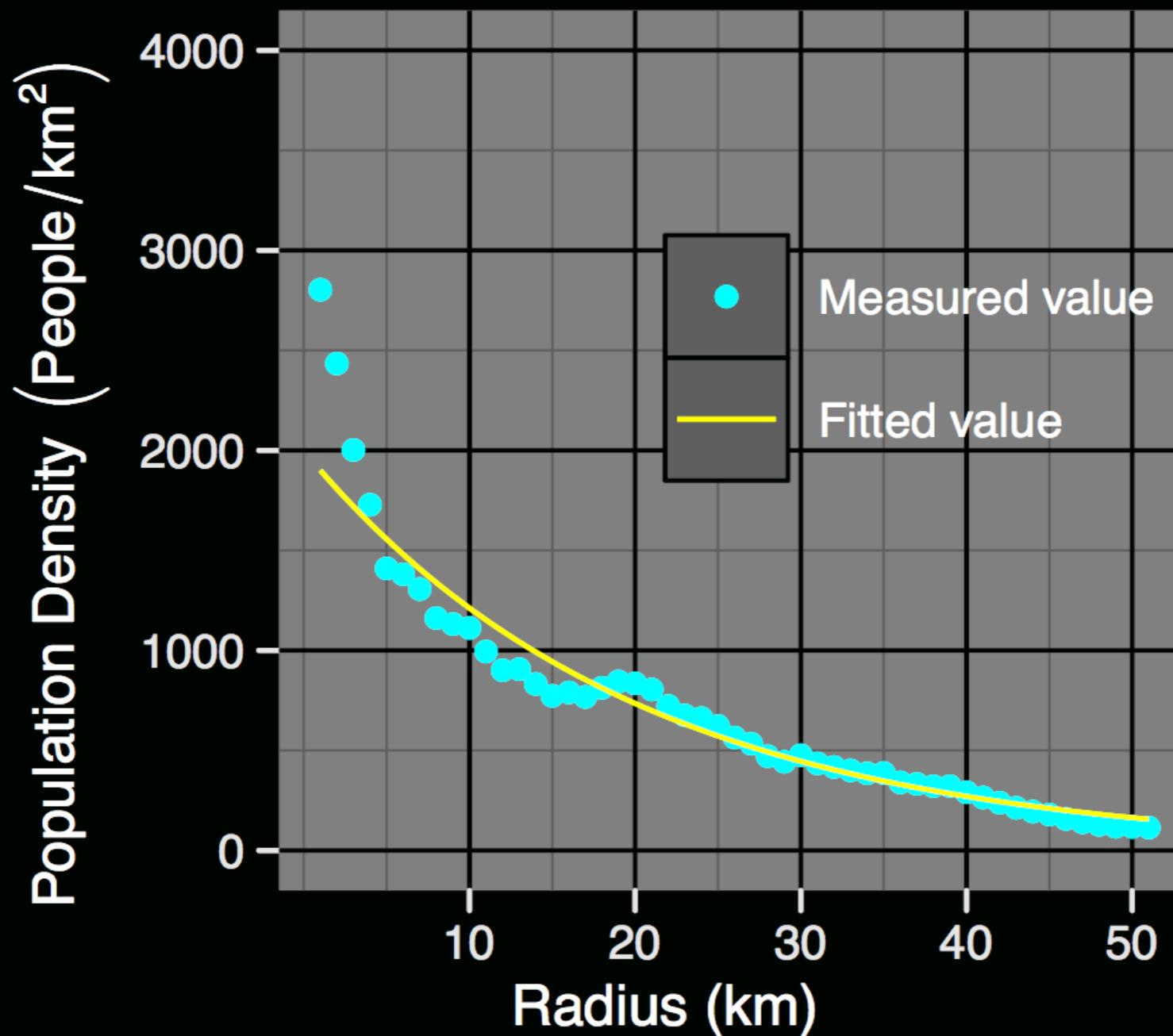
Image from Google Earth

Results: Atlanta - Population Density



Data Source:
US Census (2000)

Results: Atlanta - Population Density



$$y = Ae^{br}$$

t-value: -25.42
P-value: 0.000
Adj-R-Square: 0.931

Data Source:
US Census (2000)

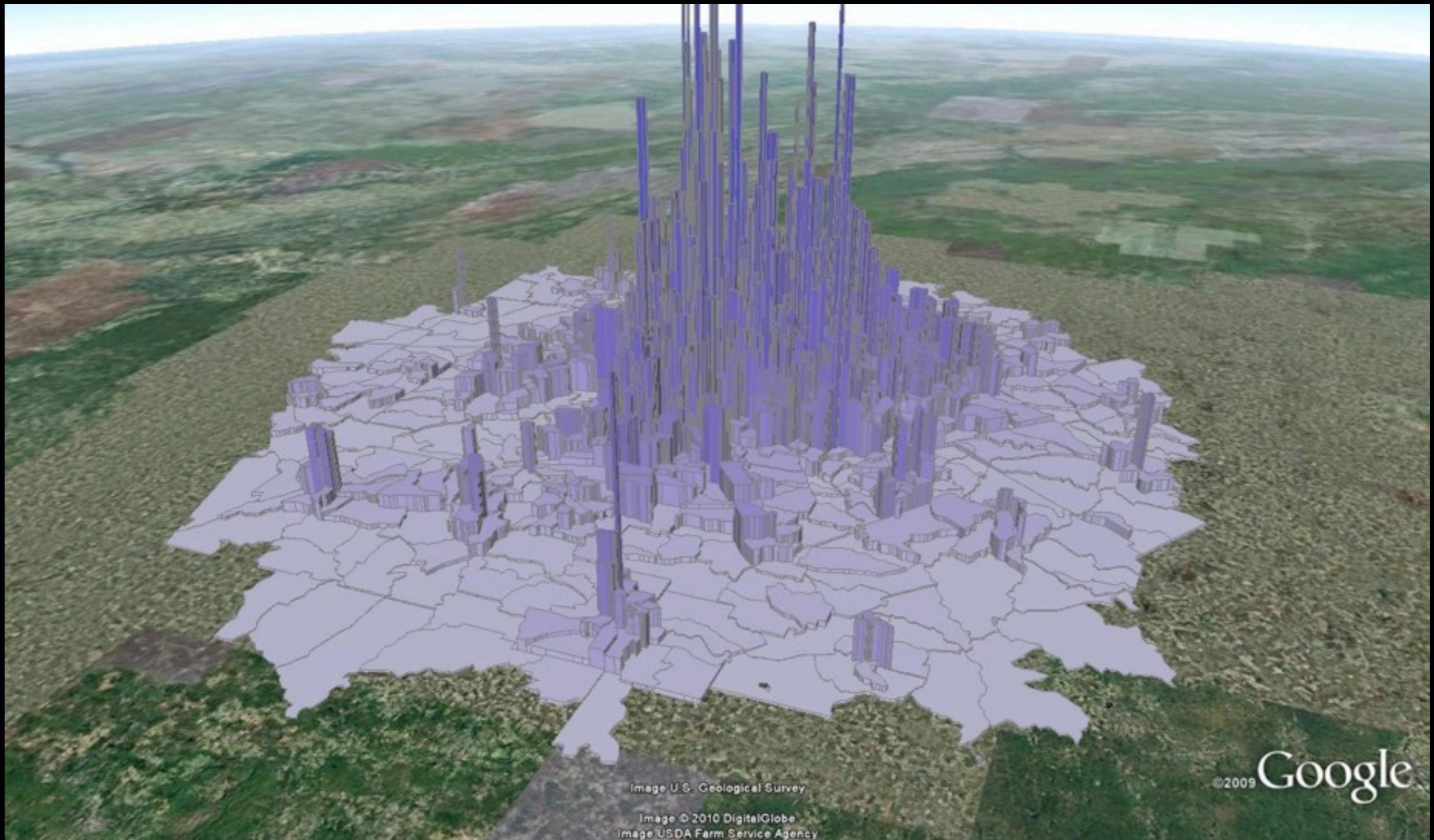
Results: Atlanta - Population Density



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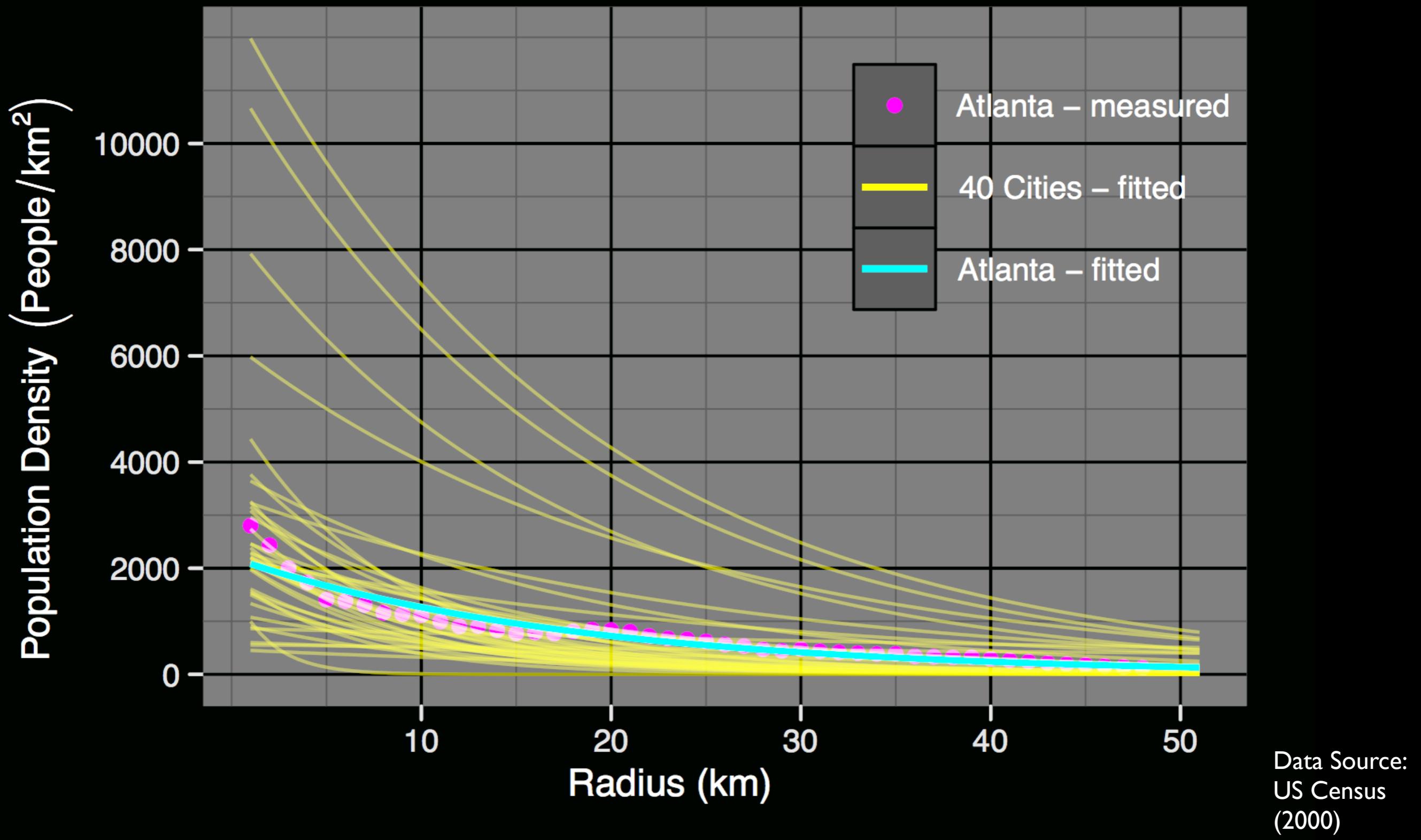
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Results: Atlanta - Population Density



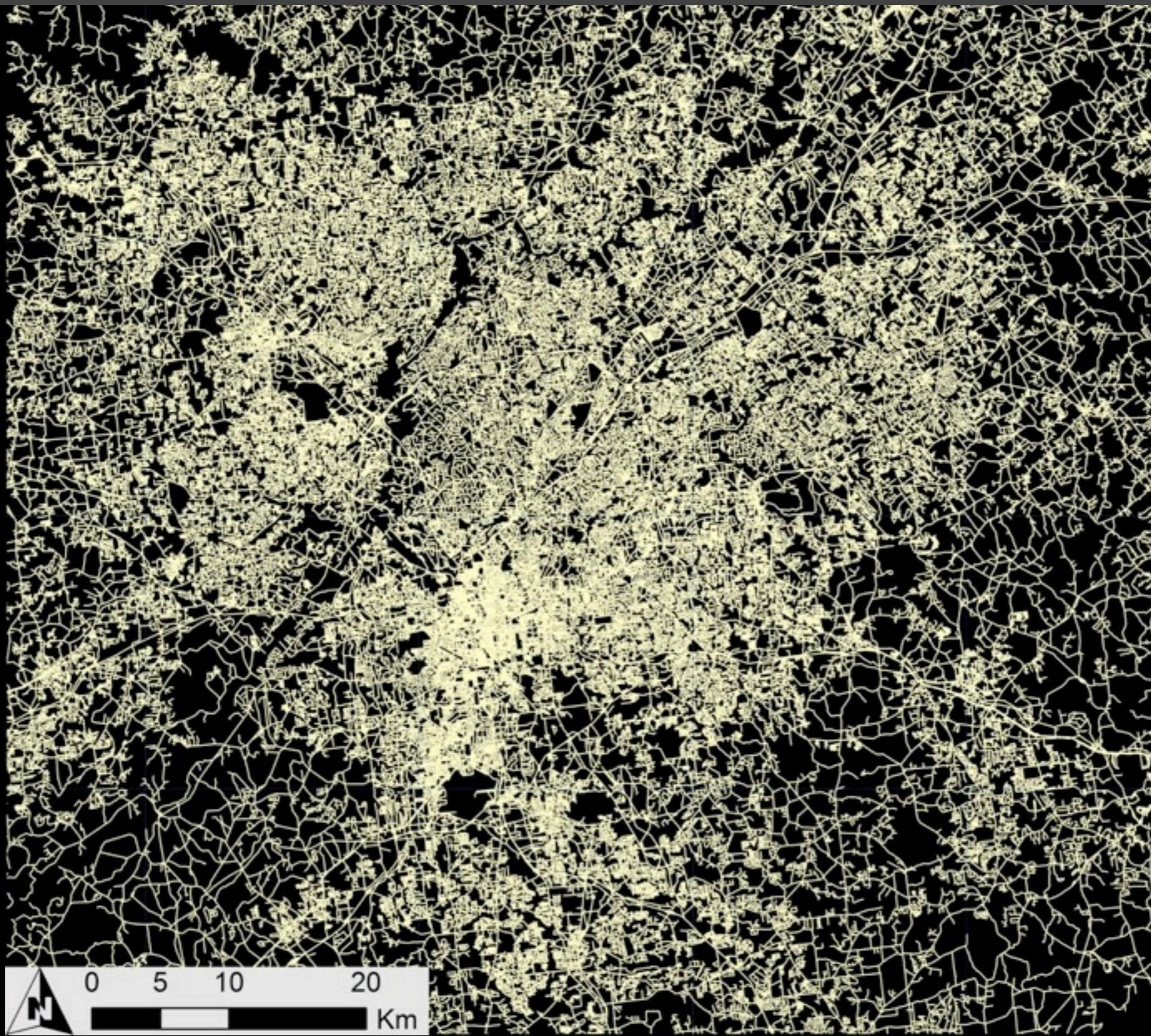
Results:

