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Disparities in Telehealth Accessibility to Primary Care Physicians in Baton Rouge, Louisiana

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CONTENTS

BACKGROUND

BACKGROUND: Equity in health care delivery

- Uneven spatial distribution
- Telehealth Benefits

BACKGROUND: can telehealth reduce the spatial barrier ?

Limited internet service

- Irreplaceable Hospital visit

BACKGROUND: Increasing telehealth , increasing disparity

Exacerbate disparity for certain groups

- Digital Divide
- Challenge of New technology

Certain racial/ethnic groups
The elderly and low-income group
Rural area

COVID-19

BACKGROUND: Measuring disparity in Telehealth accessibility

Duality of distance dependence and digital divide

Integrating Physical accessibility and Virtual accessibility (From 2SFCA to 2SVCA)

BACKGROUND : Objectives

Assesses the telehealth accessibility of primary care physicians (PCPs) in the Baton Rouge Metropolitan Statistical Area (BRMSA), Louisiana, and

Examines the disparities across geographic areas and socio-demographic groups

DATA & METHODOLOGY

DATA & METHODOLOGY : Data Source

Primary Care Physicians（FTE）

594 primary care physicians (PCP) in 172 locations
by the Centers for Medicare and Medicaid Services (CMS)

Demand and socioeconomic data

574 block groups with total population of 849,530.
Poverty status data, Broadband subscription rate is extracted from the 2016-2020 Five-Year American Community Survey (ACS),

Road network data

U.S. Census Bureau web site (2020)

Urbanicity data

U.S. Census Bureau web site (HPSM) (2020)