Population Density: $y = Ae^{br}$

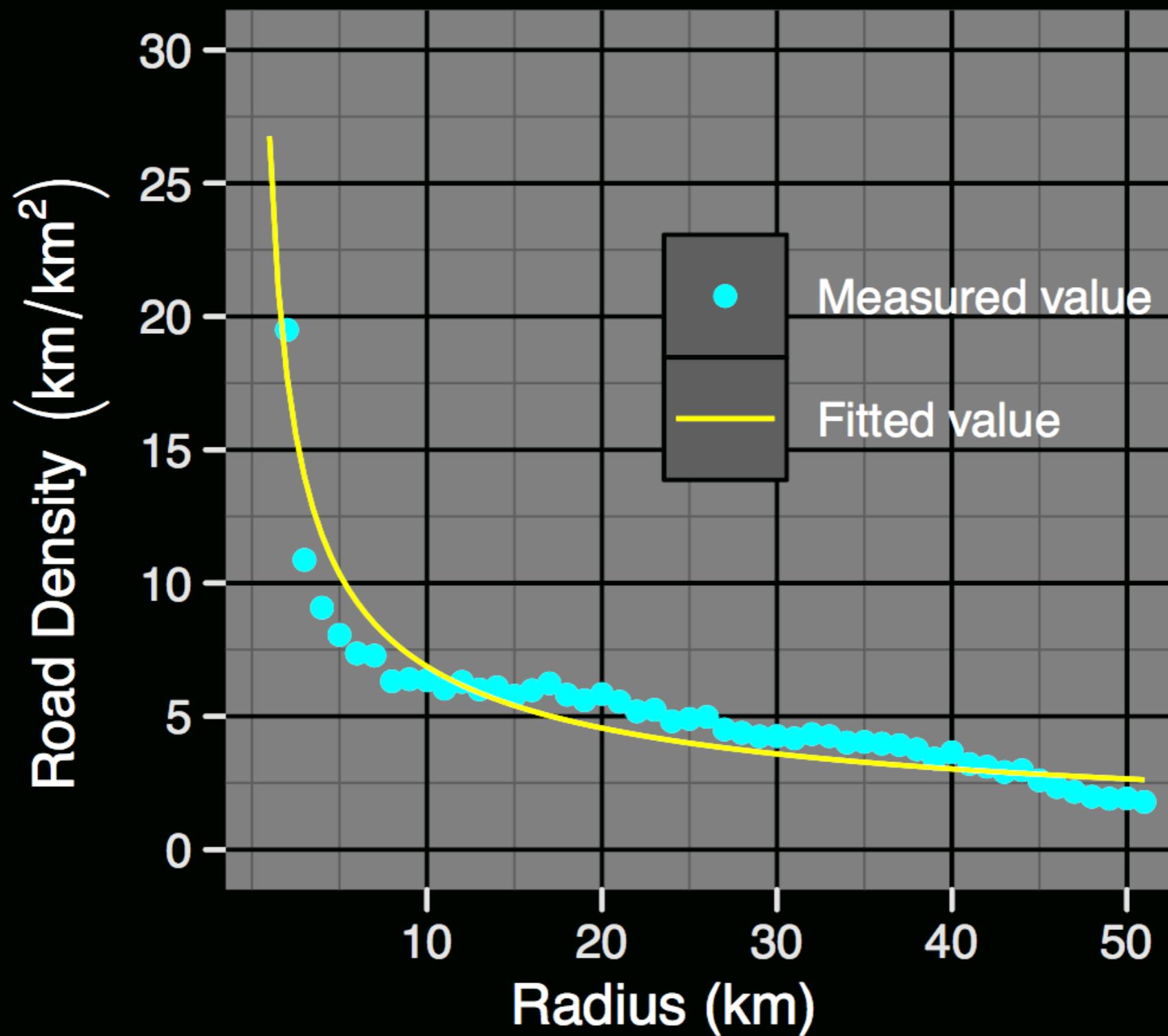


Results: Atlanta - Local Road Density

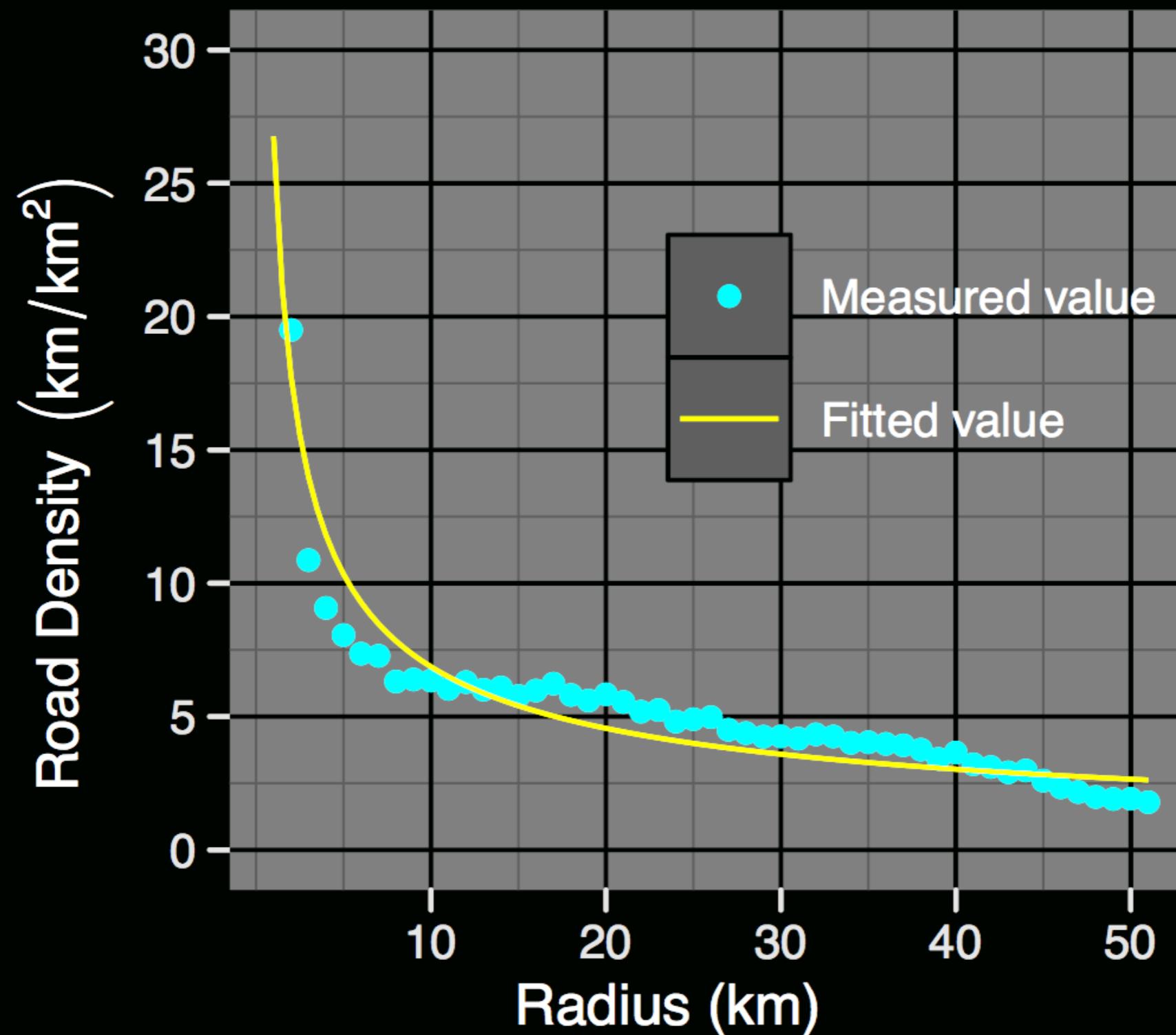
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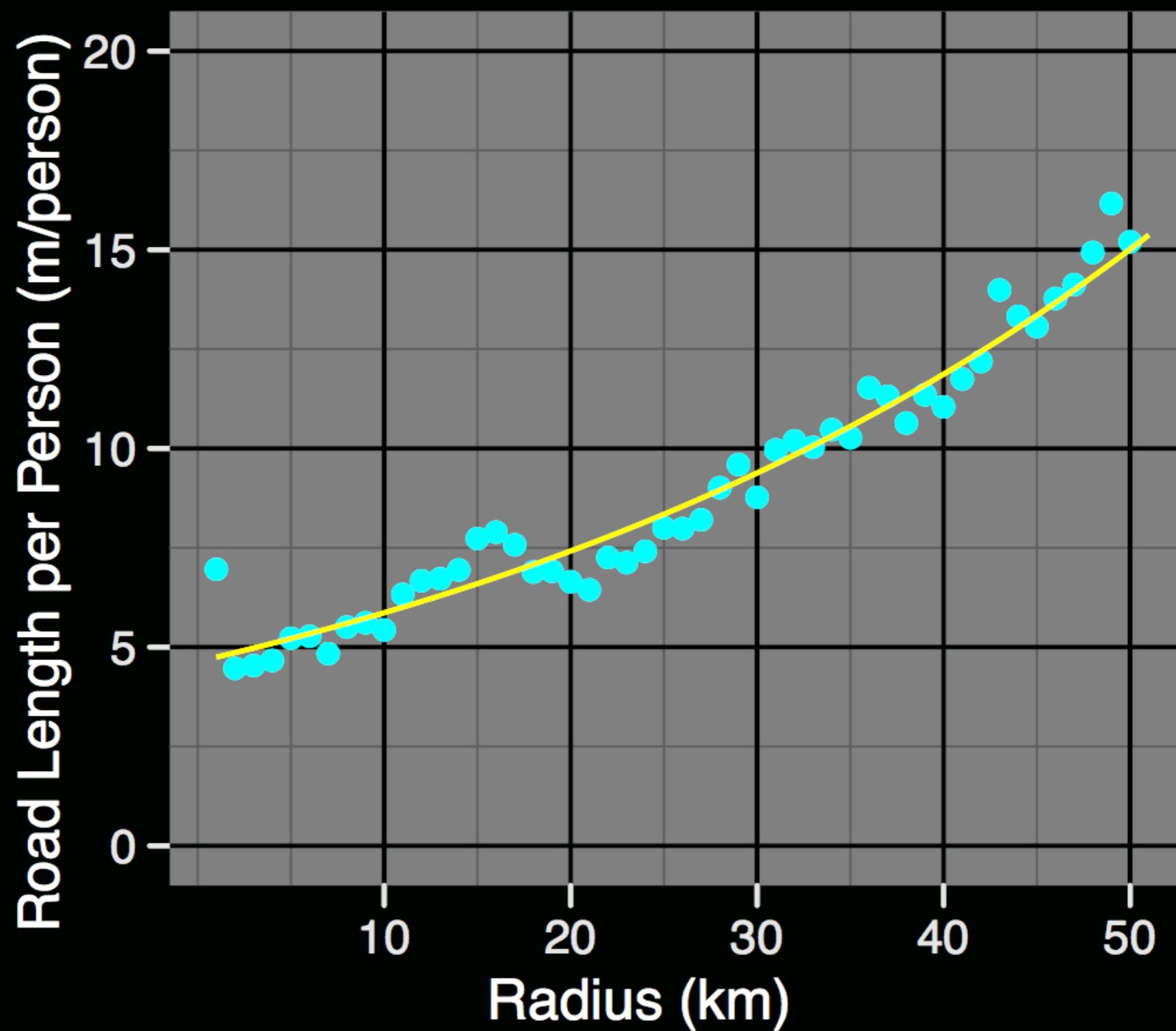


Results: Atlanta - Local Road Density

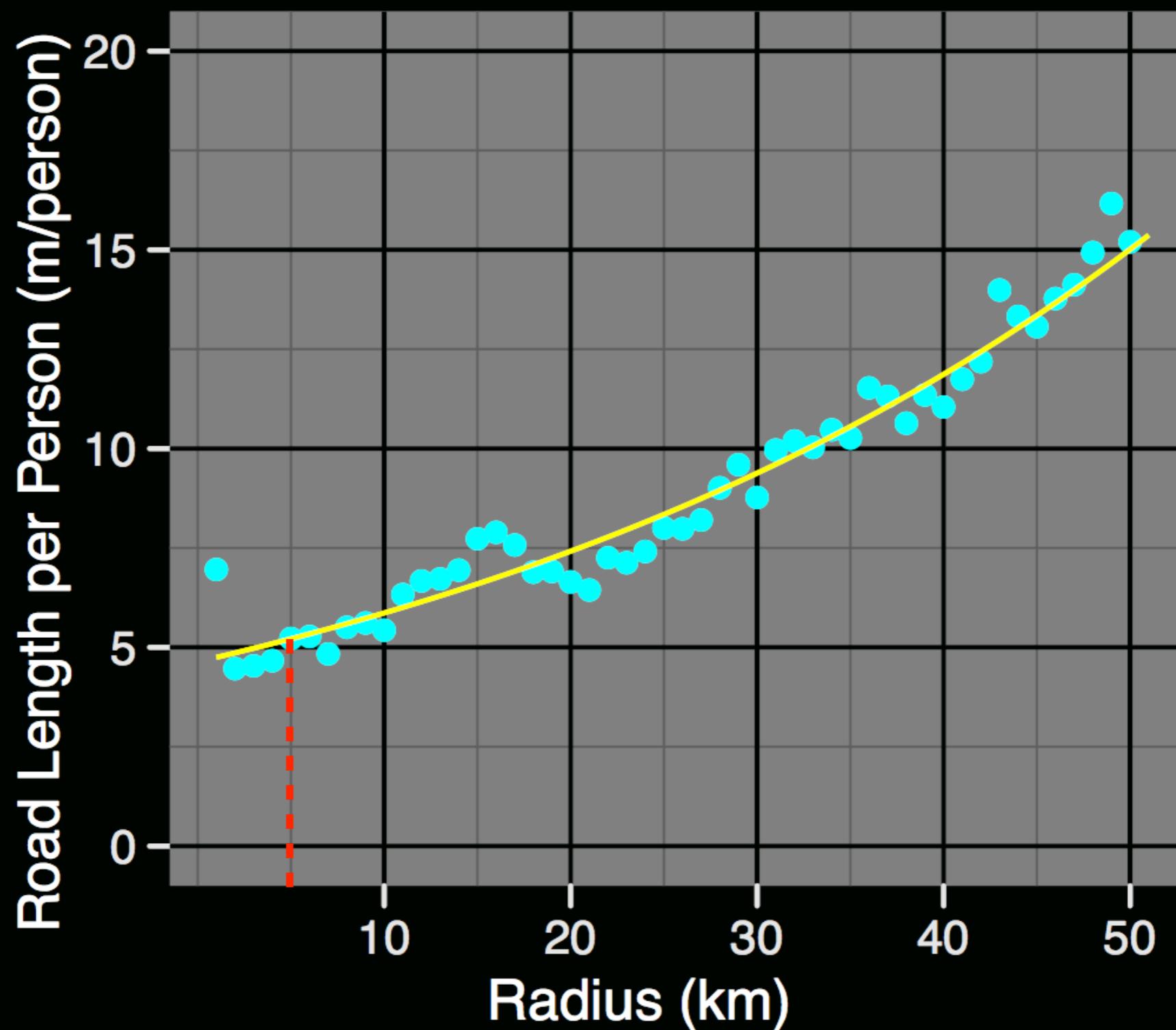


$$y = Ar^b$$

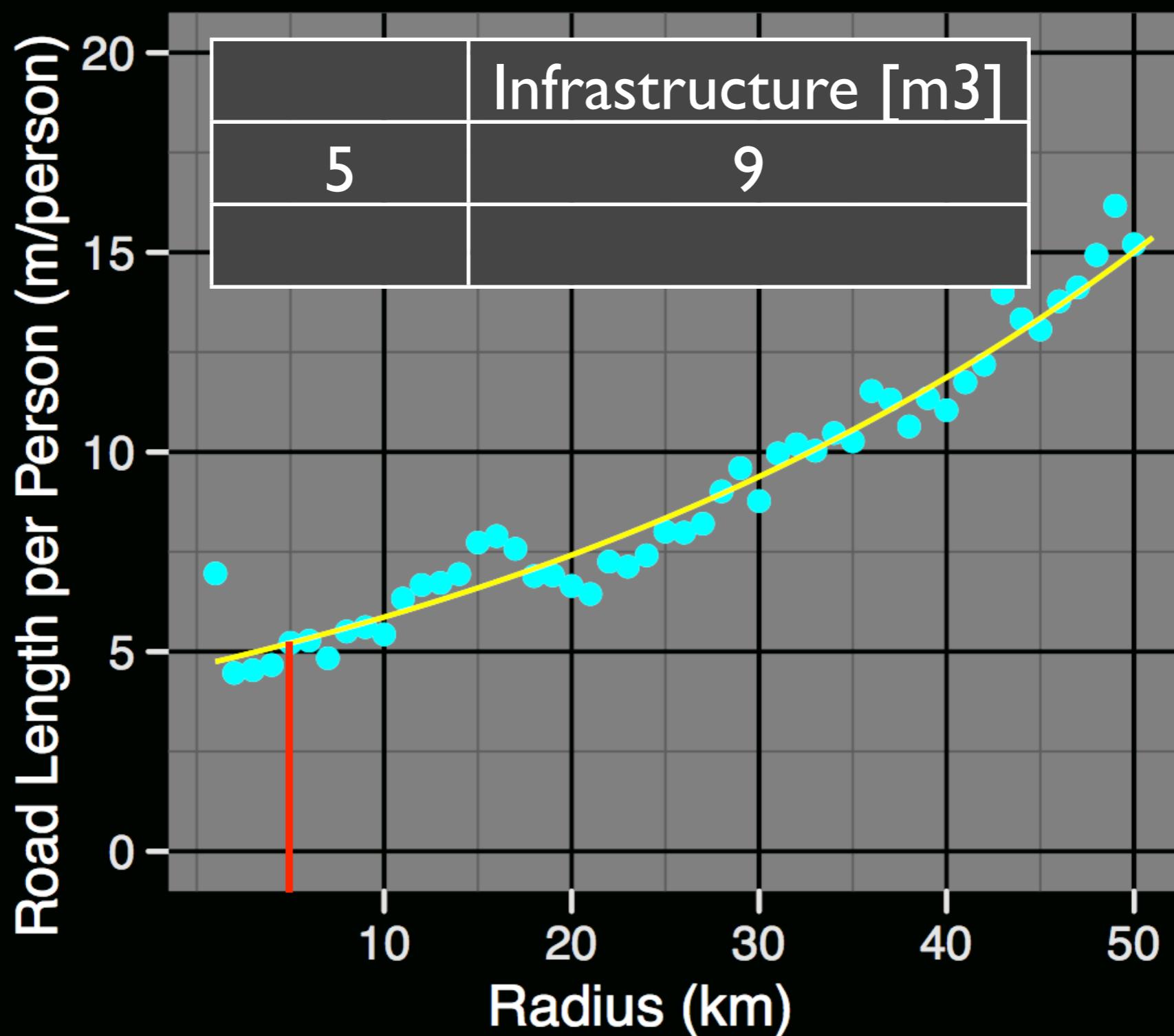
Results: Atlanta - Local Road per Person



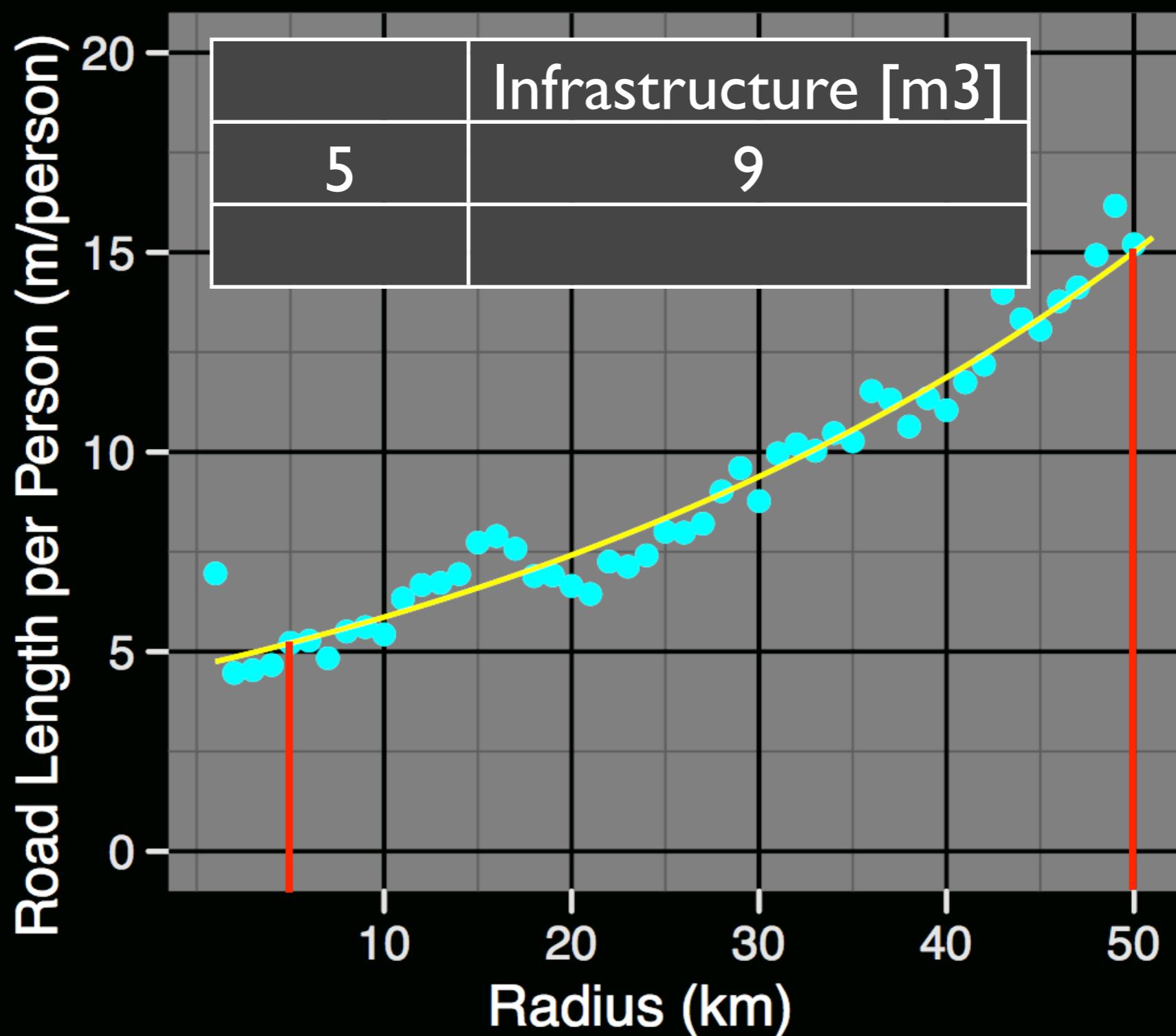
Results: Atlanta - Local Road per Person



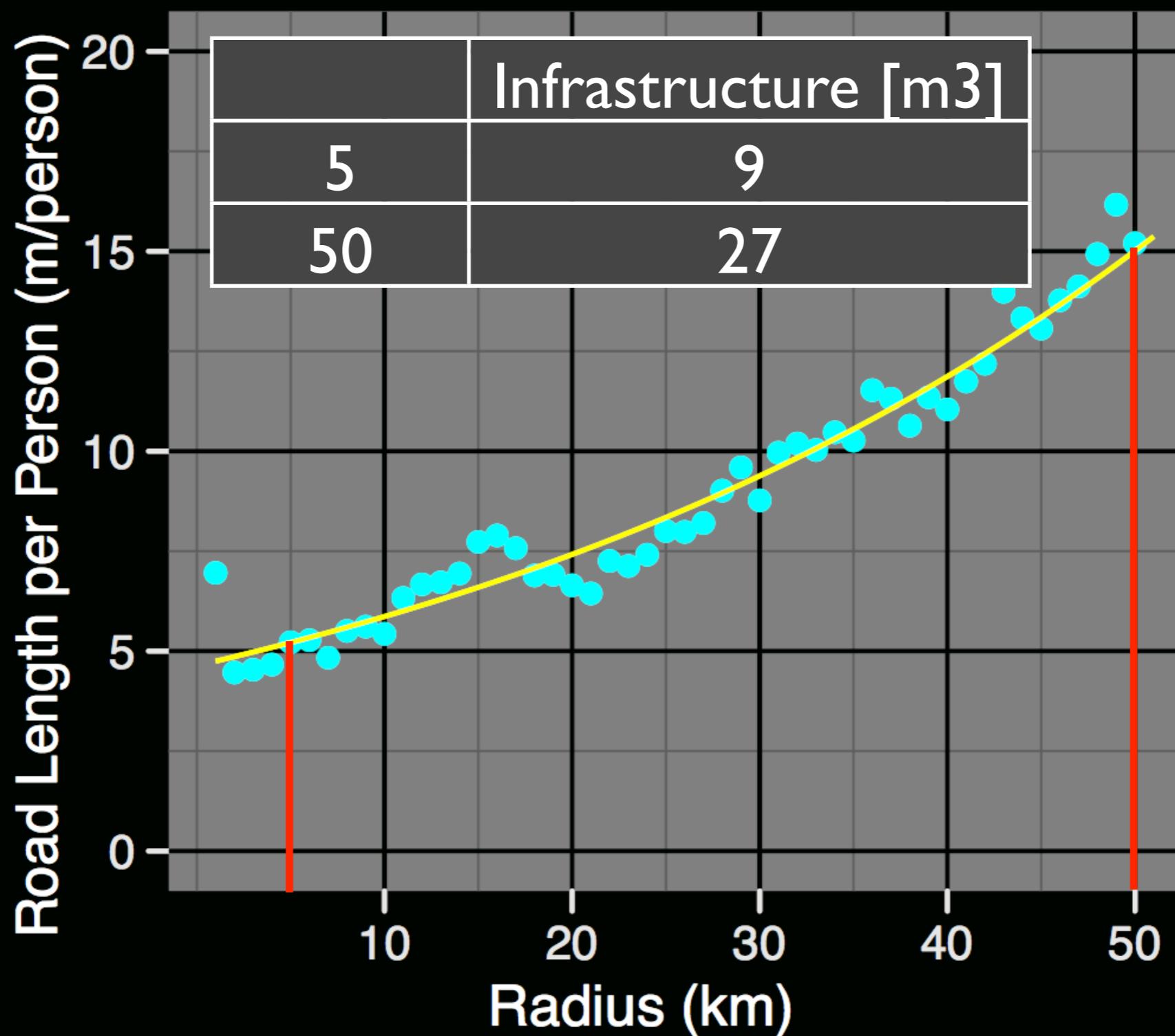
Results: Atlanta - Local Road per Person



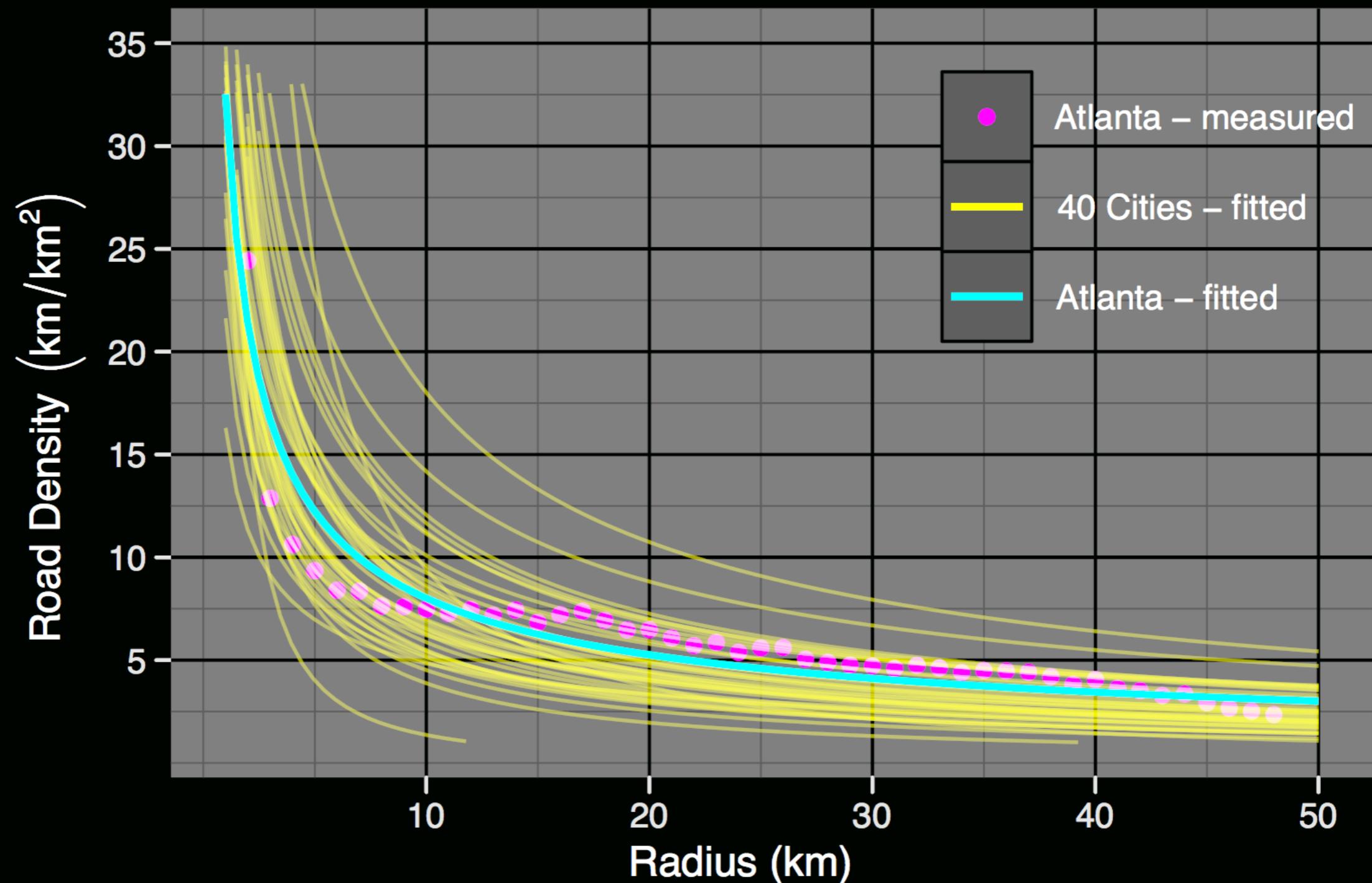
Results: Atlanta - Local Road per Person



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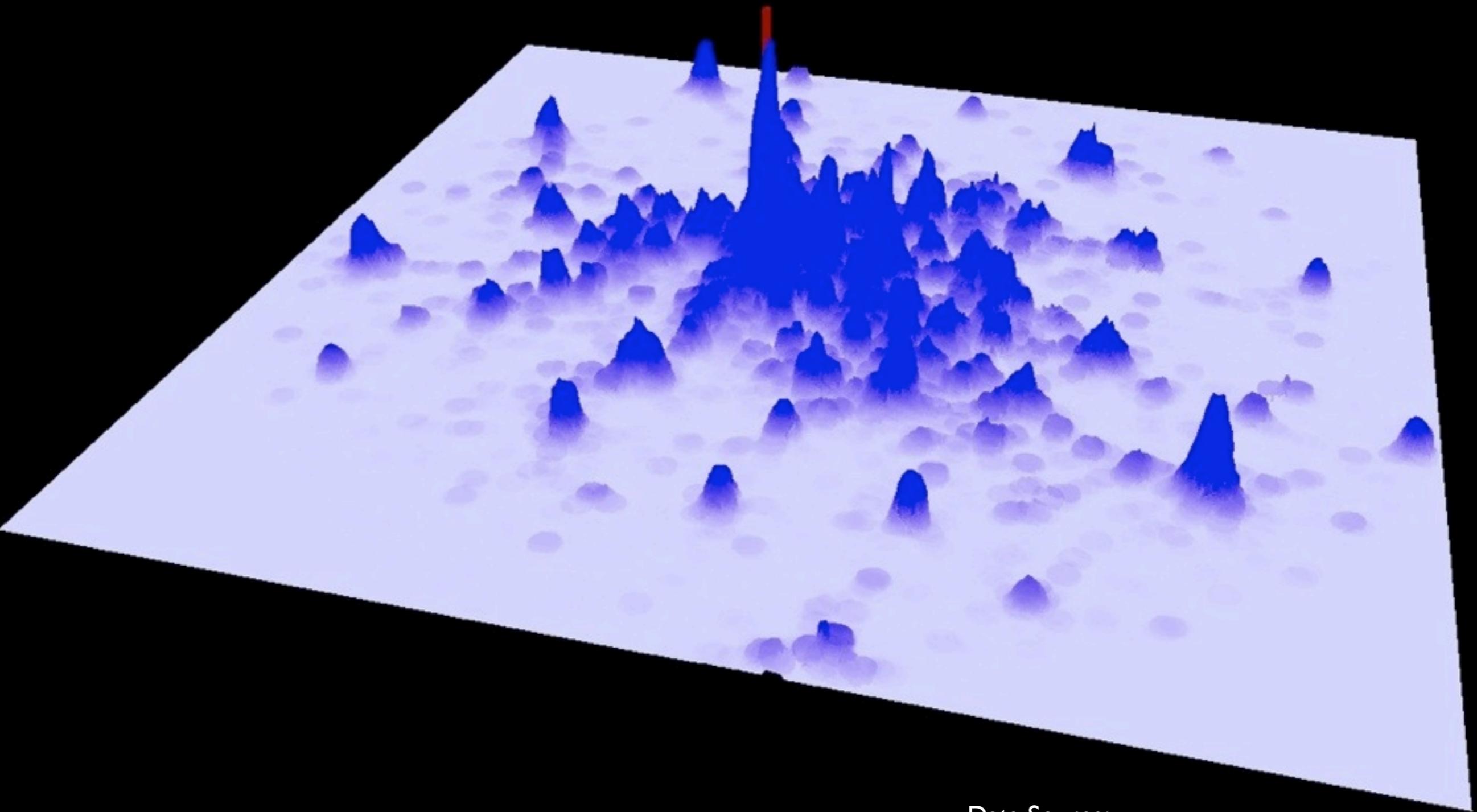