Broadband connectivity data

Federal Community Commission (FCC) Fixed Broadband Deployment Block Data

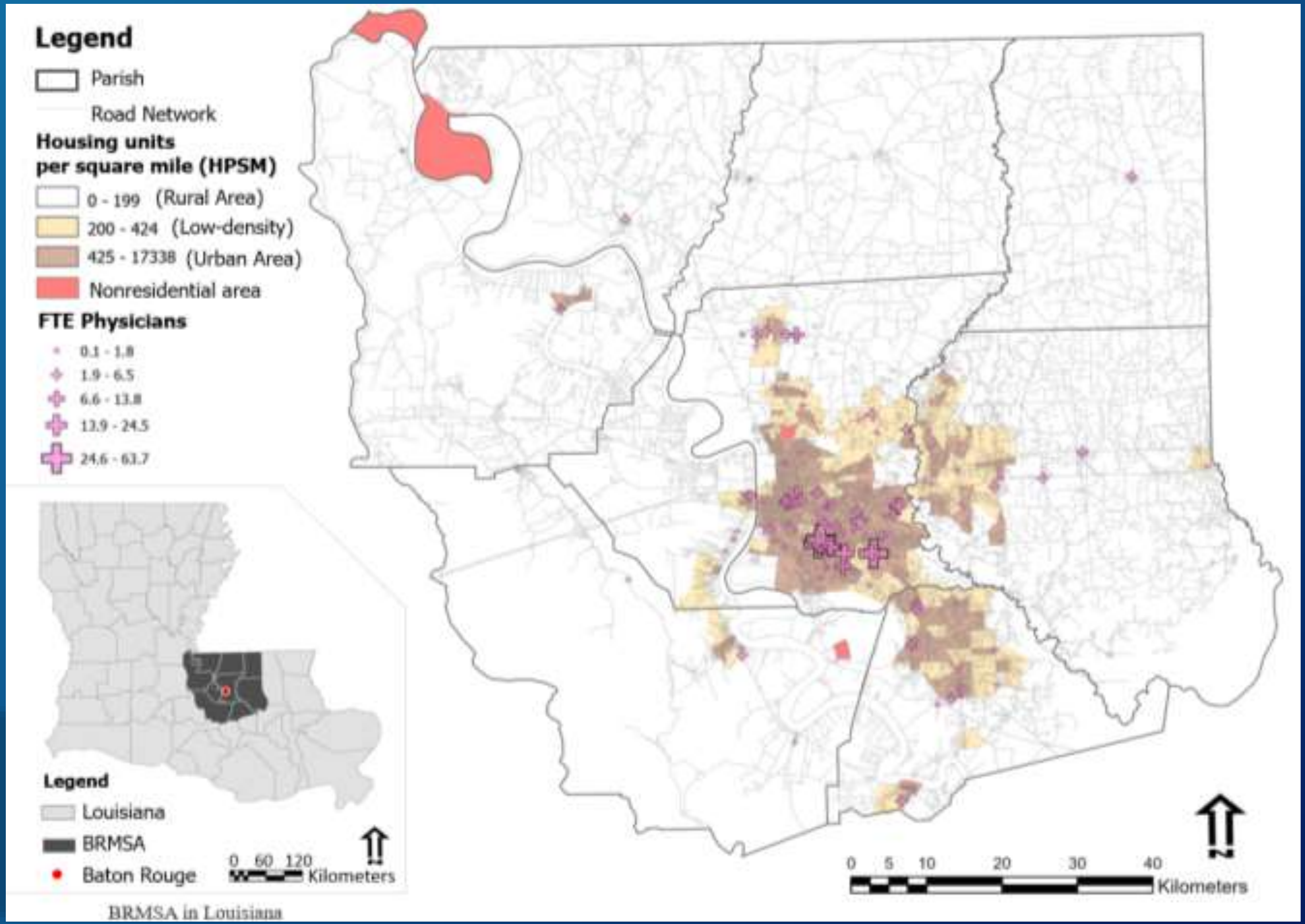


Figure 1 Primary care physicians and urban areas in Baton Rouge MSA

DATA & METHODOLOGY : Socioeconomics data

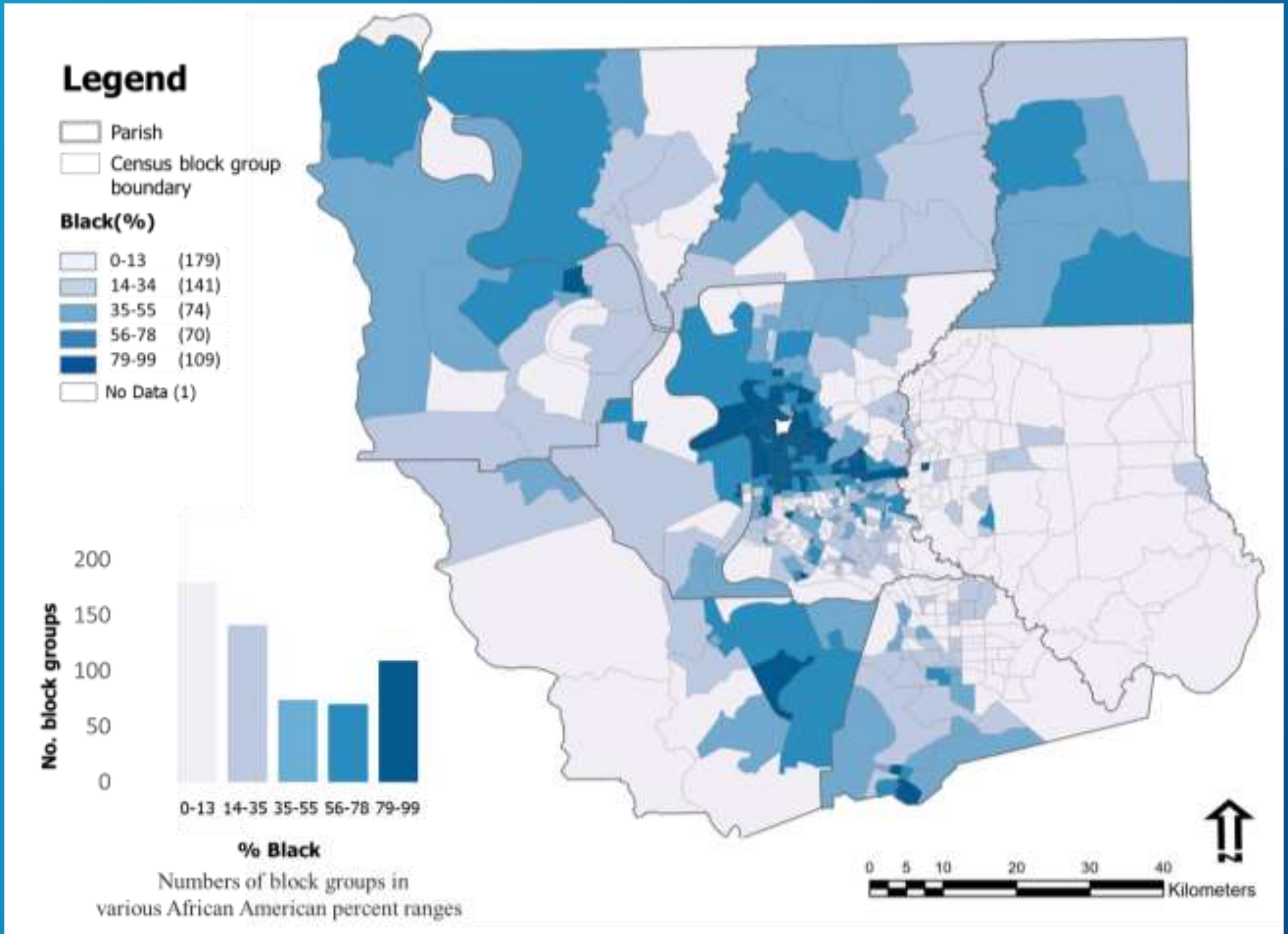


Figure 2 African American percent across block groups in Baton Rouge MSA 2020

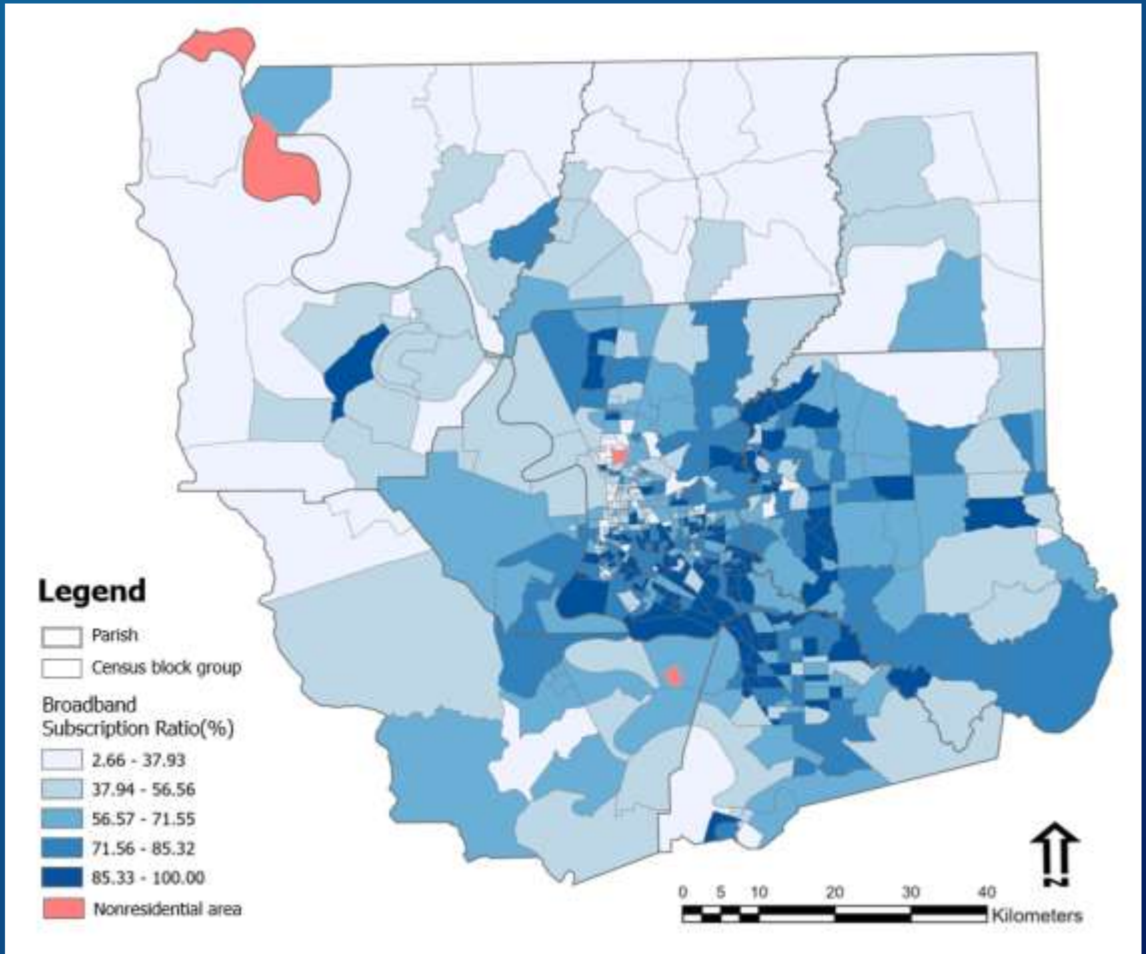


Figure 3 Broadband availability in BRMSA 2020

DATA & METHODOLOGY : Broadband Speed

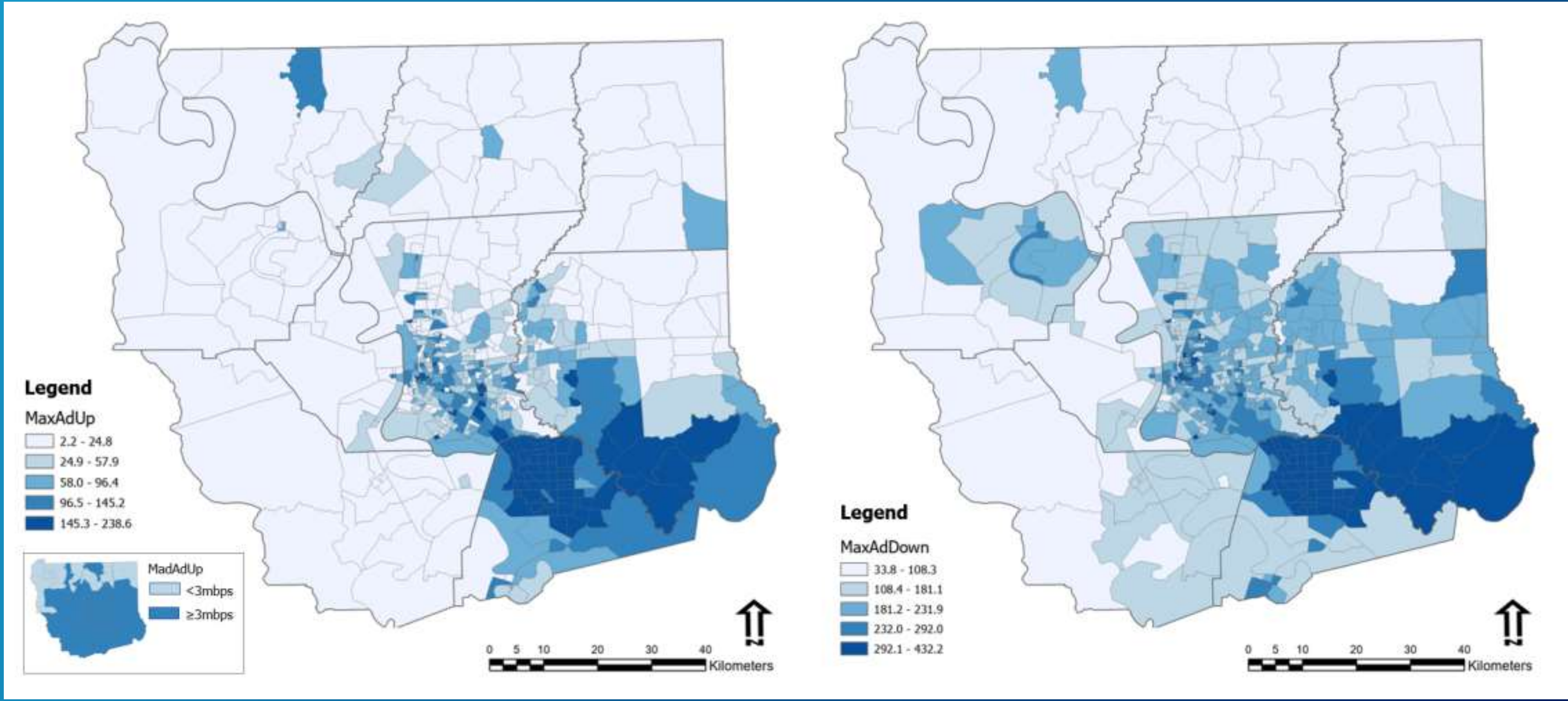


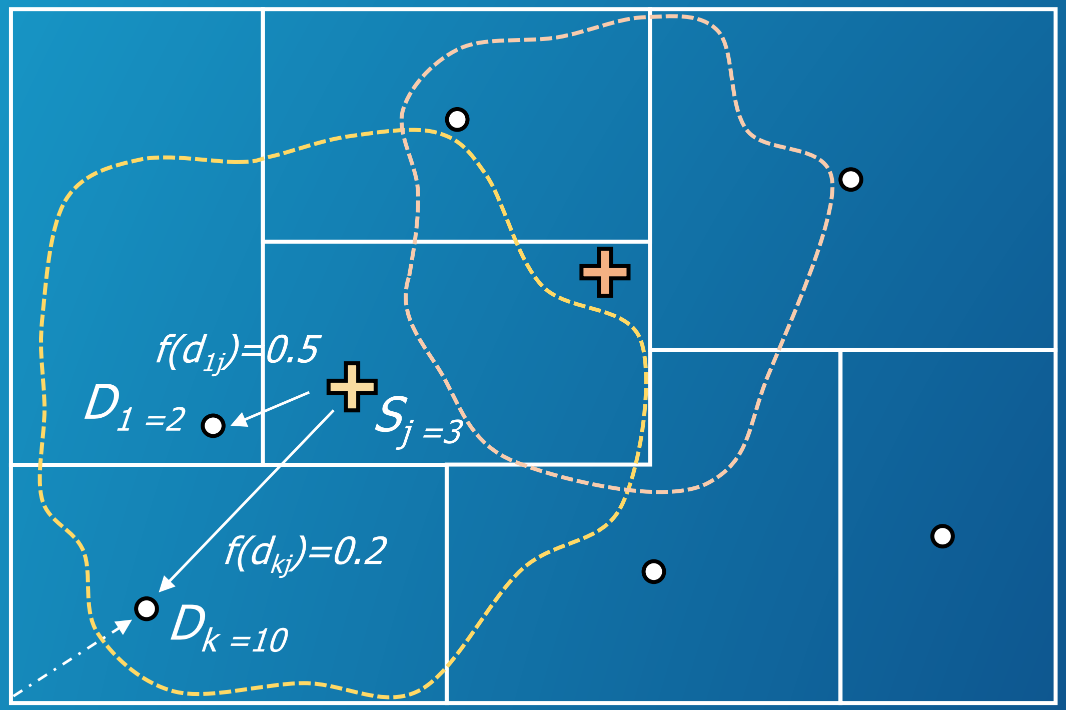
Figure 4 Mean download and upload FBB speeds in BRMSA 2020.