Results: Local Road Density



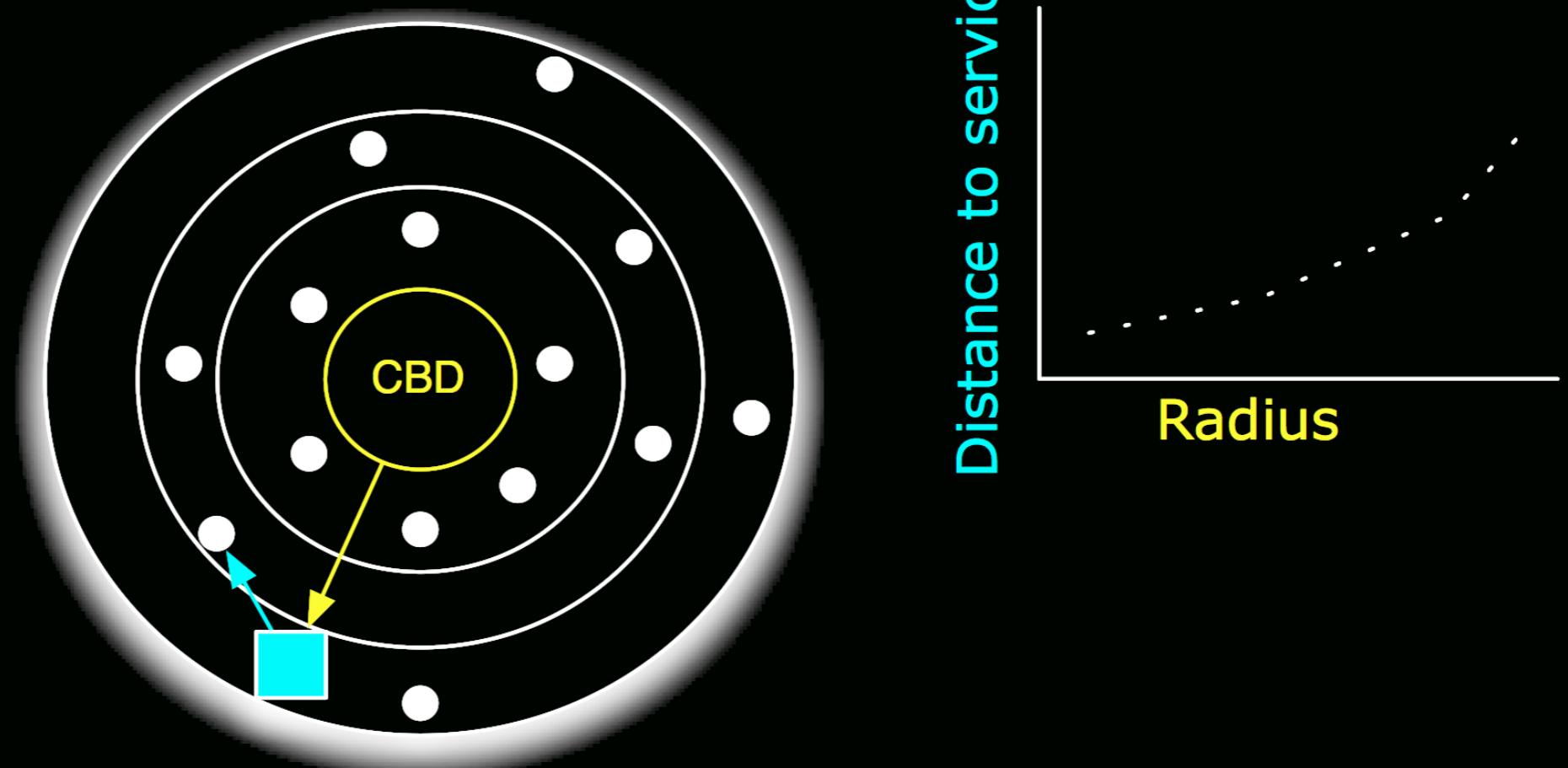
Methodology: Service Distance Gradient

Methodology: Atlanta - density of services

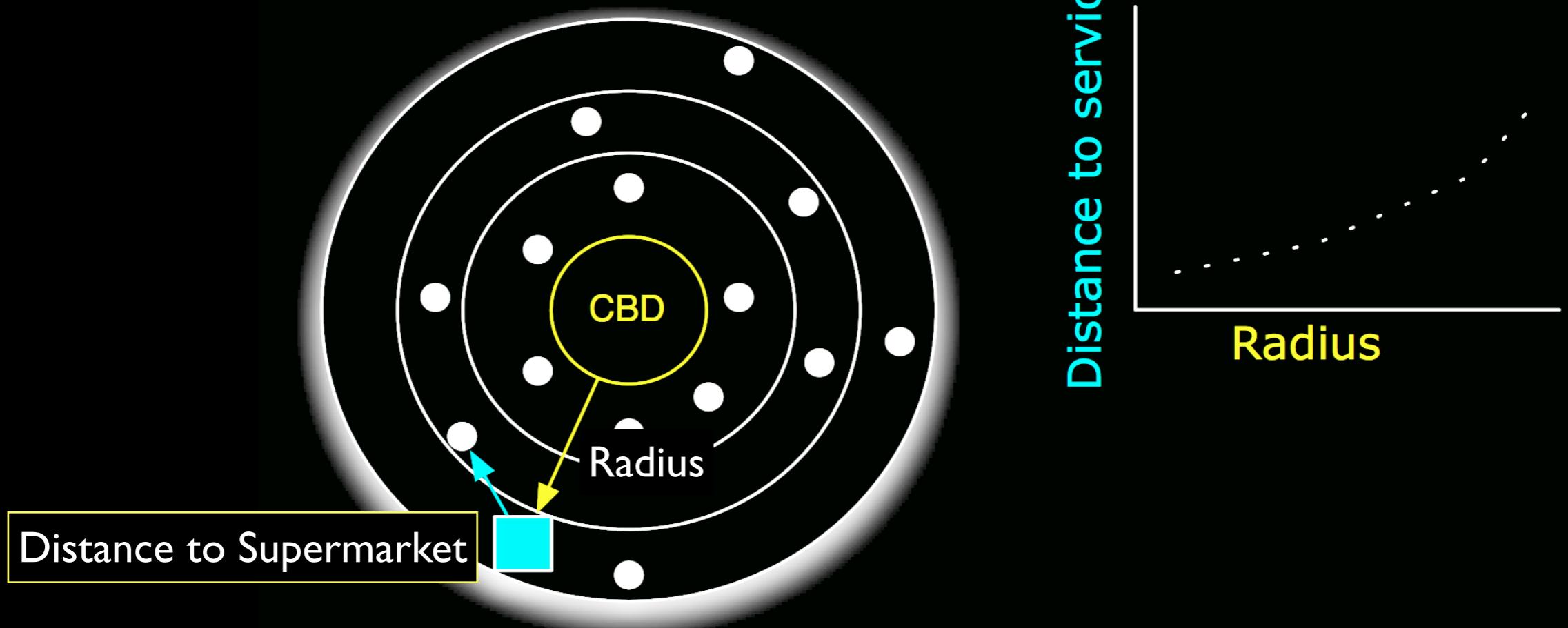


Data Source:
ESRI Business
Analyst 2009

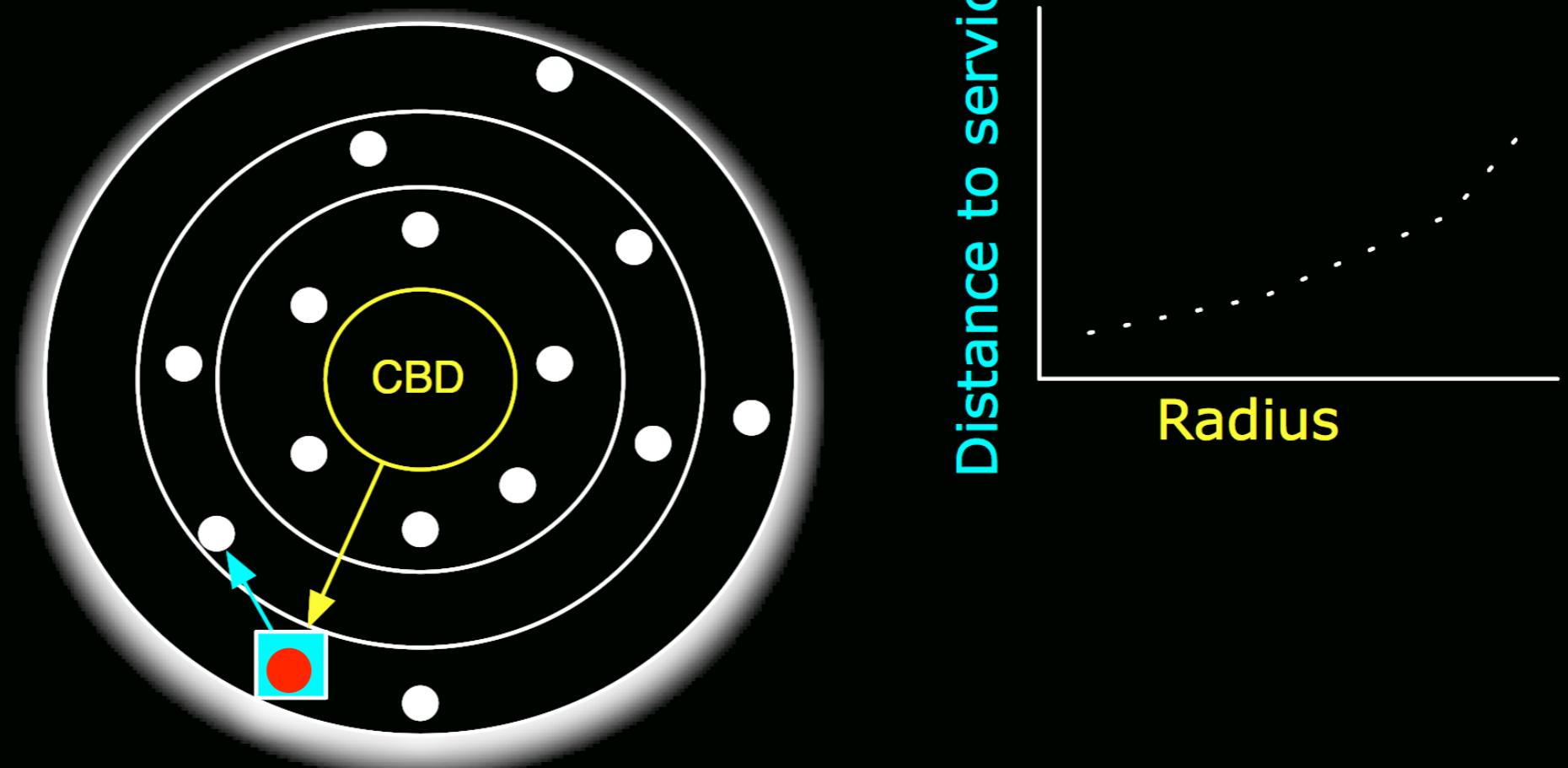
Methodology: Service Distance Gradient



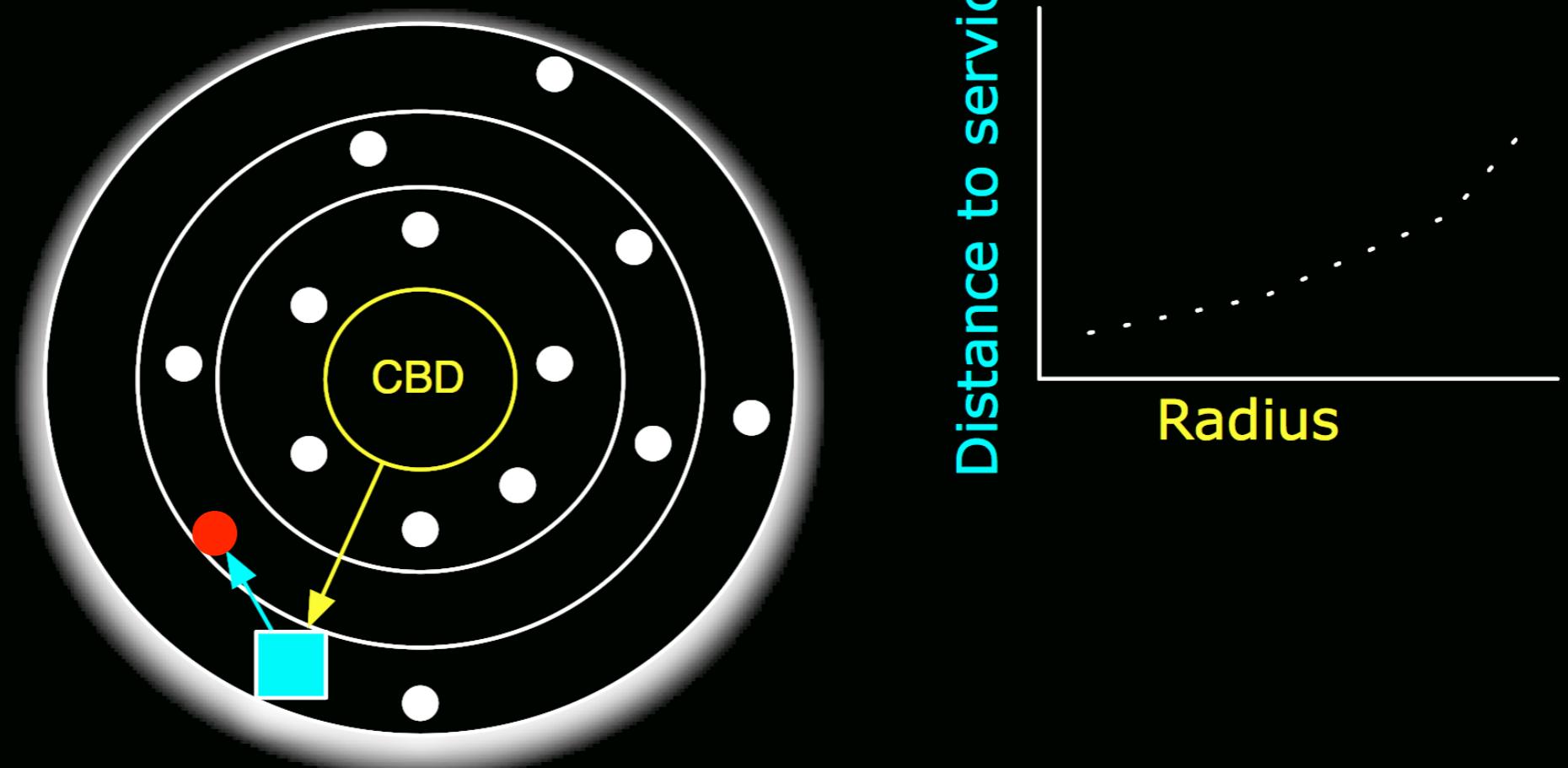
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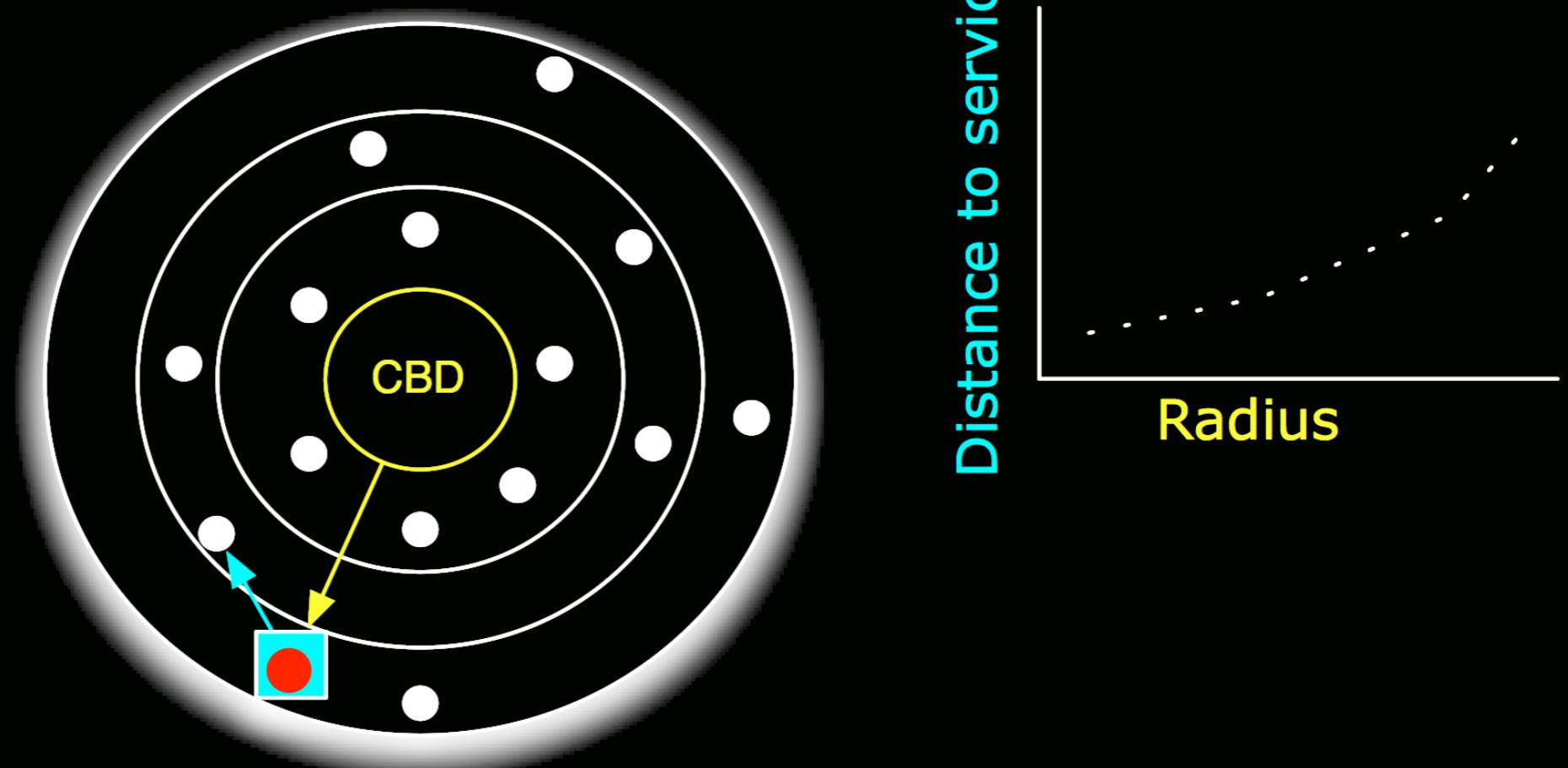
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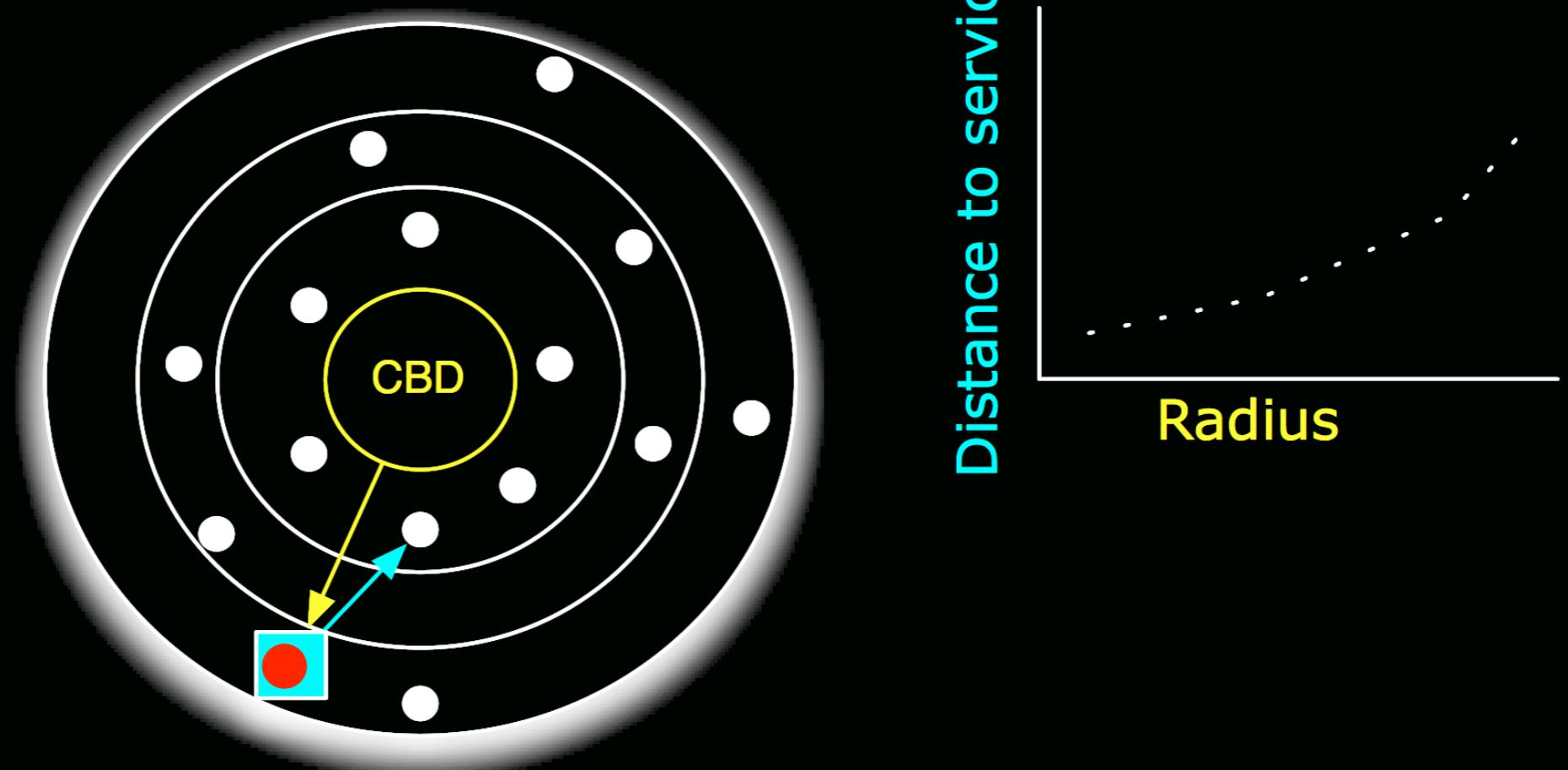
Methodology: Service Distance Gradient