DATA & METHODOLOGY : Broadband Speed

Table 1 Demography and broadband access across areas of urbanicity

Area (No. block groups)	Population	Area sq-km	White %	Black %	Poverty %	Broad band %	MaxDownload (mbps)			MaxUpload (mbps)		
							Min	Mean	Max	Min	Mean	Max
Total (n =570)	849,233	10,776	51.2	38.8	16.8	65.6	33.8	208.7	432.2	2.2	65.6	238.6
Rural (n = 164)	247,593 (29.2%)	9,807 (91.0%)	65.1	27.7	15.4	57.3	33.8	158.3	369.1	2.2	36.9	226.8
Low density (n = 82)	133,907 (15.8%)	472 (4.4%)	60.5	29.1	10.4	70.9	104.5	232.1	358.7	5.2	80.32	228.5
Urban (n=324)	467,733 (55.0%)	497 (4.6%)	41.8	46.8	19.1	68.5	42.3	228.3	432.2	2.4	76.4	238.6

DATA & METHODOLOGY : 2SFCA and G2SFCA



Legend

- Healthcare Service
- Population Centroid
- Healthcare Service Catchment

2SFCA

$$PA_i = \sum_{j \in (d_{ij} \le d_0)}^{n} [S_j / \sum_{k \in (d_{kj} \le d_0)}^{m} D_k]$$

$$PA_i = 3 * (\frac{\cancel{10}}{10+2}) / \cancel{10} + \cdots$$

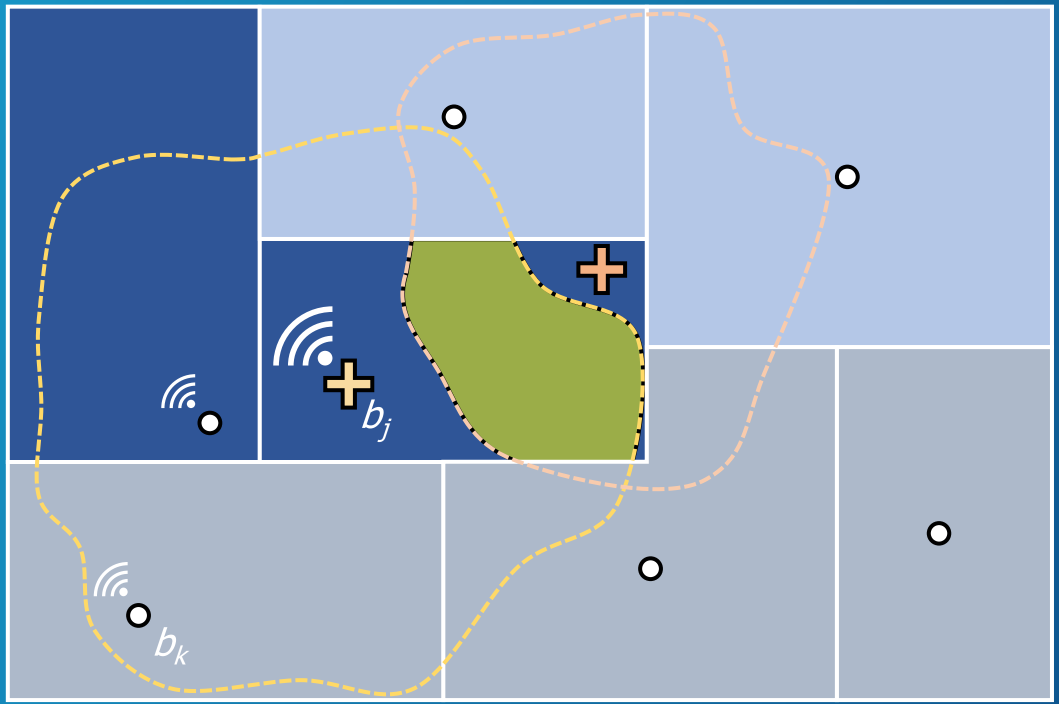
Generalized 2SFCA

$$PA_i = \sum_{j=1}^{n} \left[S_j f\left(d_{ij}\right) / \sum_{k=1}^{m} \left(D_k f\left(d_{kj}\right) \right) \right]$$

$$PA_i = 3 * (\frac{\cancel{10} * 0.2}{10 * 0.2 + 2 * 0.5}) / \cancel{10} + \cdots$$

↓ Supply ↓ Portion ↓ Per Capita

DATA & METHODOLOGY : 2SVCA



Legend

- Healthcare Service
- Population Centroid
- Healthcare Service Catchment
- Low Broadband Speed
- Medium Broadband Speed
- High Broadband Speed
- Area of Highest Accessibility (within catchment of both facilities, and high underlying broadband speed)

2SFCA

$$PA_i = \sum_{j\in(d_{ij}\le d_0)}^{n} \left[S_j / \sum_{k\in(d_{kj}\le d_0)}^{m} D_k\right]$$

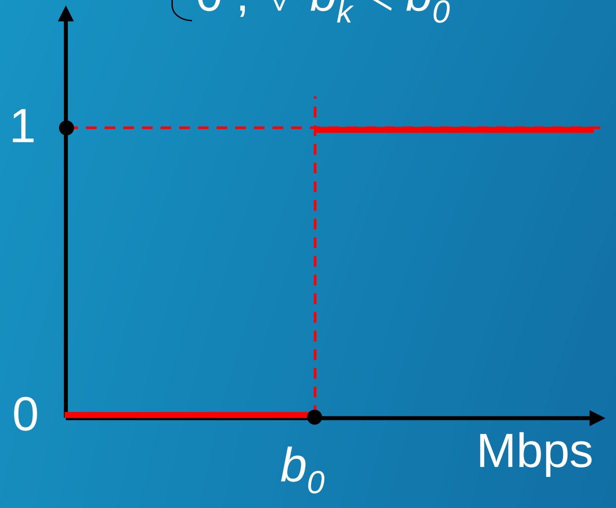
2SVCA

$$VA_i = \sum_{j\in(d_{ij}\le d_0)}^{n} \left[S_j f\left(b_i, b_j\right) / \sum_{k\in(d_{kj}\le d_0)}^{m} \left(D_k f\left(b_k, b_j\right)\right)\right]$$

*Conceptualization of the 2-step virtual catchment area method (refined from Alford-Teastor et al. 2021)

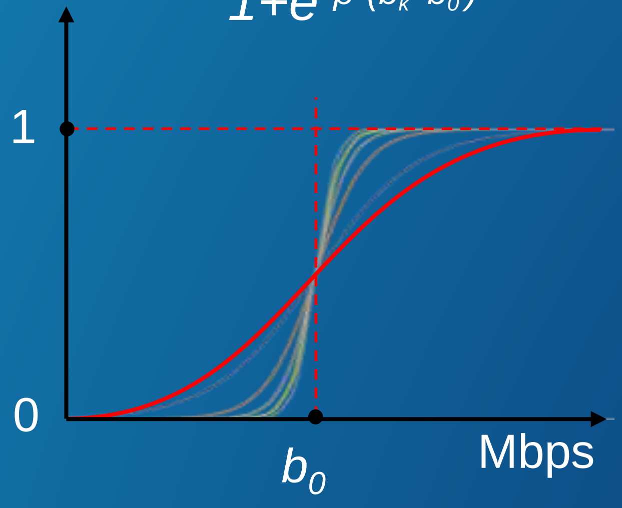
DATA & METHODOLOGY : 2SVCA

$$f(b_k)=\begin{cases}1, & \forall\, b_k \geq b_0 \\ 0, & \forall\, b_k < b_0\end{cases}$$