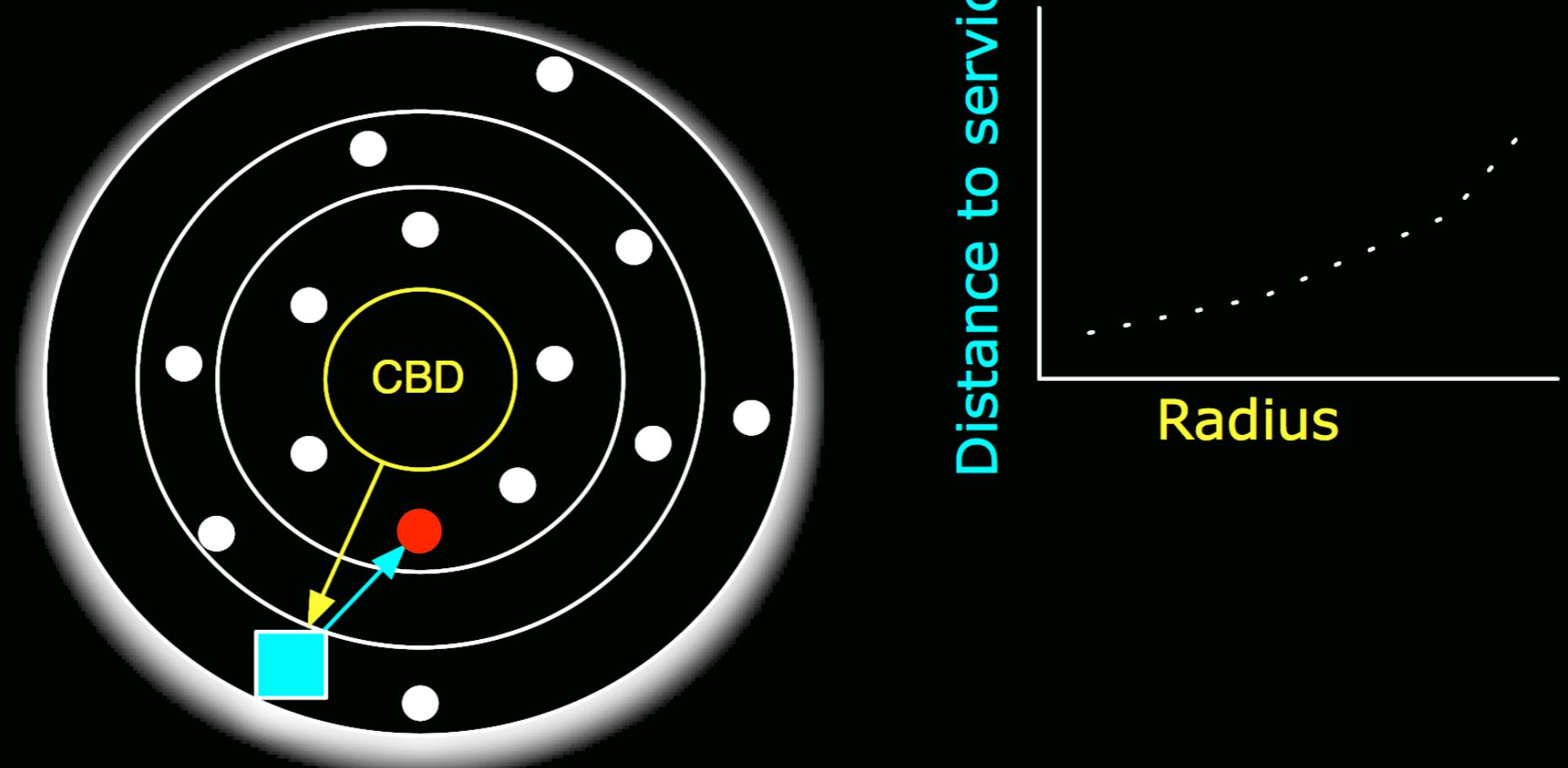
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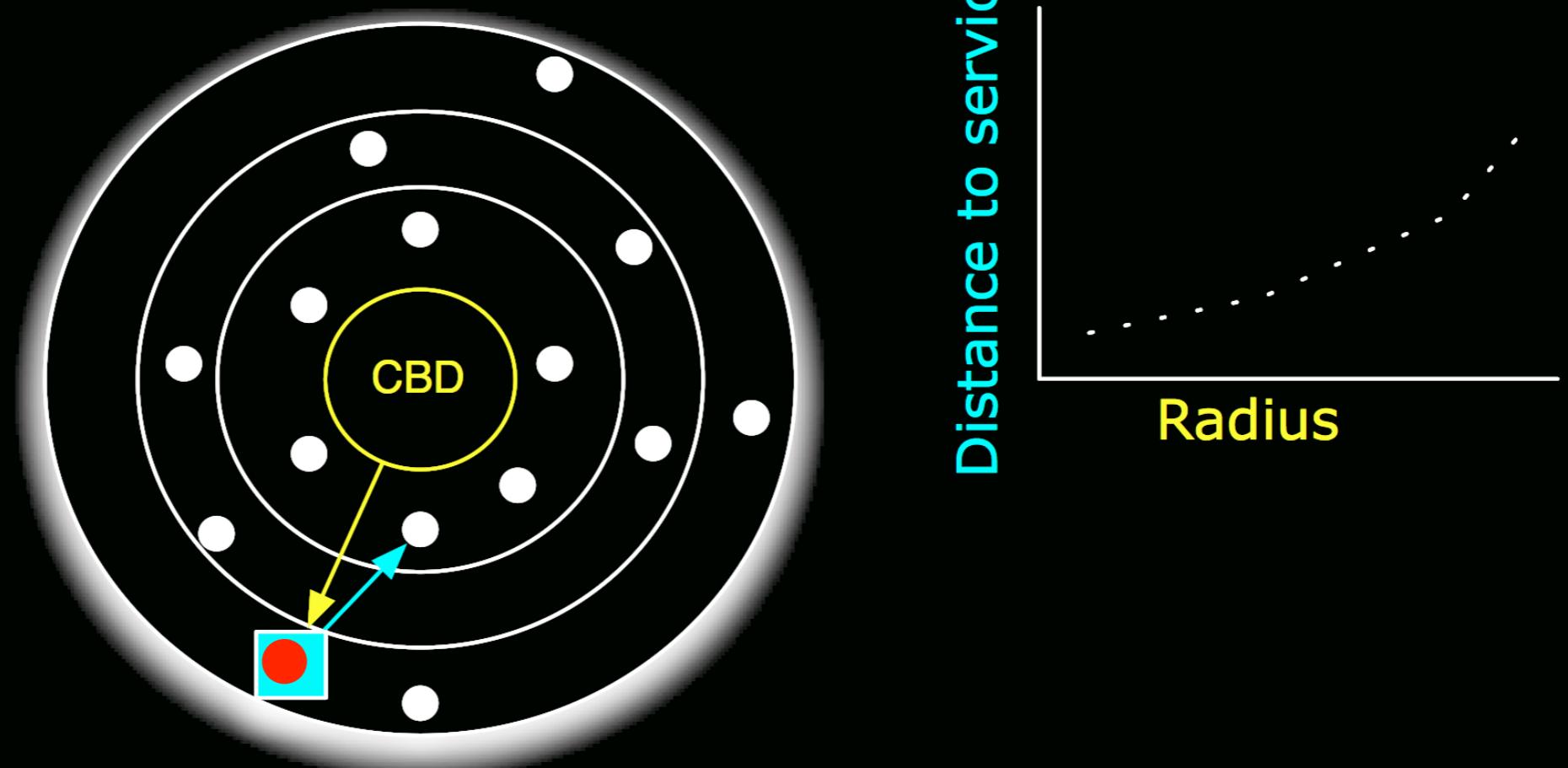
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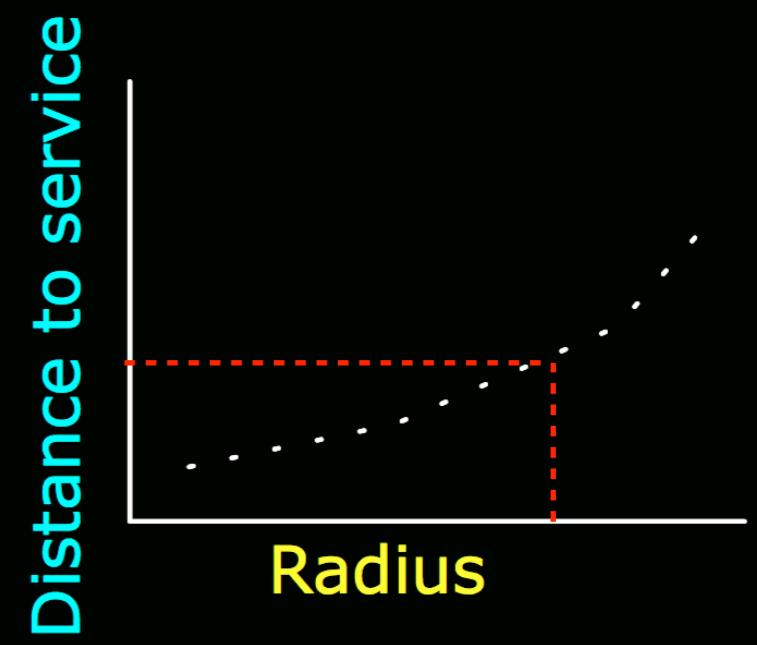
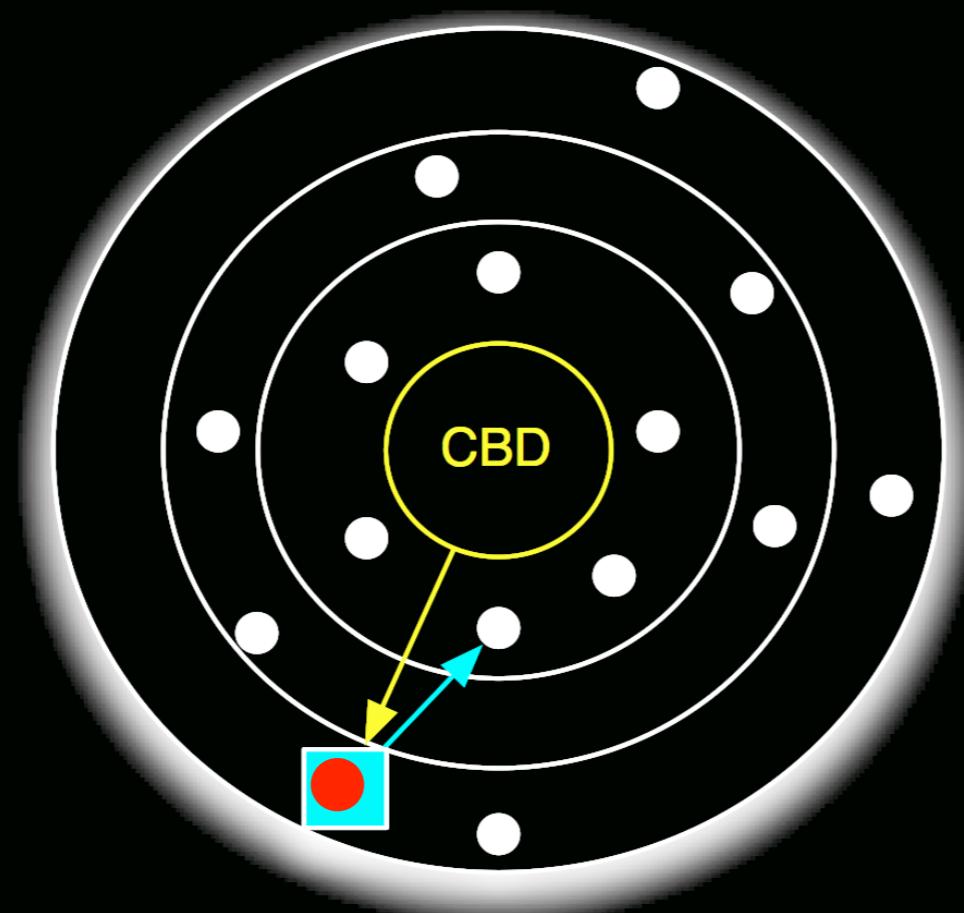
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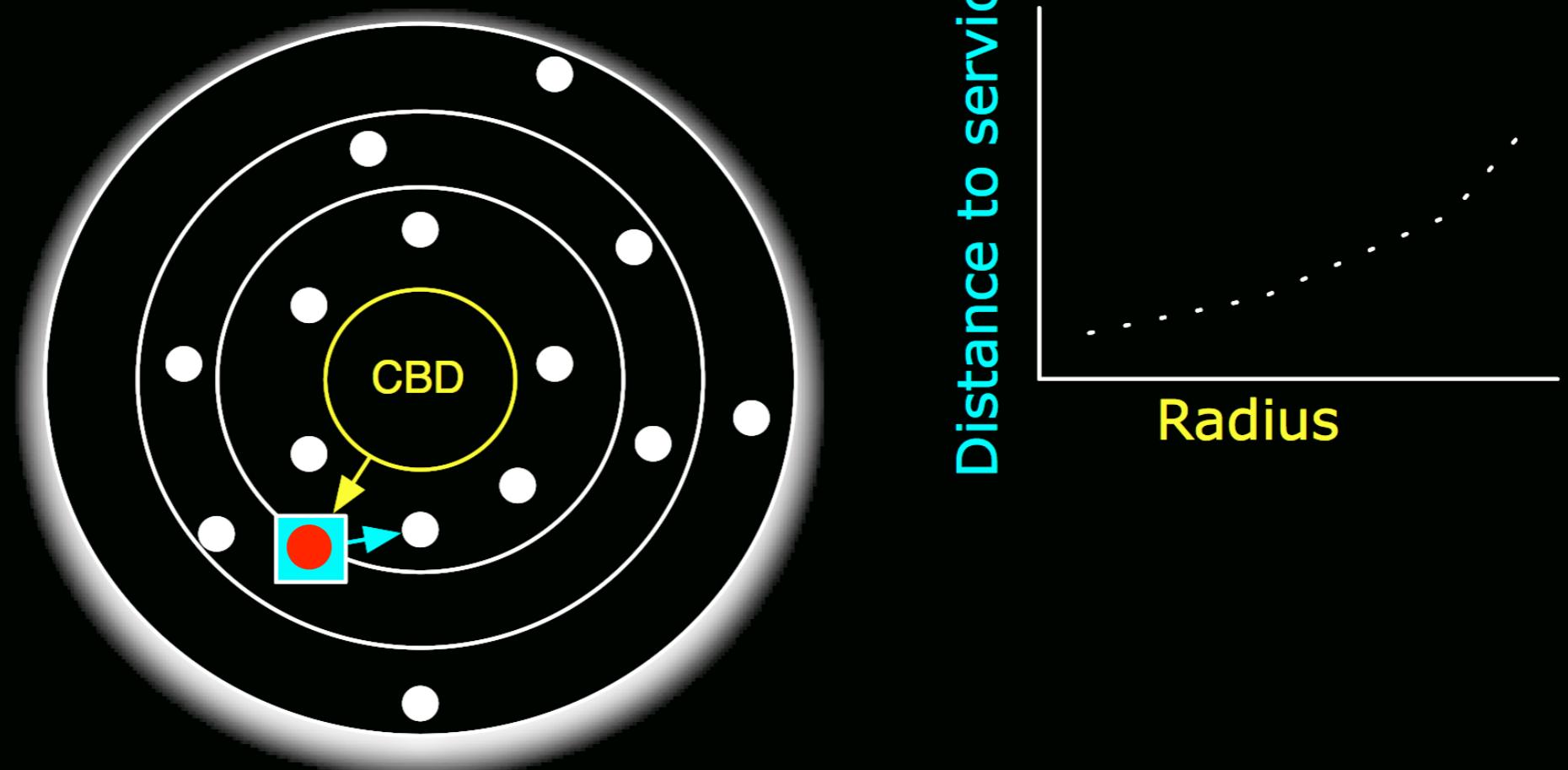
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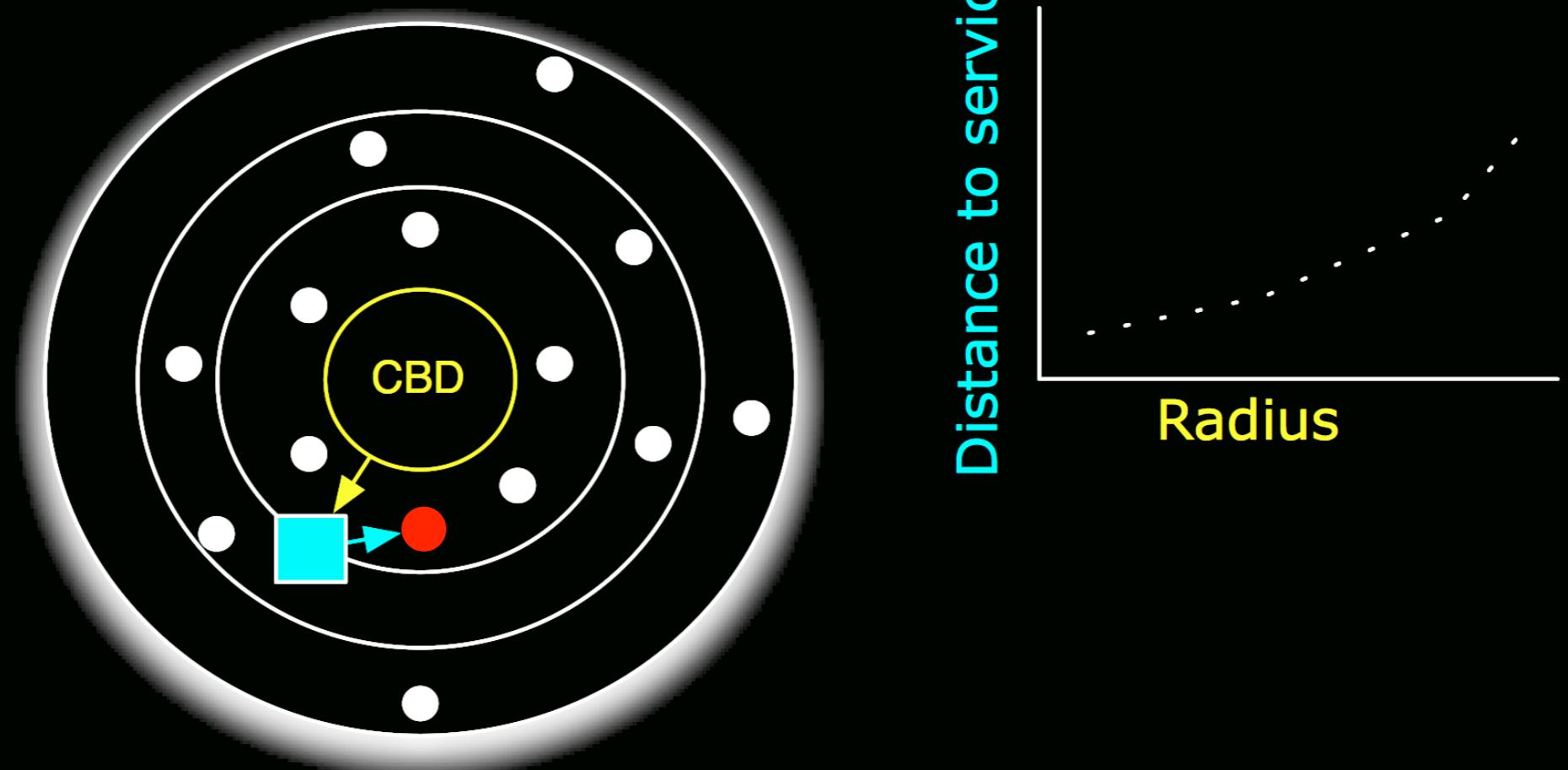
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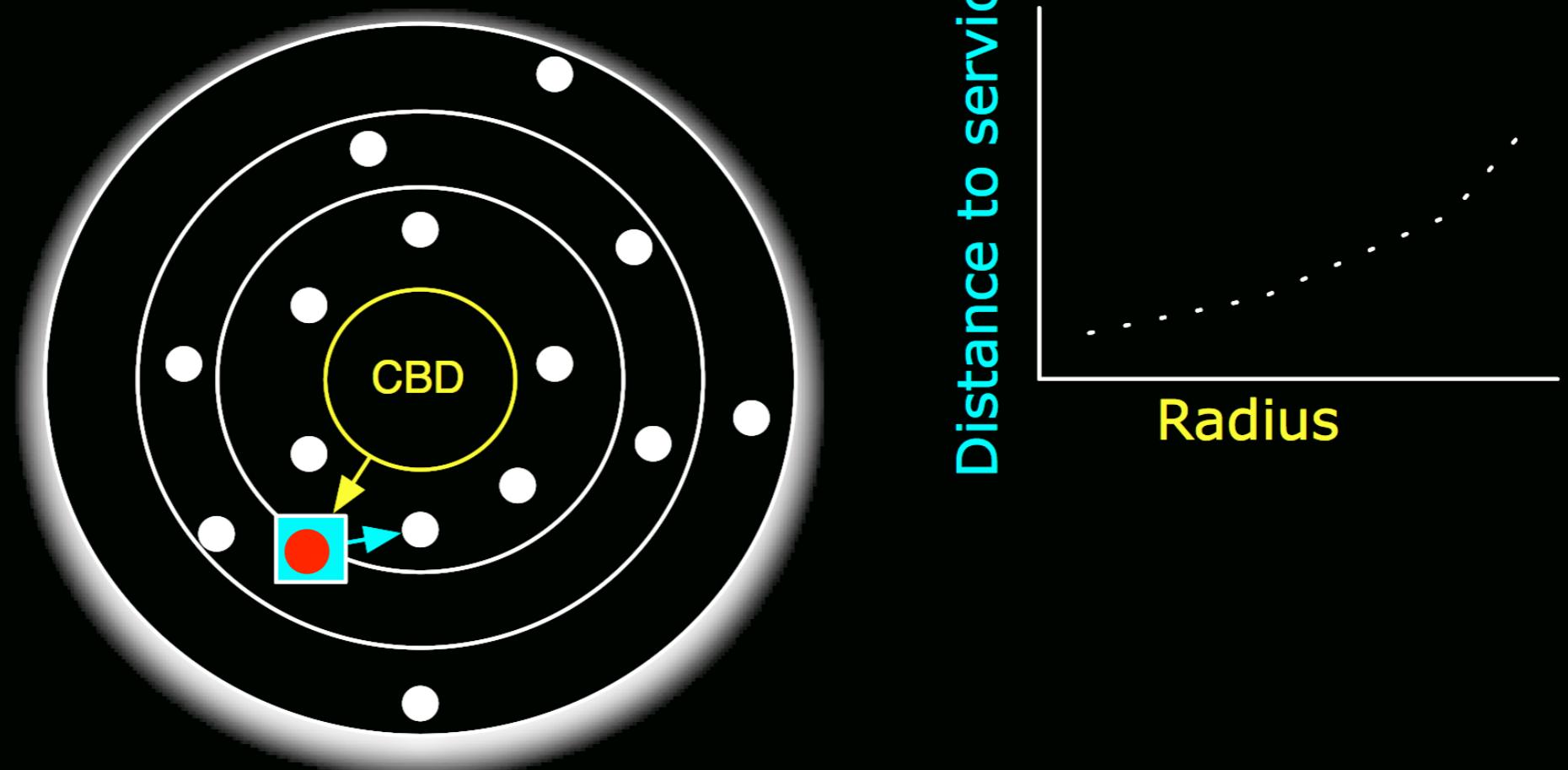
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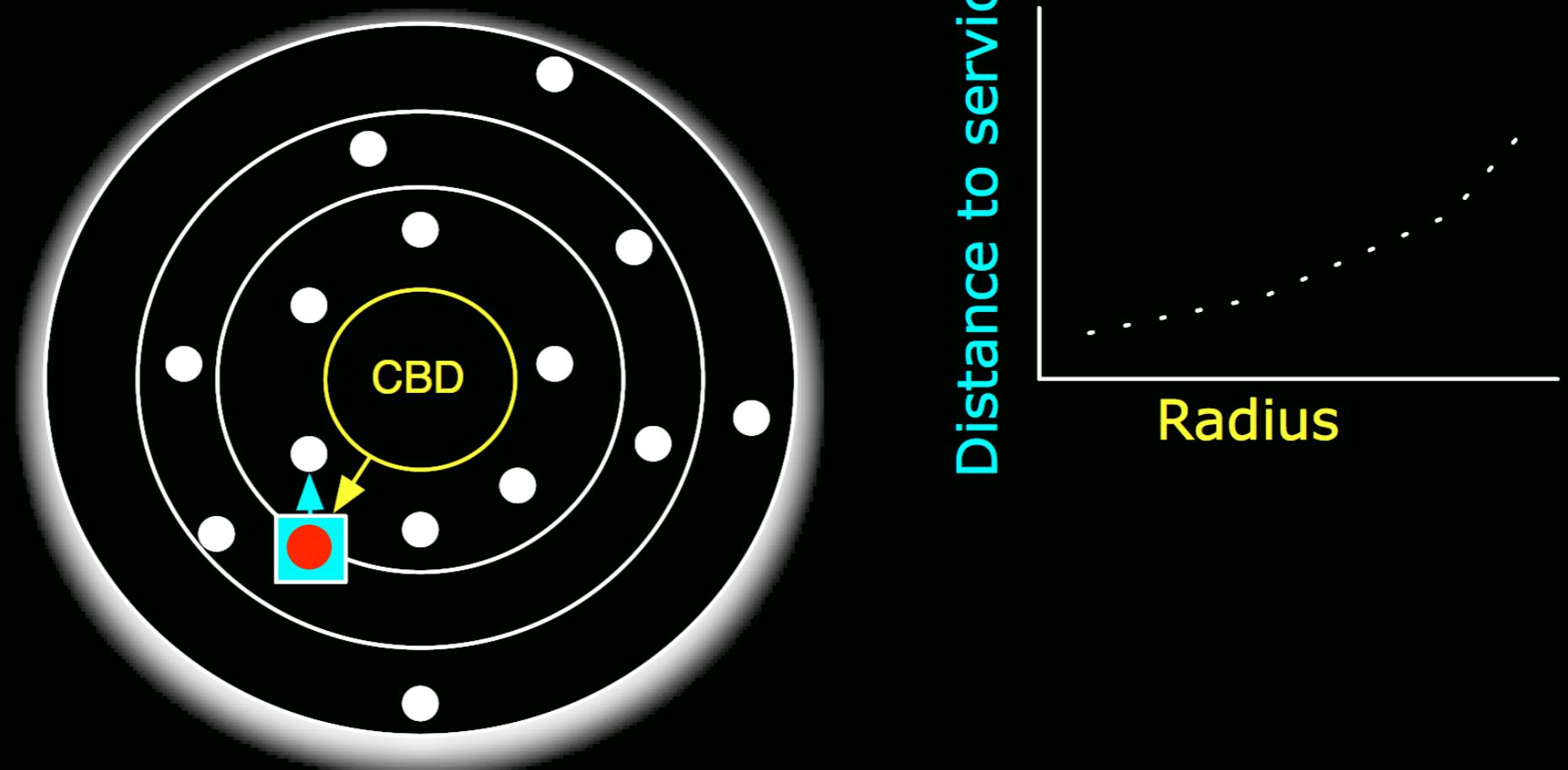
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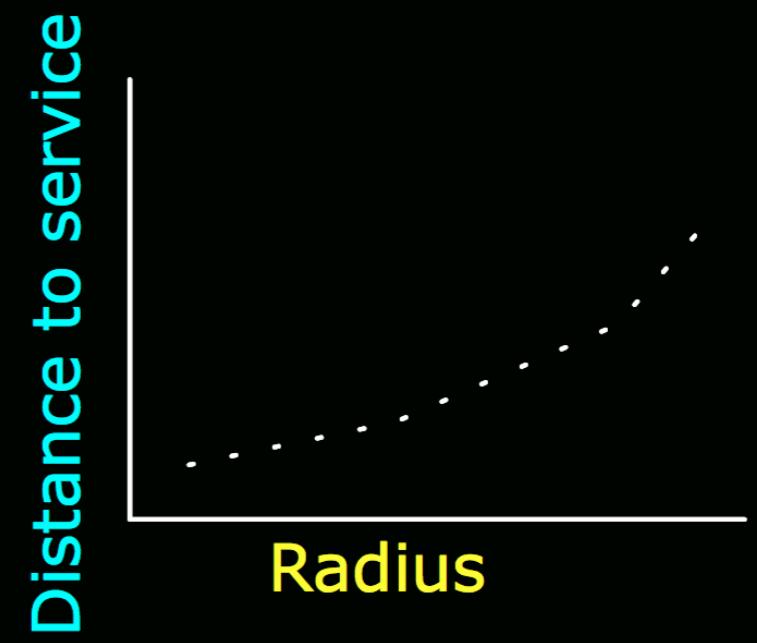
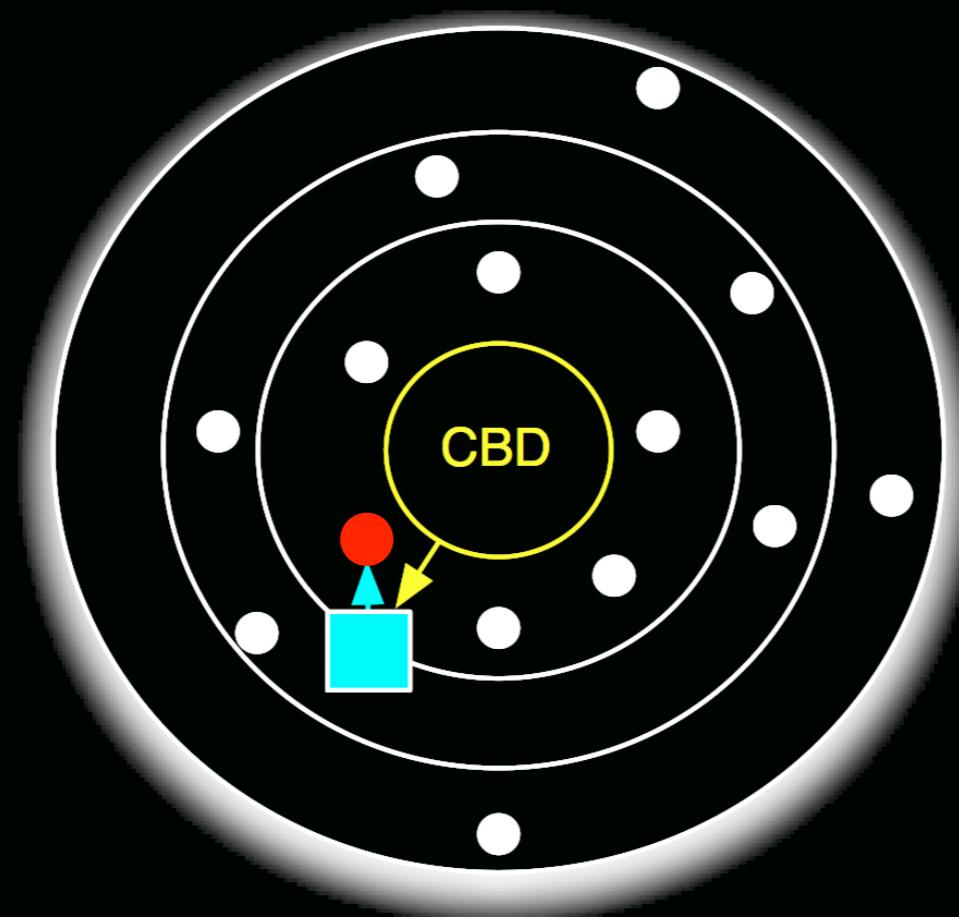
Methodology: Service Distance Gradient