(a) 2SVCA

$$f(b_k)=1-\frac{1}{1+e^{\beta^*(b_k-b_0)}}$$

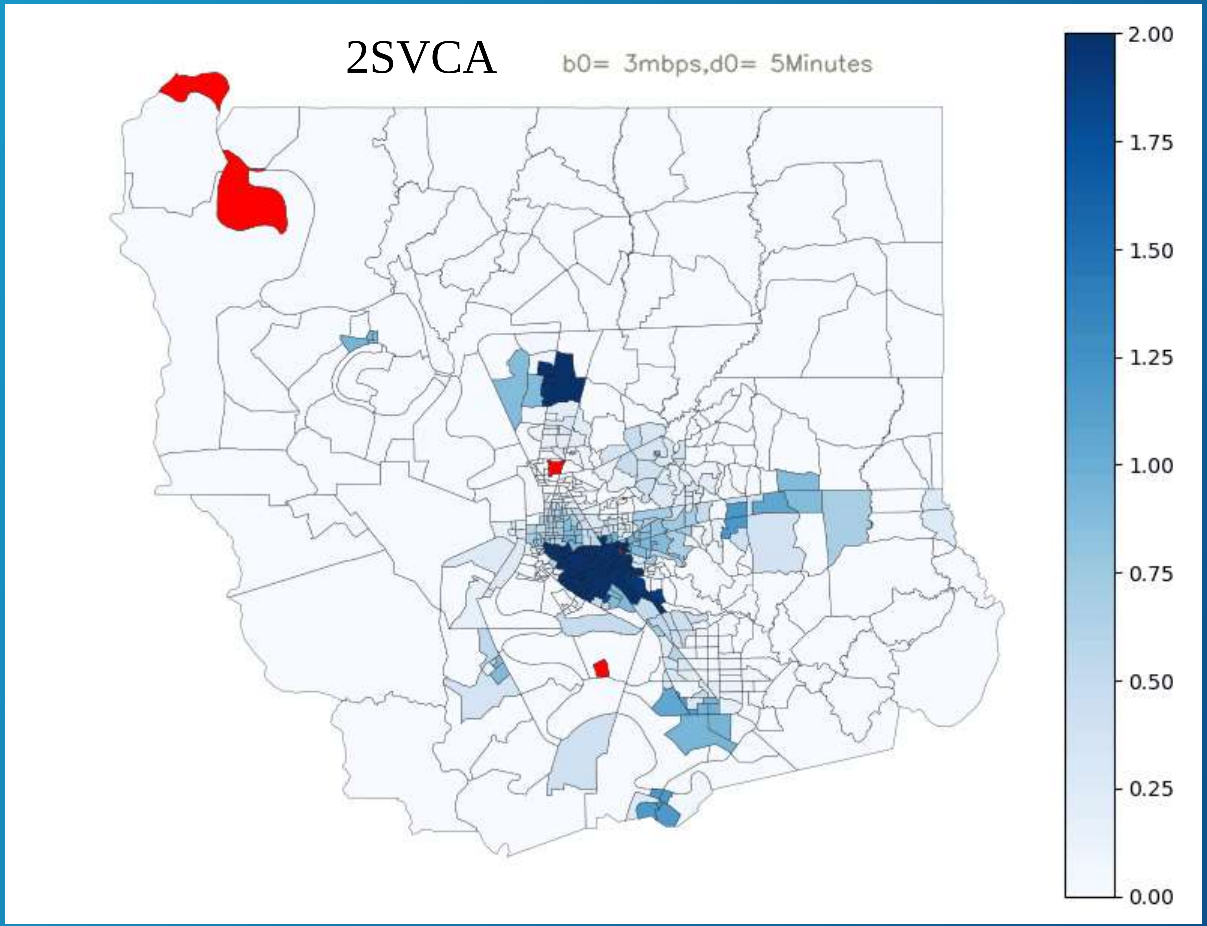


(b) 2SVCA-logistic Growth

$$VA_i=\sum_{j\in(d_{ij}\leq d_0)}^{n}\left[S_j f(b_i,b_j)\Big/\sum_{k\in(d_{kj}\leq d_0)}^{m}\left(D_k f(b_k,b_j)\right)\right]$$

RESULT

RESULT : 2SFCA scores and 2SVCA scores



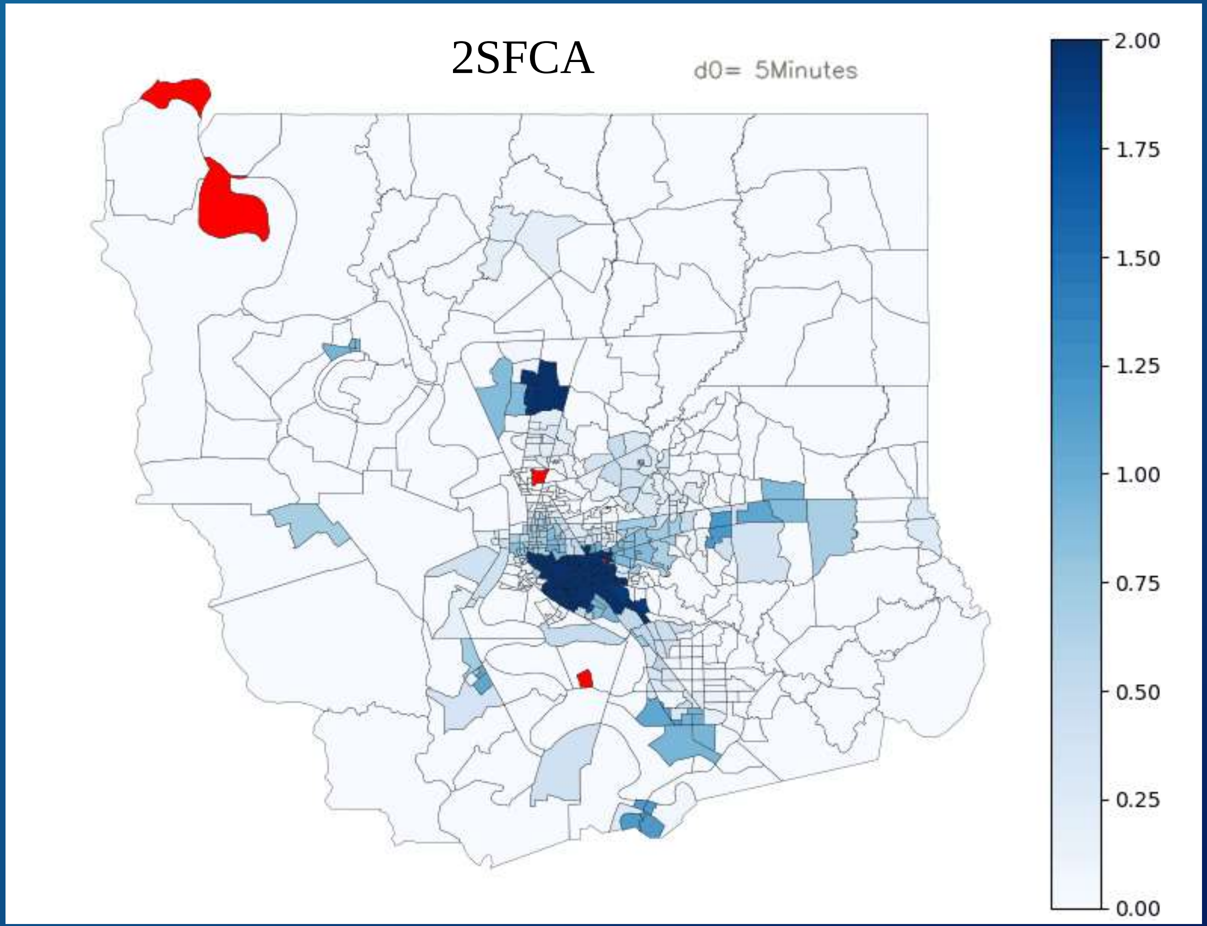
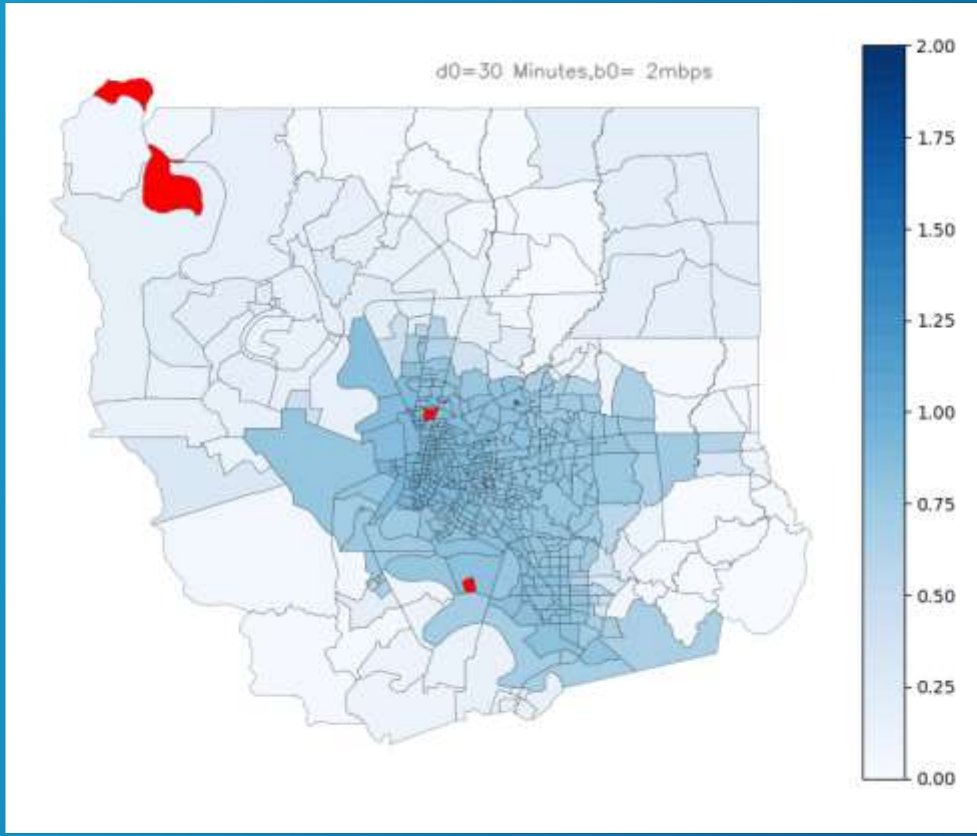