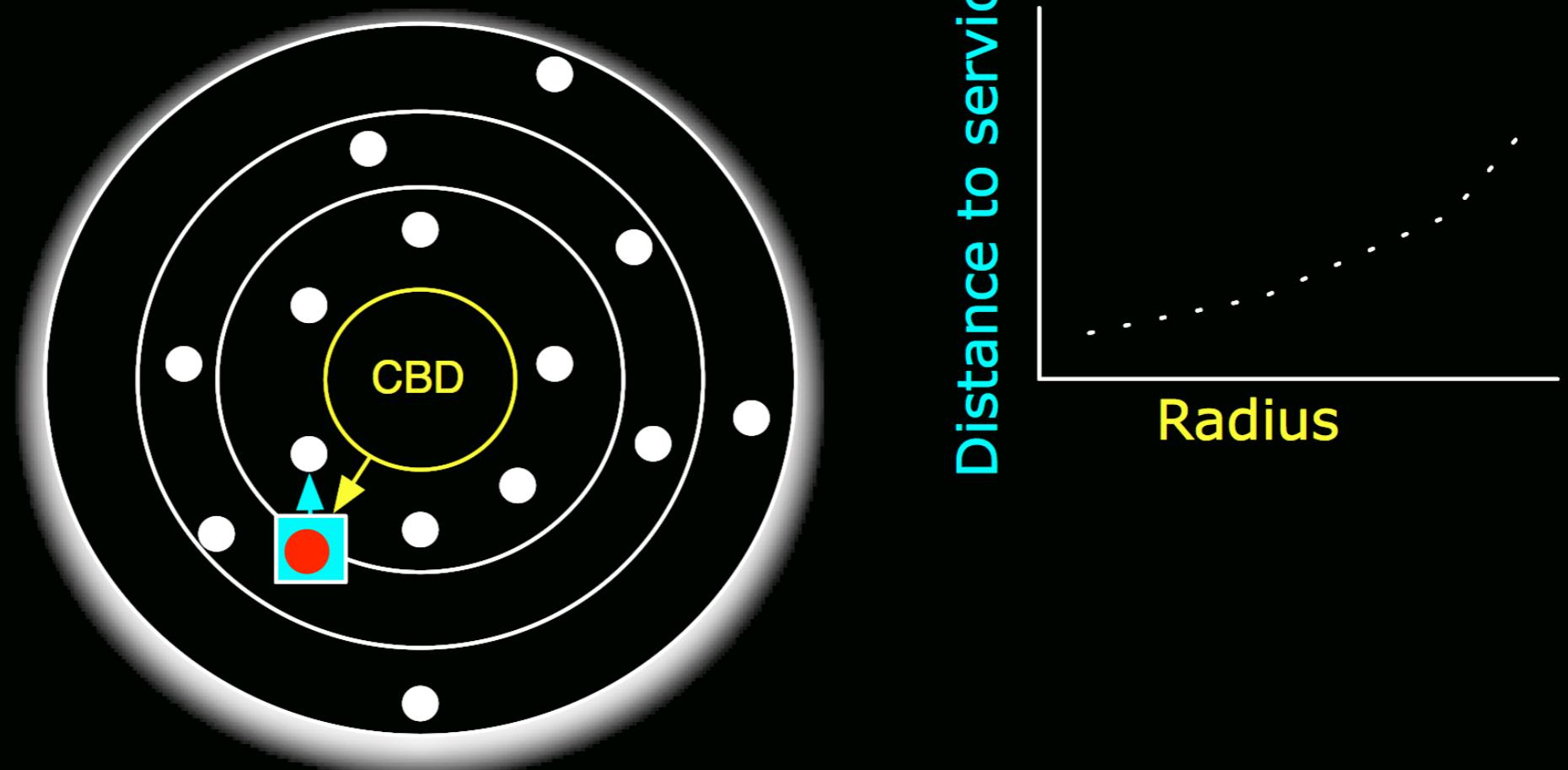
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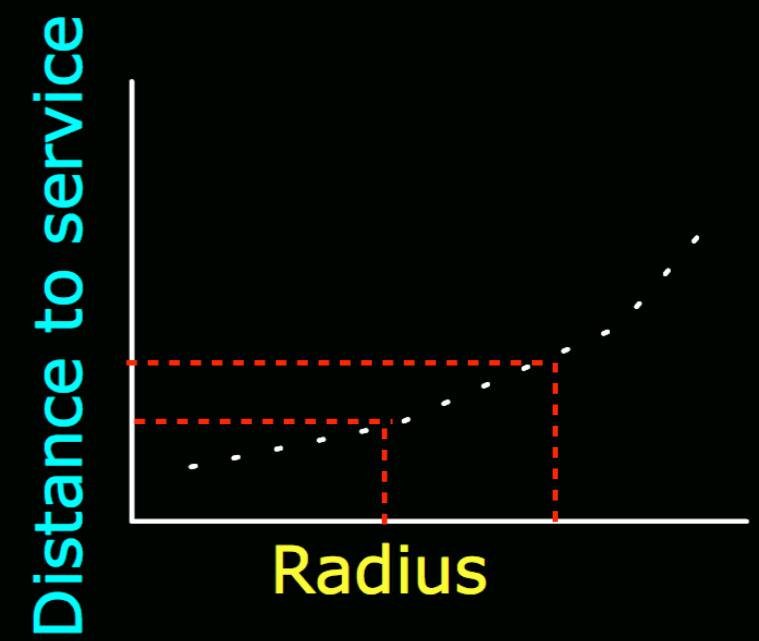
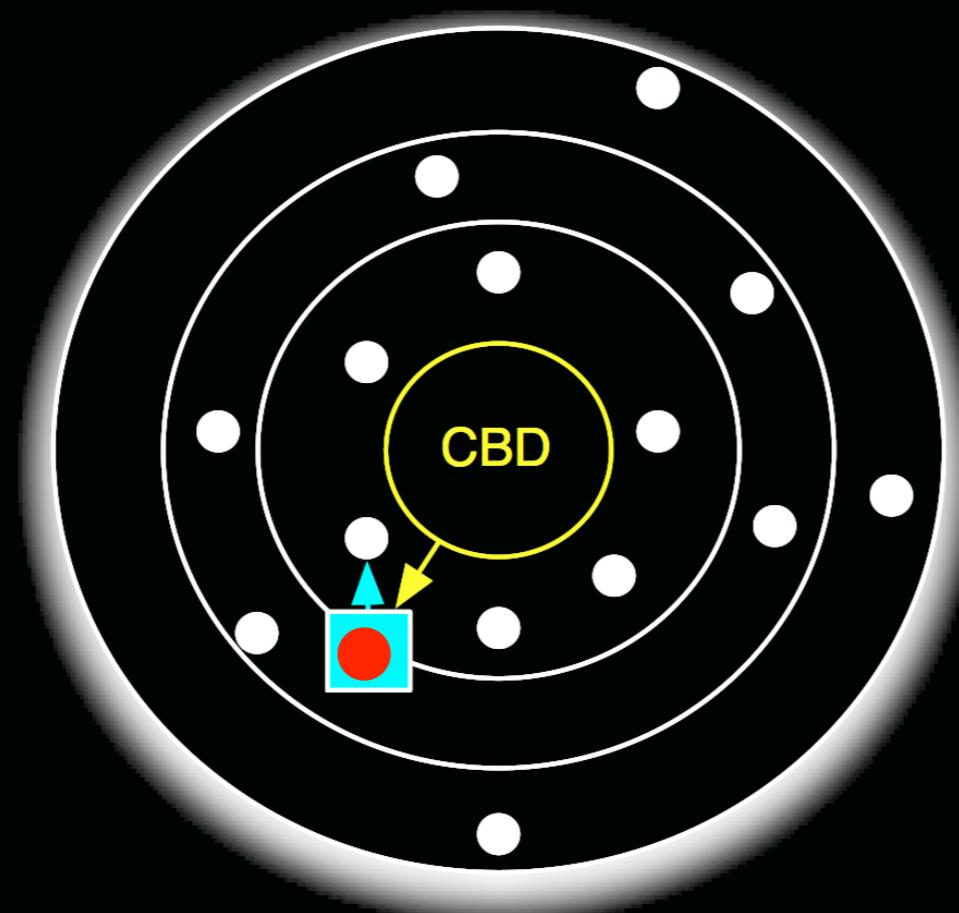
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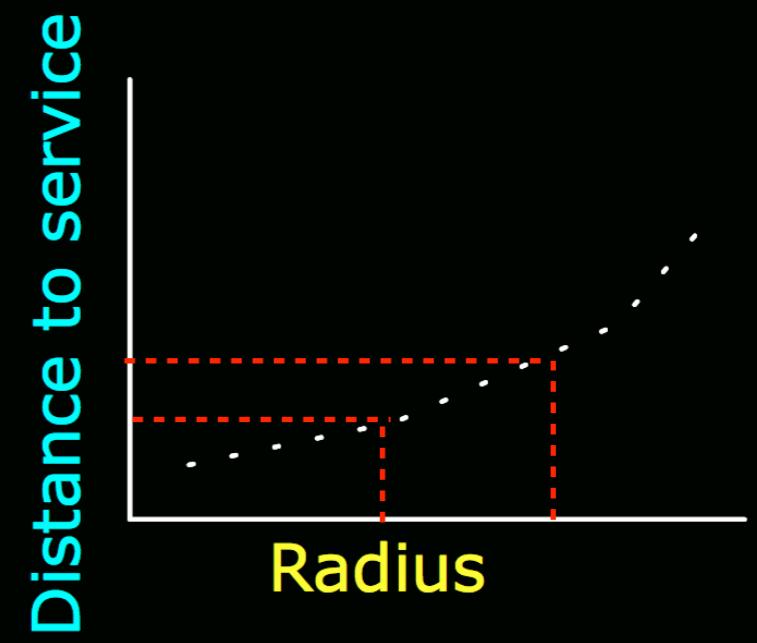
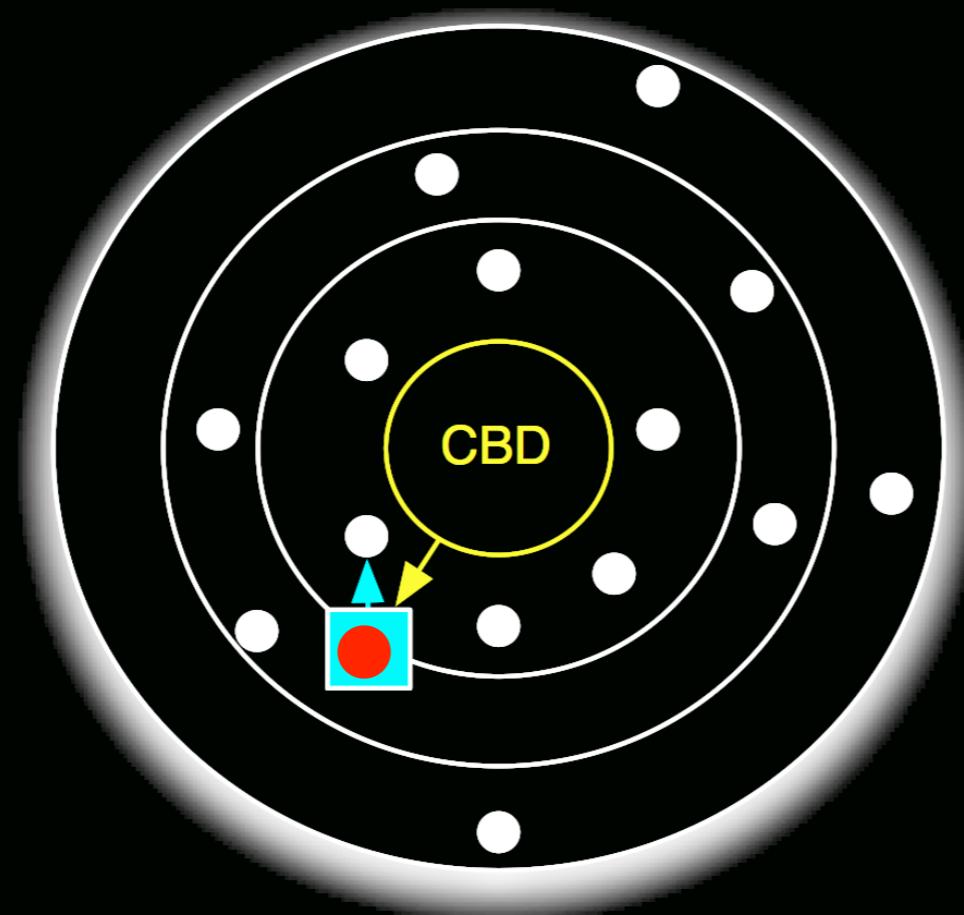
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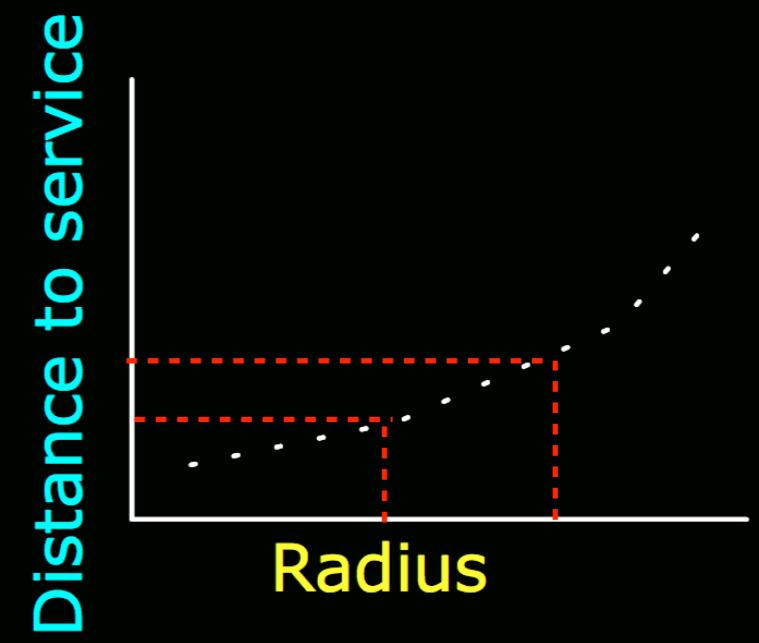
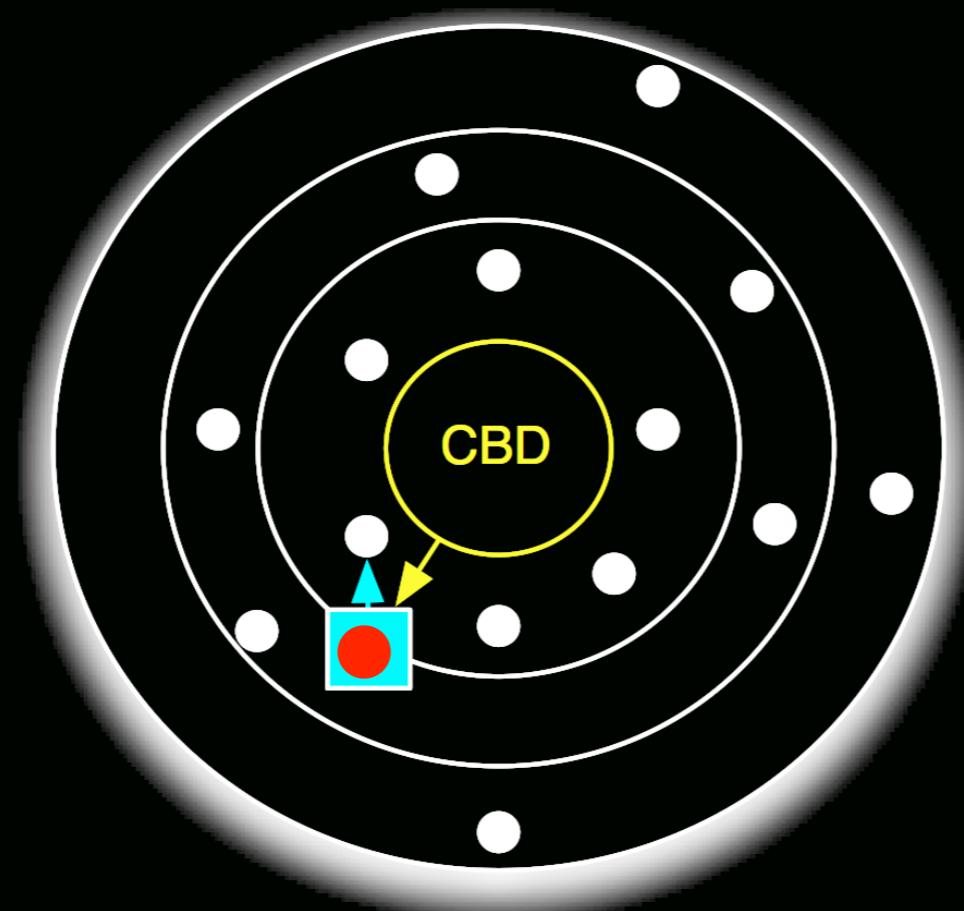