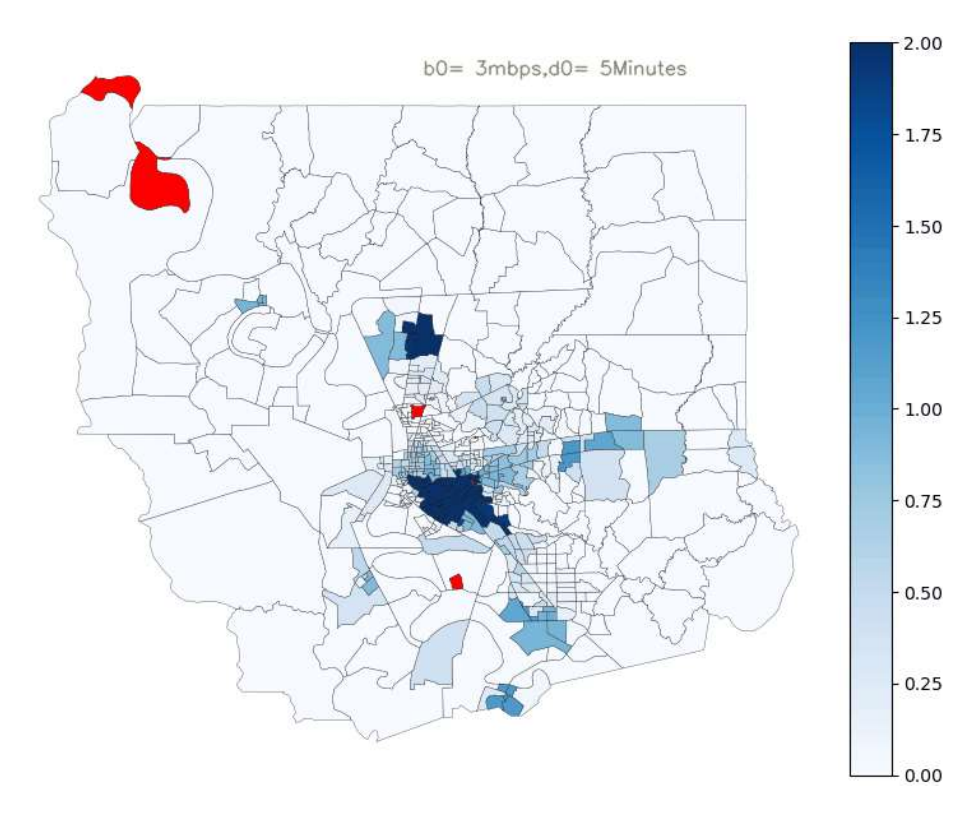
Figure 6. (a) Virtual accessibility by 2SVCA (d_0=5-30 minutes, b_0= 3Mbps) vs.(b) physical accessibility by 2SFCA (d_0=5-30 minutes)

RESULT : 2SFCA scores and 2SVCA scores

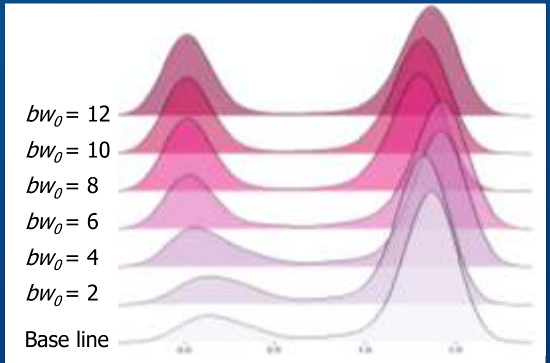
Sensitive Analysis—— 2SVCA



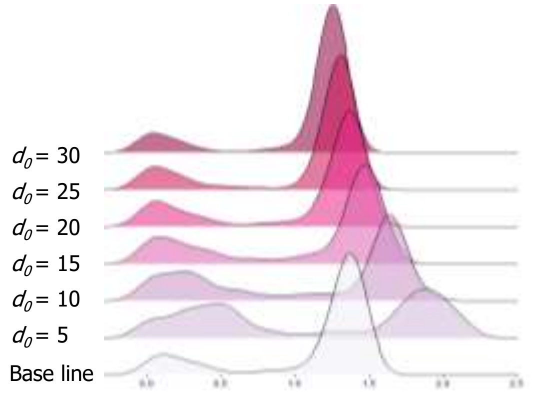
(a) 2SVCA (Varying b_0)
Fixed Parameter: d_0= 30



(b) 2SVCA (Varying d_0)
Fixed Parameter : b_0= 3



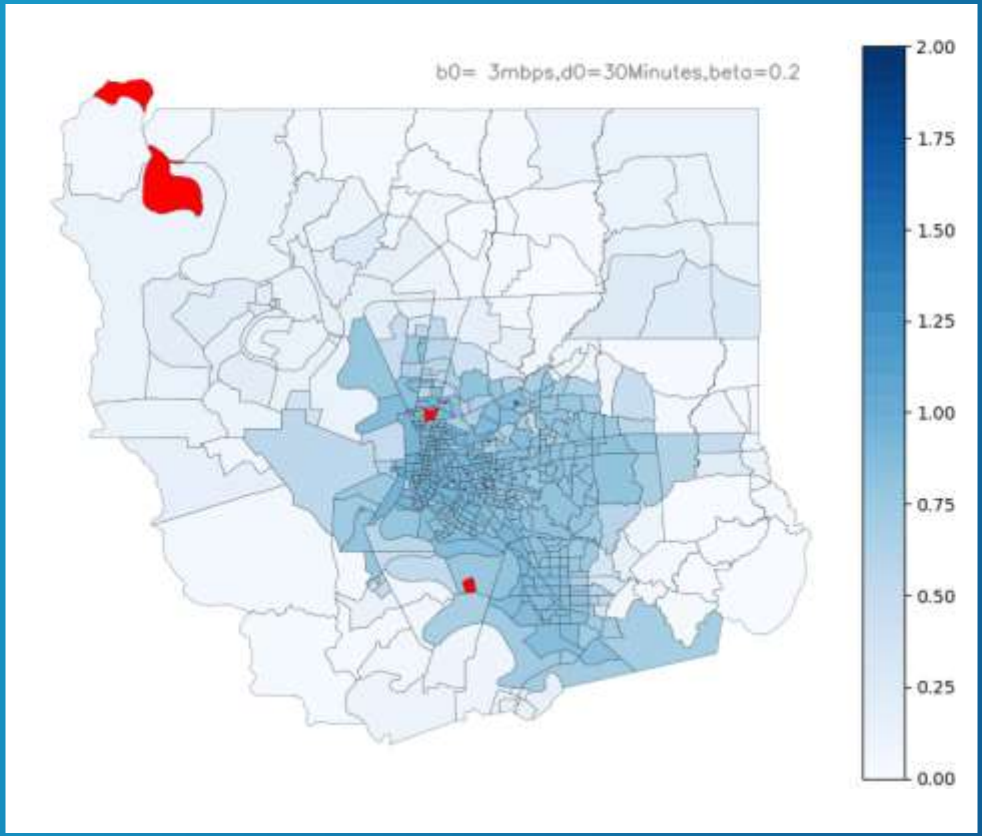
(a) 2SVCA (Varying b_0)
Fixed Parameter: d_0= 30