Methodology: Service Distance Gradient



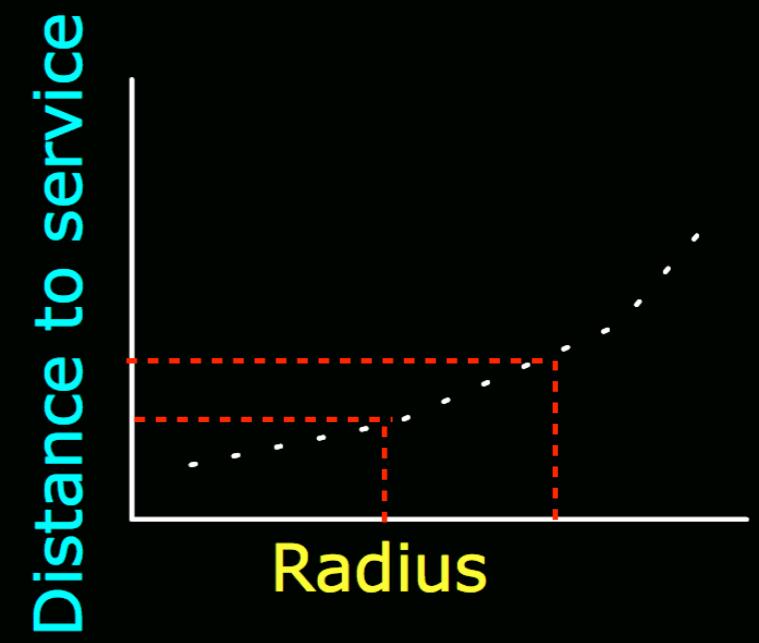
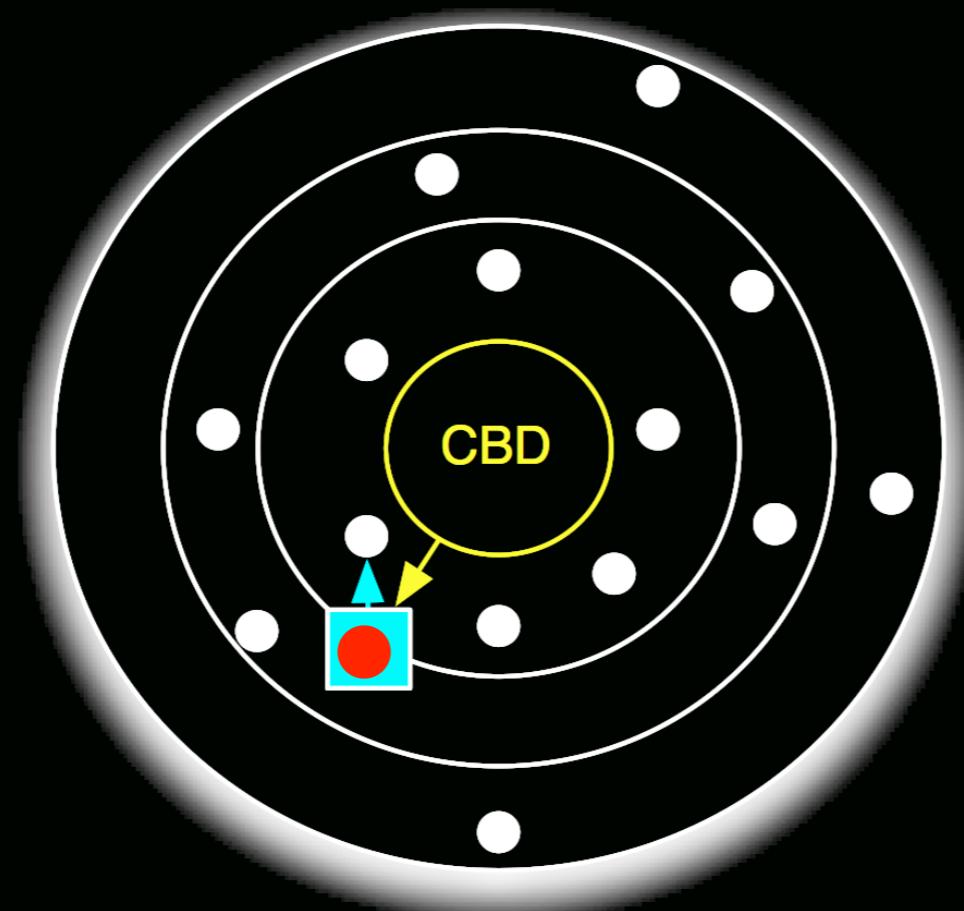
$$y = Ae^{br}$$