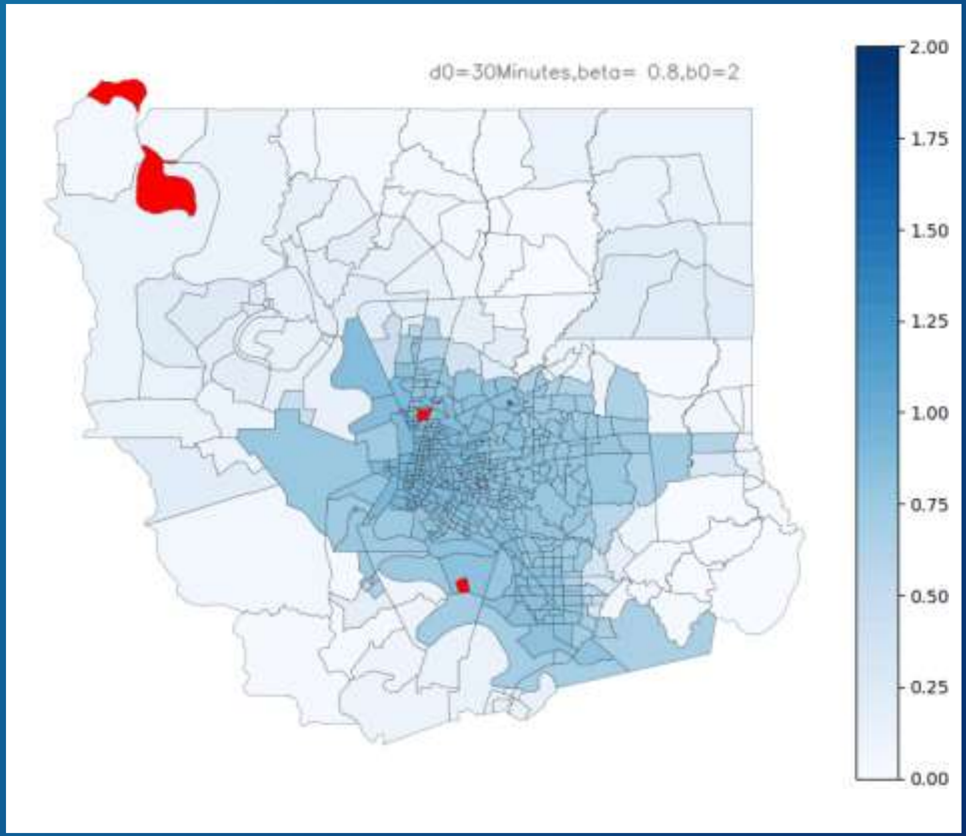
(b) 2SVCA (Varying d_0)
Fixed Parameter : b_0= 3

RESULT : 2SFCA scores and 2SVCA scores

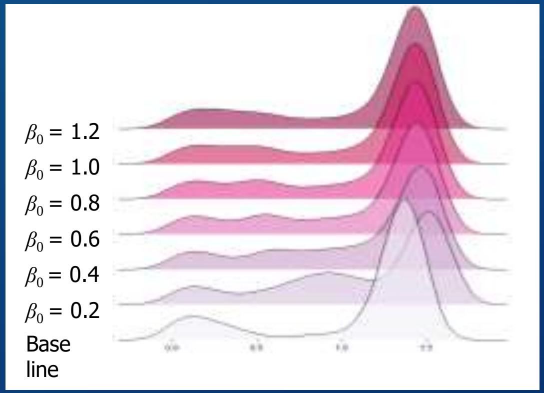
Sensitive Analysis—— 2SVCA-logistic Growth



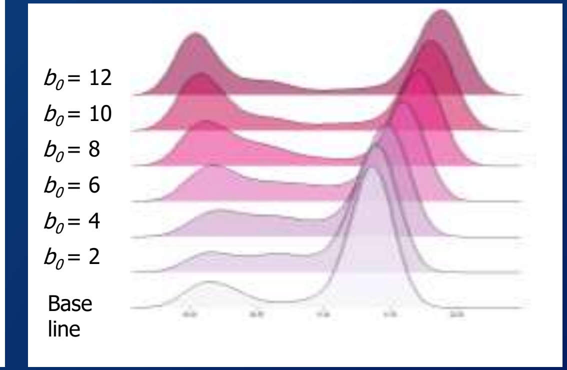
(c) 2SVCA_Logistic Growth(Varying β_0)
Fixed Parameter: $d_0 = 30$, $b_0 = 3$



(d) 2SVCA_Logistic Growth (Varying b_0)
Fixed Parameter: $d_0 = 30$, $\beta_0 = 0.8$



(c) 2SVCA_Logistic Growth(Varying β_0)
Fixed Parameter: $d_0 = 30$, $b_0 = 3$



(d) 2SVCA_Logistic Growth (Varying b_0)
Fixed Parameter: $d_0 = 30$, $\beta_0 = 0.8$

RESULT : Disparity in accessibility by Urbanicity

Table 2. Healthcare accessibility across areas of urbanicity

No. block groups	Travel time from nearest PCP (minutes)	2SVCA average accessibility (Physicians per 1000)		2SFCA average accessibility (Physicians per 1000)	
		$d_0 = 25$	$d_0 = 30$	$d_0 = 25$	$d_0 = 30$
Total (n =570)	4.715	0.686	0.686	0.699	0.699
UA (n = 324)	2.160	0.876	0.827	0.885	0.838
LD (n = 82)	3.083	0.699	0.743	0.707	0.751
RA (n = 164)	10.426	0.320	0.390	0.345	0.410

RESULT : Disparity in accessibility by Urbanicity

Dummy Variable: the reference category "RA" is coded as $x_1 = 0$, $x_2 = 0$; the category "LD" is coded as $x_1 = 1$, $x_2 = 0$; "UA" as $x_1 = 0$, $x_2 = 1$. The model is written as: $A = b_0 + b_1 x_1 + b_2 x_2$

Table 3 Disparity in average travel time and accessibility across areas of urbanicity

	Travel time from the nearest PCP (minutes)	2SVCA Accessibility score (Physicians per 1000)		2SFCA Accessibility score (Physicians per 1000)	
		$d_0 = 25$	$d_0 = 30$	$d_0 = 25$	$d_0 = 30$
Rural Area (reference)	10.623*** (34.36)	0.290*** (15.080)	0.354*** (21.25)	0.318*** (17.14)	0.377*** (23.91)
Low Density (LD)	−7.556*** (−14.11)	0.427*** (12.826)	0.401*** (13.91)	0.405*** (12.61)	0.384*** (14.05)
Urban Area (UA)	−8.625*** (−22.73)	0.601 *** (25.462)	0.482*** (23.57)	0.582*** (22.56)	0.471*** (24.28)

RESULT : Disparity in accessibility across demographic groups

Table 4. Weighted average travel time and accessibility by demographic groups

	Travel time from the nearest primary care provider (minutes)	2SVCA Accessibility score (Physicians per 1000)		2SFCA Accessibility score (Physicians per 1000)	
		d_0 = 25	d_0 = 30	d_0 = 25	d_0 = 30
All population	4.715	0.686	0.686	0.699	0.699
White	5.456	0.622	0.647	0.636	0.660
Black	3.858	0.764	0.728	0.778	0.743
Household under poverty	4.439	0.716	0.697	0.730	0.713

RESULT : Disparity in accessibility across demographic groups

Weighted OLS: Y = a + b ∗ Flag

Table 5. disparity in average time and accessibility across demographic groups

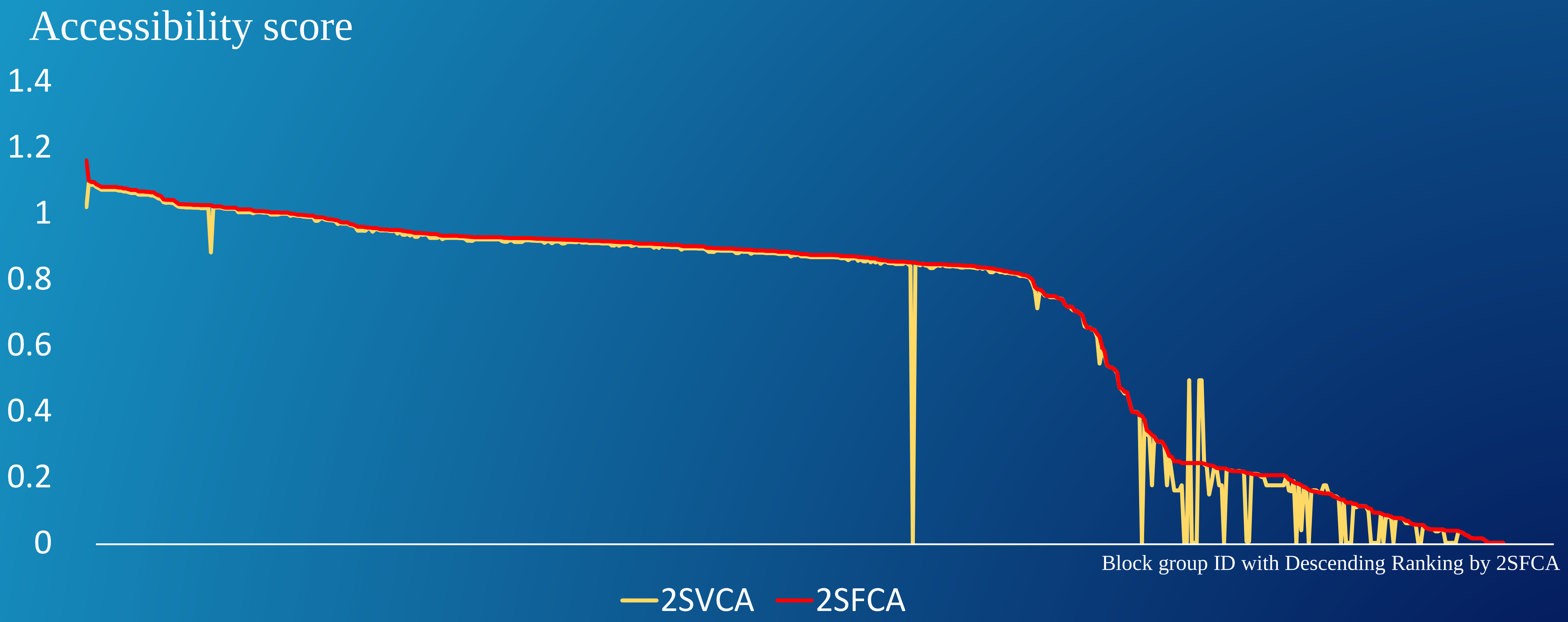
	Travel time from the nearest primary care provider (minutes)			2SVCA Accessibility score (Physicians per 1000) (d_0 = 30)			2SFCA Accessibility score (physicians per 1000) (d_0 = 30)		
	≤4.715 (Flag = 1)	>4.715 (Flag = 0)	Difference (t-value)	>0.686 (Flag = 1)	≤0.686 (Flag = 0)	Difference (t-value)	>0.699 (Flag = 1)	≤0.699 (Flag = 0)	Difference (t-value)
No. block groups (n)	408	162		435	135		433	137	
White %	45.79	64.77	−18.98*** (−6.84)	46.85	65.15	−18.30*** (−6.17)	46.68	65.41	−18.73*** (−6.36)
Black %	49.55	27.93	21.62 *** (5.16)	41.91	28.70	13.21*** (4.20)	42.05	28.46	13.59*** (4.35)
Household under poverty %	17.20	15.67	1.53 (0.99)	16.75	16.84	−0.09 (−0.06)	16.74	16.83	−0.09 (−0.05)

RESULT : How Broadband Subscription Ratio be influenced

$$Y_{\text{Broadband Ratio}} = b_0 + b_1\, x_{\textit{household under poverty}} + b_2\, x_{\text{Black\% or White\%}}$$

	Black %				White %			
	Intercept	Household under poverty %	Black %	R^2	Intercept	Household under poverty %	White %	R^2
RA	0.691*** (26.987)	−0.266* (−2.106)	−0.280*** (−4.626)	0.174	0.455*** (8.679)	−0.296* (−2.324)	0.251*** (4.053)	0.151
LD	0.810*** (28.634)	−0.708*** (−4.002)	−0.095 (−1.278)	0.246	0.706*** (11.616)	−0.684*** (−3.895)	0.123 (1.589)	0.272
UA	0.885*** (59.692)	−0.411*** (−7.992)	−0.260*** (−9.112)	0.468	0.647*** (29.752)	−0.408*** (−7.810)	0.278*** (8.845)	0.462

RESULT : Difference between 2SVCA and 2SFCA



RESULT : Difference between 2SVCA and 2SFCA

Category	Intercept	Broadband %	Reference (RA)		R^2
			LD	UA	
Black %- I (0-20%)	-0.159*** (-4.390)	0.122* (2.427)	0.063** (2.856)	0.048* (2.535)	0.10
Black %-II (20-40%)	-0.670*** (-9.308)	0.641*** (5.370)	0.149* (1.778)	0.181*** (3.273)	0.43
Black %-III (40-60%)	-0.712*** (-5.369)	0.793** (3.293)	0.044 (0.255)	0.127 (1.218)	0.26
Black %-IV (60-80%)	-0.158 (-1.285)	0.127 (0.624)	0.072 (0.628)	0.055 (0.580)	0.02
Black %- V (80-100%)	-0.201* (-6.305)	0.067* (1.859)	0.159*** (4.038)	0.151*** (5.033)	0.26

Discussion

Discussion

The integration of spatial accessibility and Internet access reflects the relative ease by which telehealth activities or services can be accessed from a given location.

Two measures of healthcare accessibility are used for residents at the census block group level, 2SFCA and 2SVCA, based on which we examine the disparities in spatial accessibility across geographic areas of various urbanicity levels and across major racial-ethnic groups and validate whether the disparities are statistically significant.

Findings

The urban advantage is evident in both measures of PCP accessibility and is validated in a statistical test.

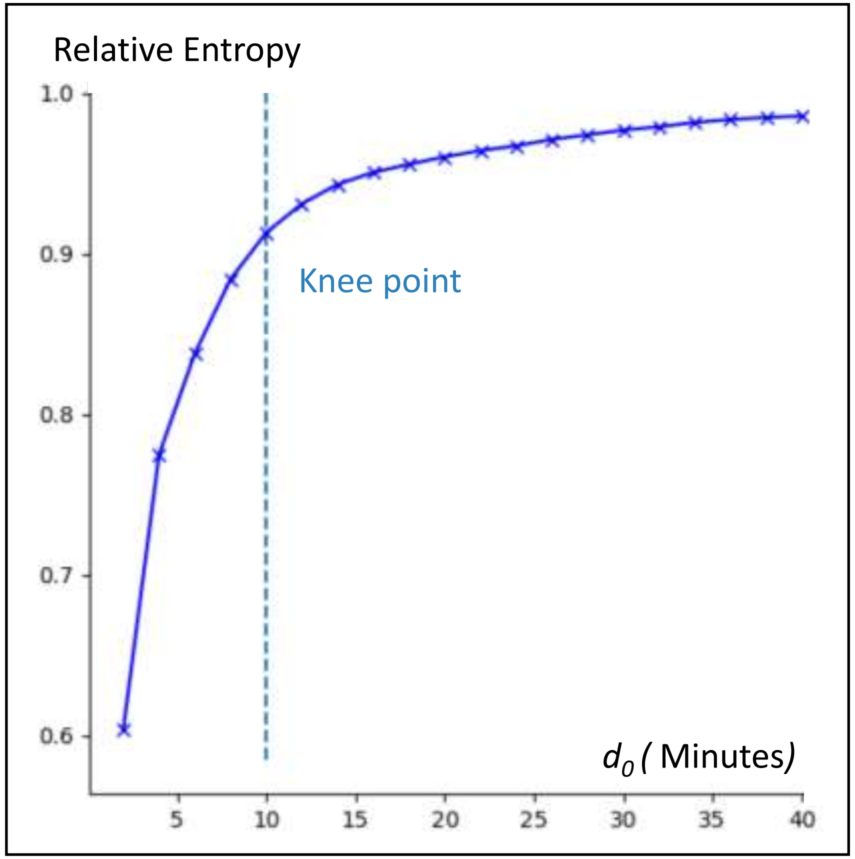
African Americans (or population under poverty) are disproportionally concentrated in areas closer to their nearest PCP in terms of travel time and also in areas with above-average accessibility, termed "reversed racial advantage". Such an advantage in accessibility may not pan out when multimodal transportation is considered, since a disproportionally higher ratio of African Americans rely on much slower public transits.

The aforementioned racial advantage for African Americans is not applicable to those in rural areas.

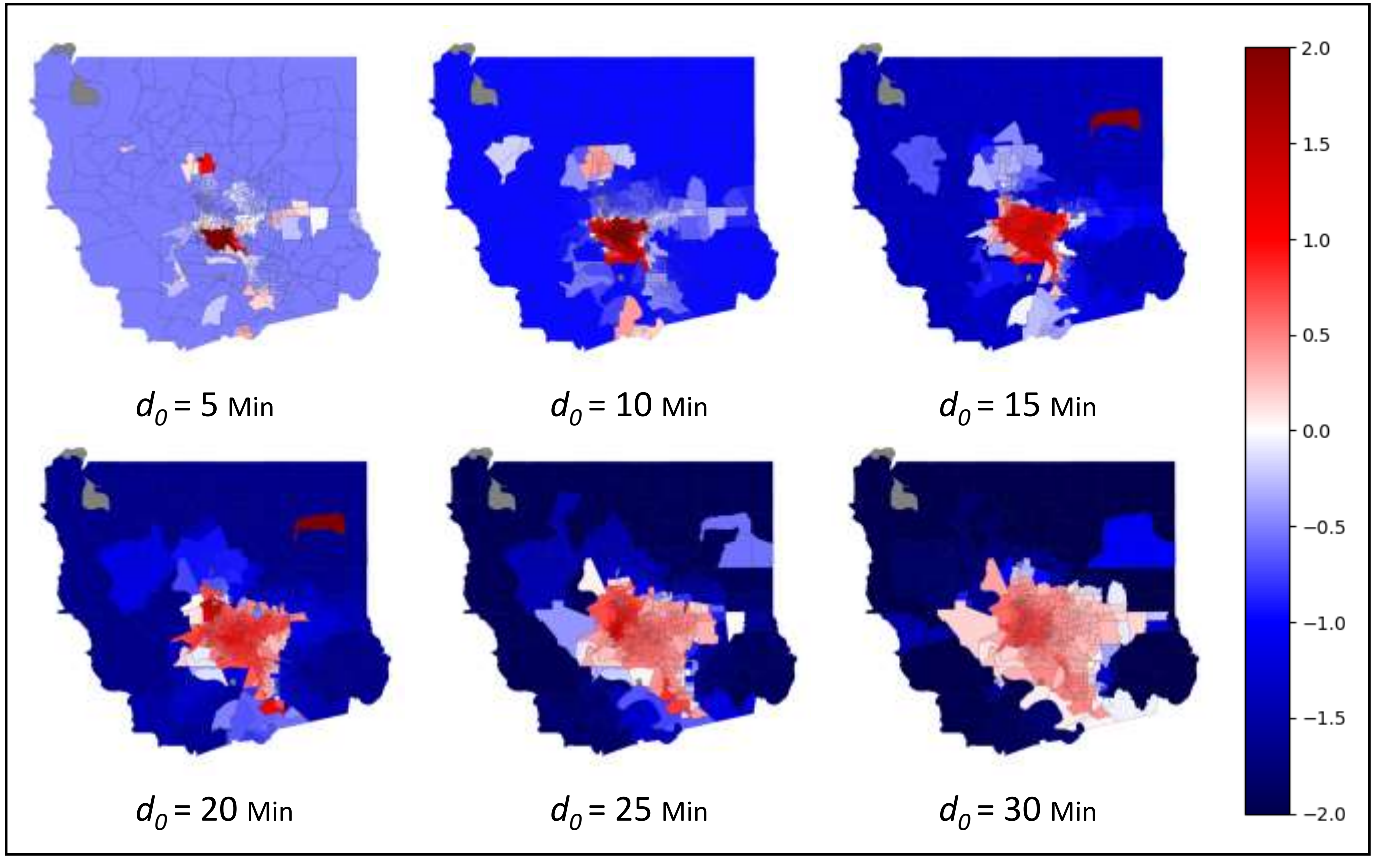
The affordability of telehealth reflected by broadband subscription ratio is highly affected by poverty status, which also exacerbate the Africa Americans both living in rural area and urban area.