Methodology: Service Distance Gradient



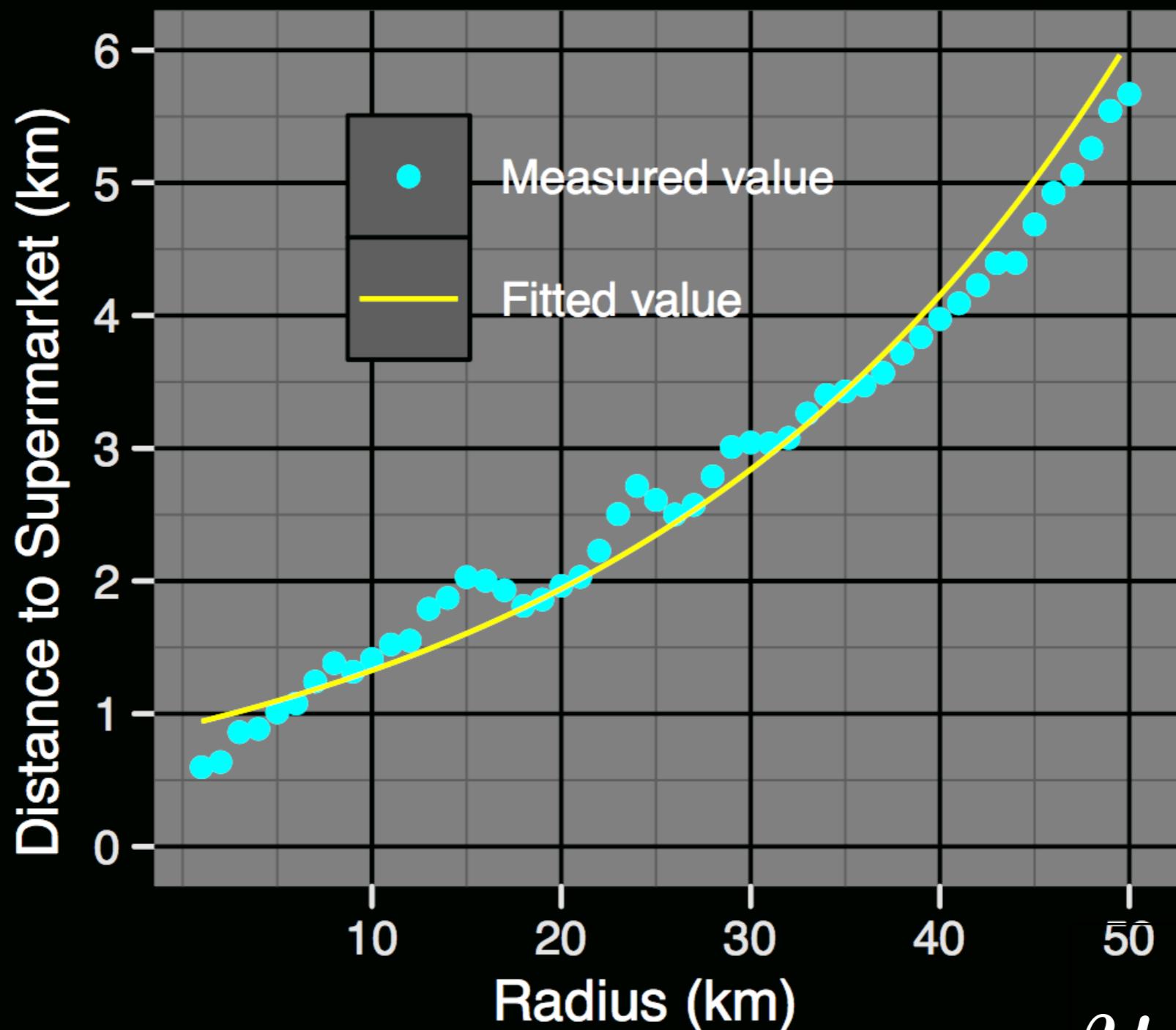
$$y = Ae^{br}$$

Methodology: Service Distance Gradient



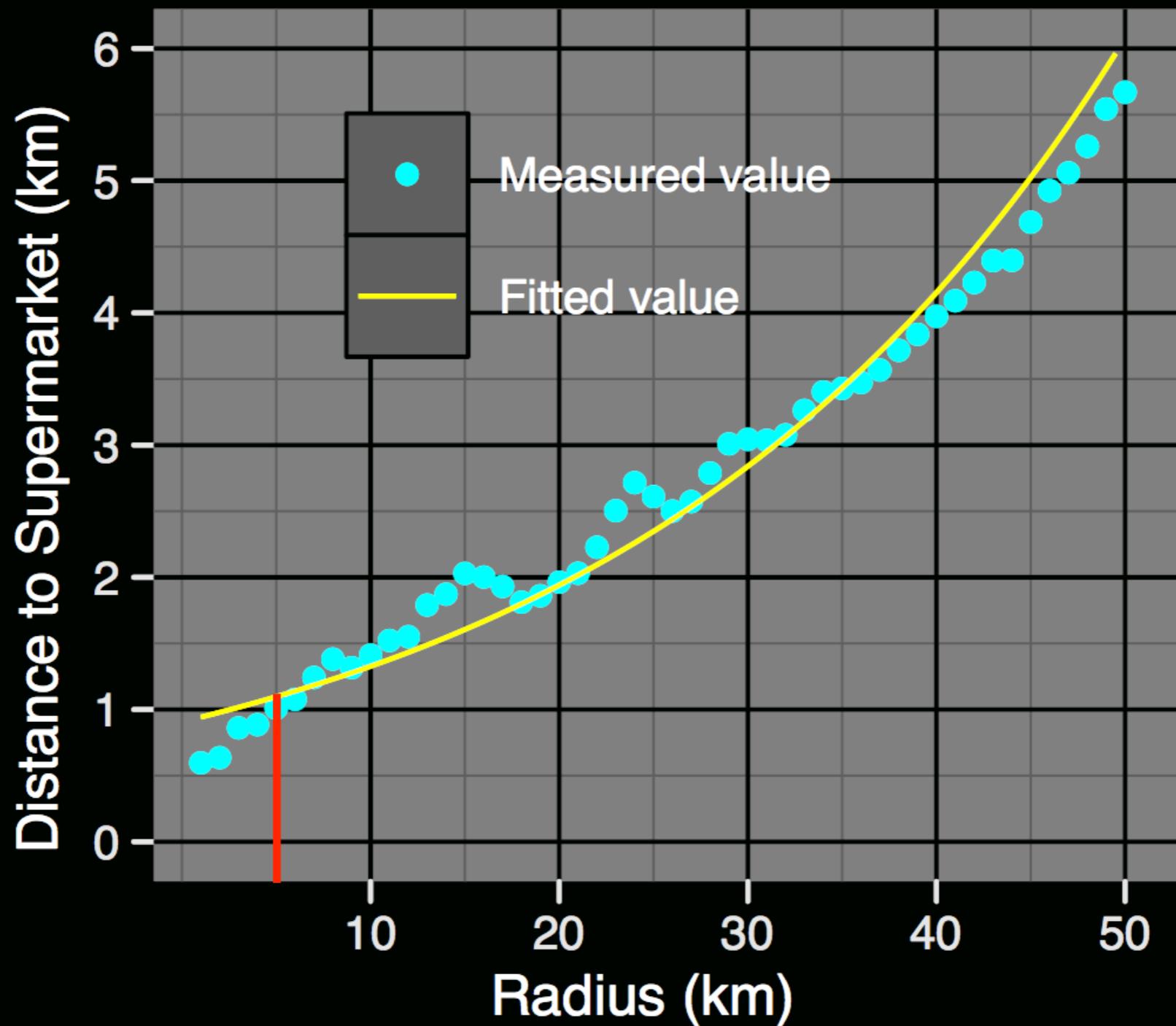
$$y = Ae^{br}$$

Results: Atlanta - Service Distance Gradient

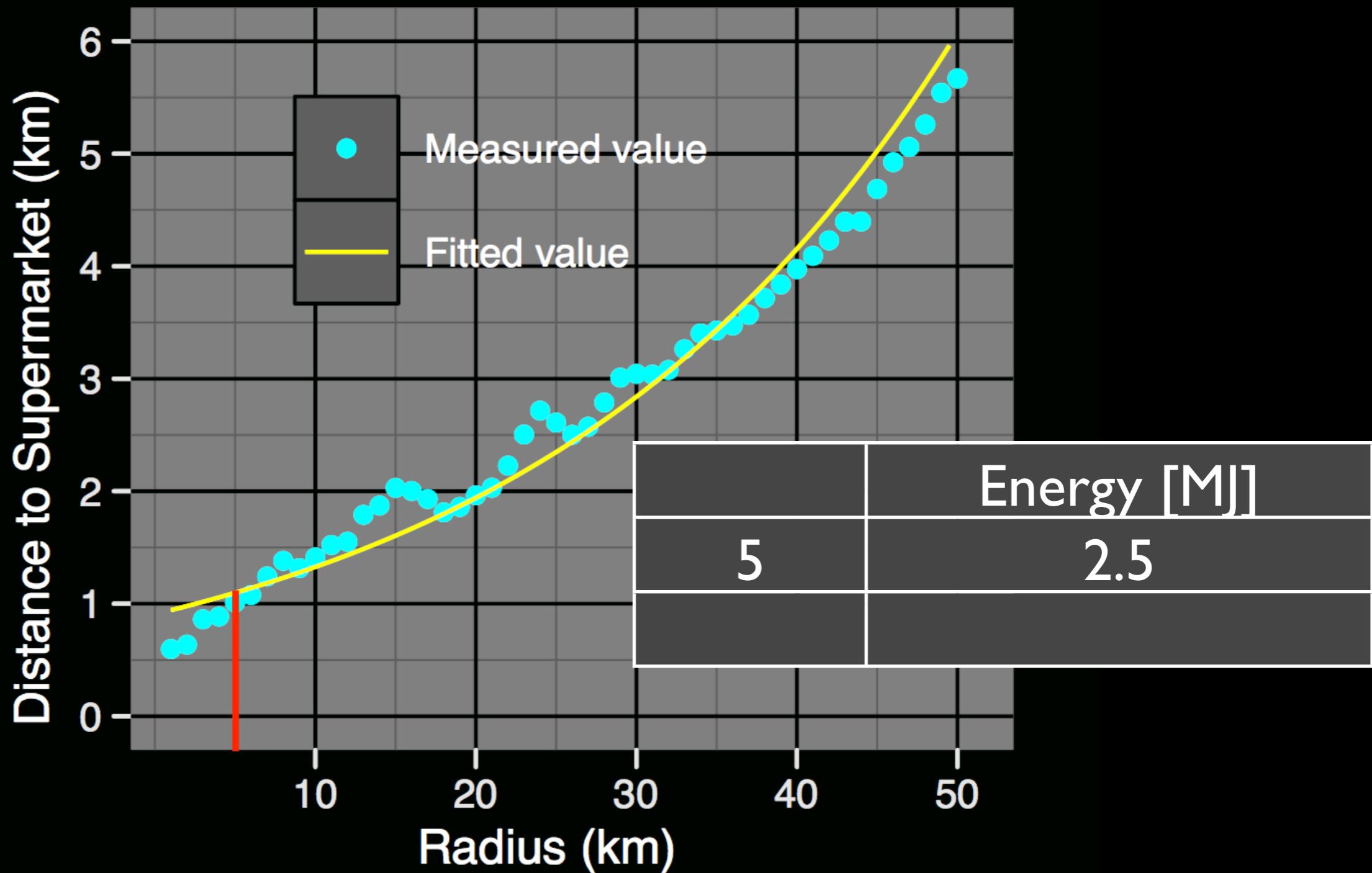


$$y = Ae^{br}$$

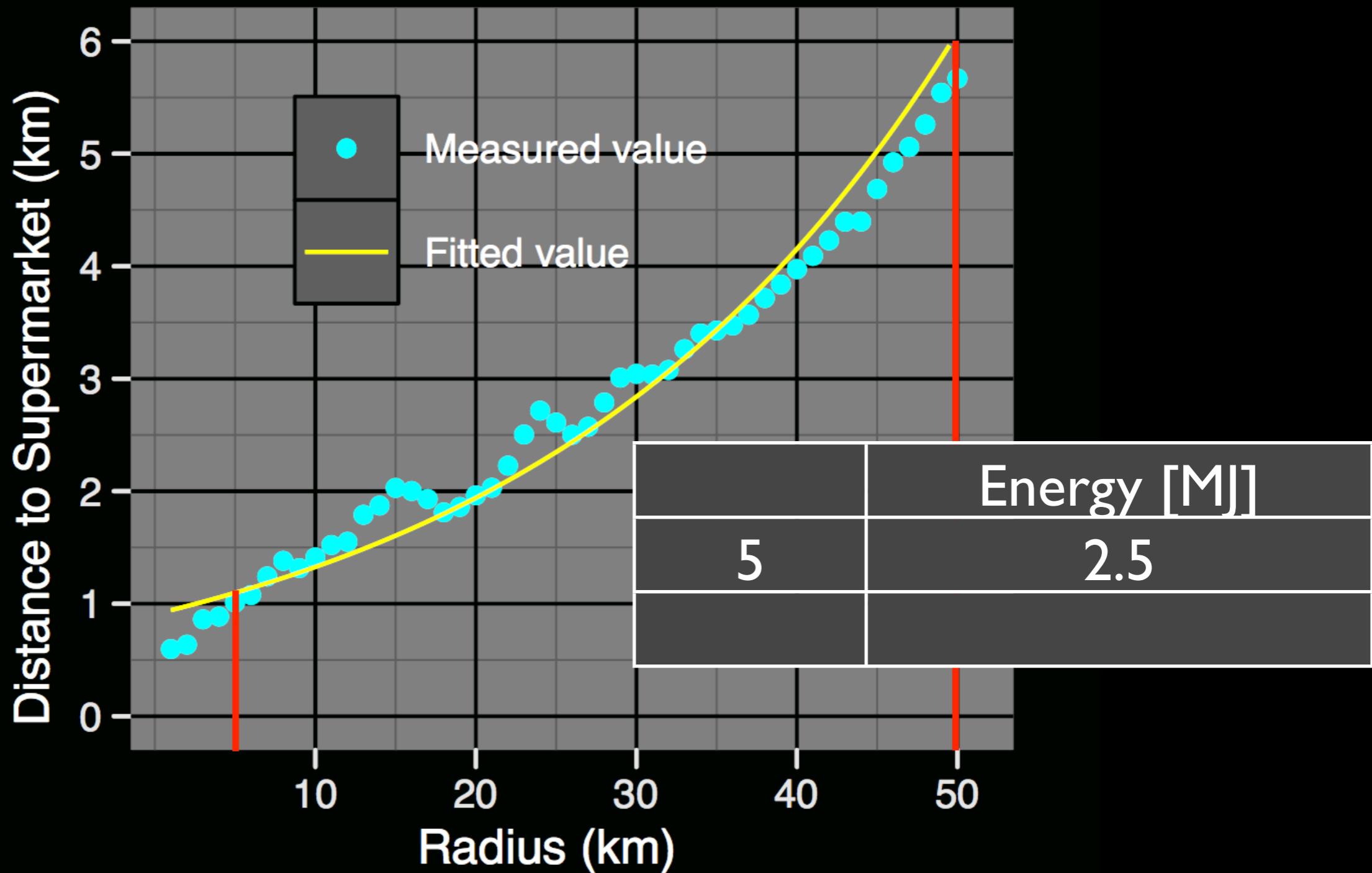
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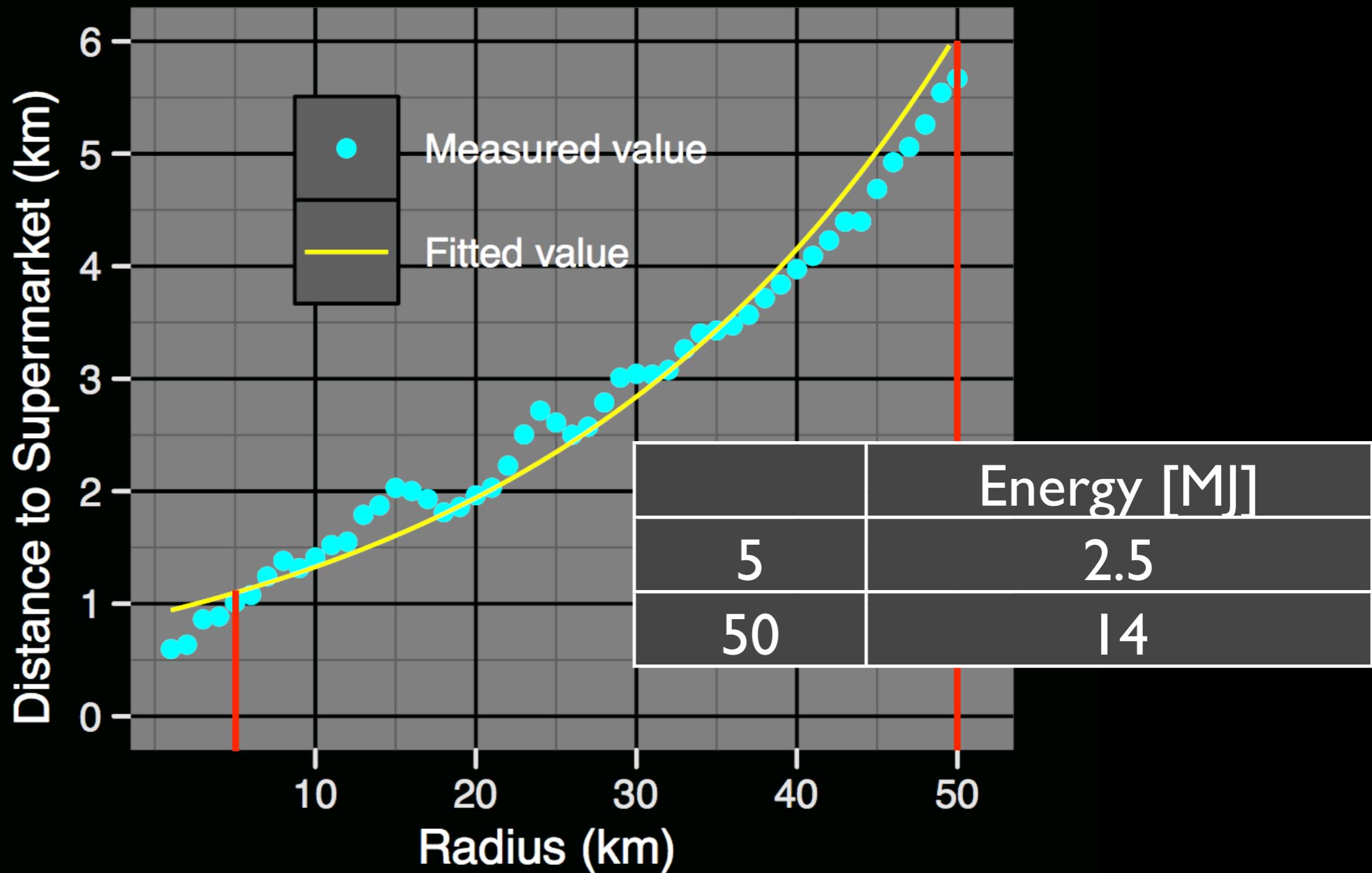
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Results: Atlanta - Service Distance Gradient



Further research:

Validate road analysis with empirical data using remote sensing data, and consider lifespan

Develop a similar tool to perform analysis at smaller spatial scales (neighborhoods)

Revise tool to function with open-source GIS software (currently just works with ArcGIS)

Conclusions:

Simple method to characterize urban form

Useful for analyzing metropolitan areas in a repeatable way

Questions?

djq@mit.edu

www.urbmet.org/analysis