Most importantly, the comparison between the attenuation effect of 2SVCA-logistic growth and the discrete threshold value in 2SVCA, and the sensitiveness analysis of varying parameters validate the robustness of 2SVCA model.

RESULT : Future work



(a) Relative Entropy



(b) Z-scores

OPEN PLATFORM for

Spatiotemporal Computation

SPATIAL DATA LAB @ CGA， IQSS

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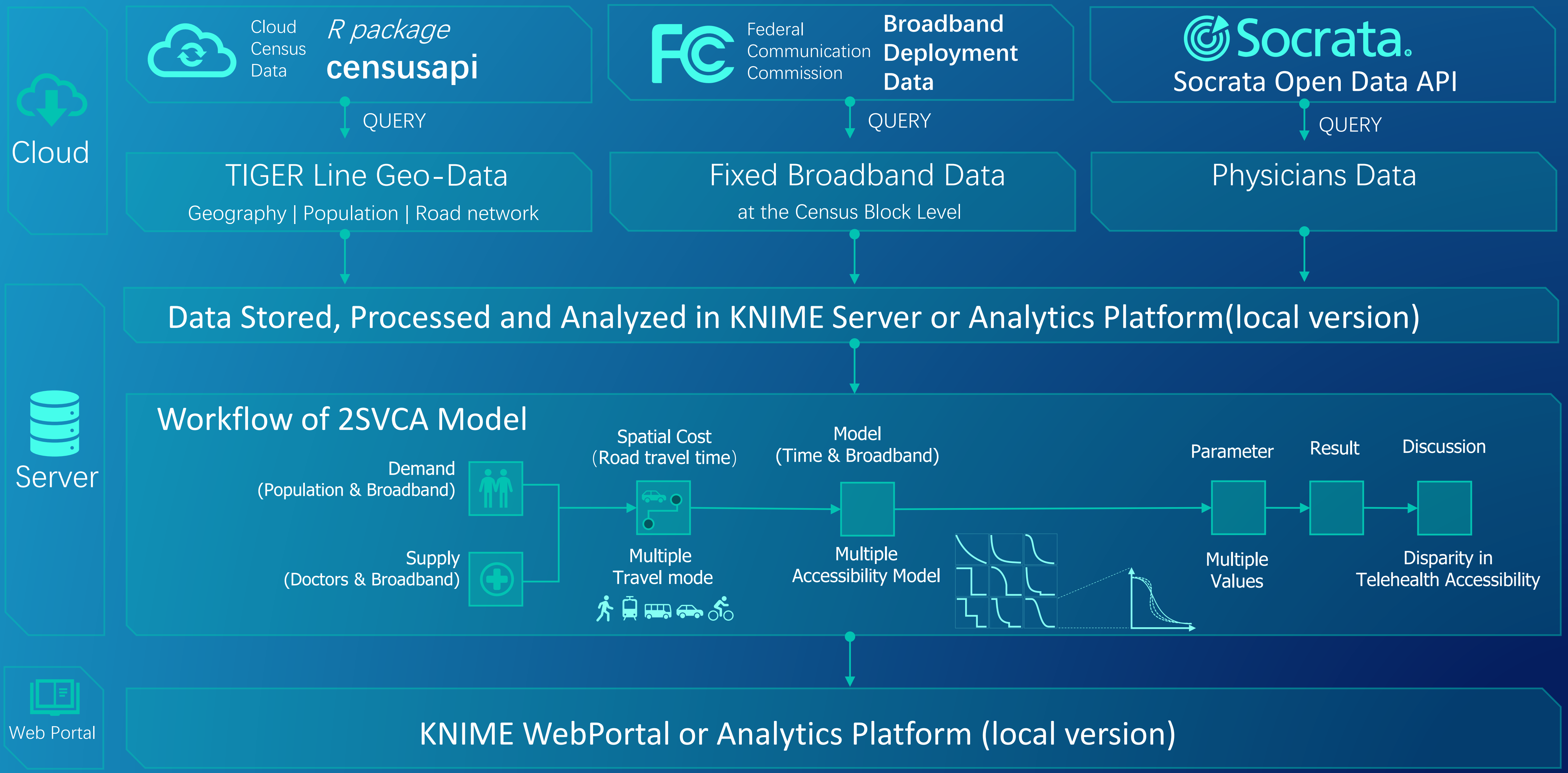
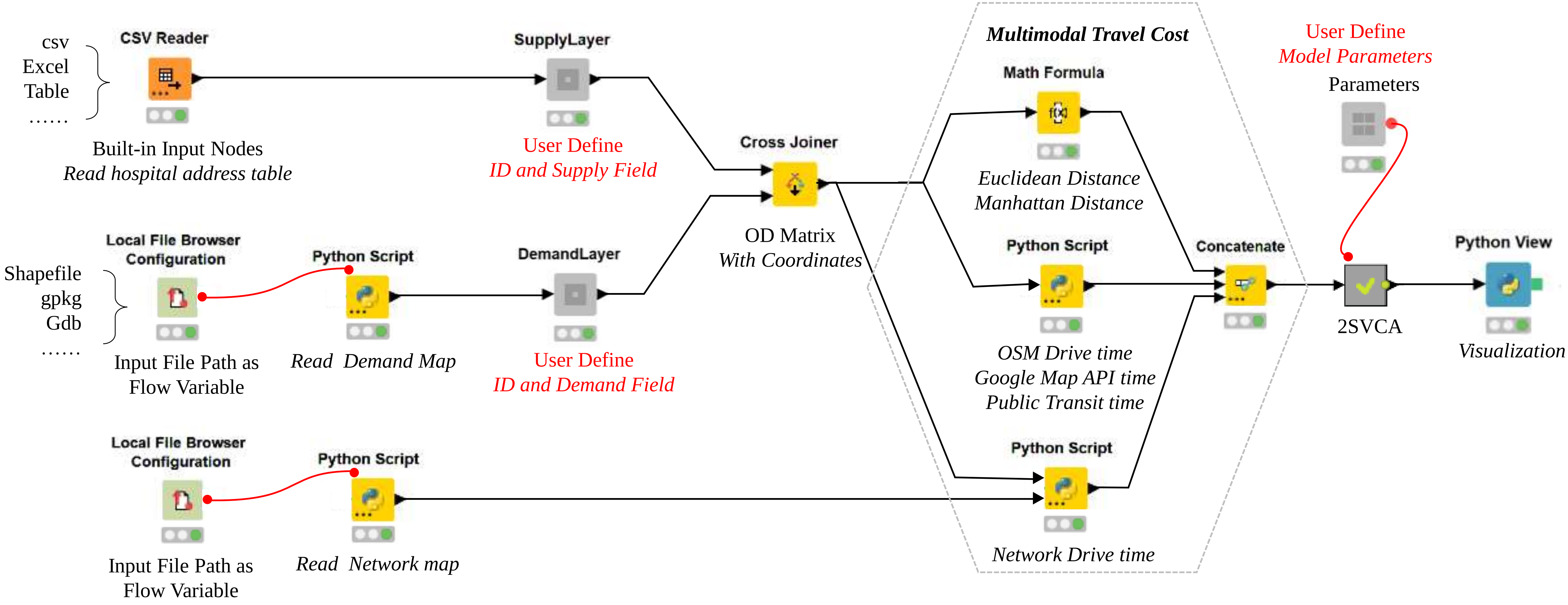
KNIME-based CI for Geospatial Computation



KNIME-based CI for Spatiotemporal Computation



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THANKS

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