



Caltrans Division of Research,  
Innovation and System Information



# RESEARCH CONNECTION

**Is It  
Location, Location, Location?**

Do People Who Live Near Employment Sub-Centers Drive More? Or Less?

***WELCOME***



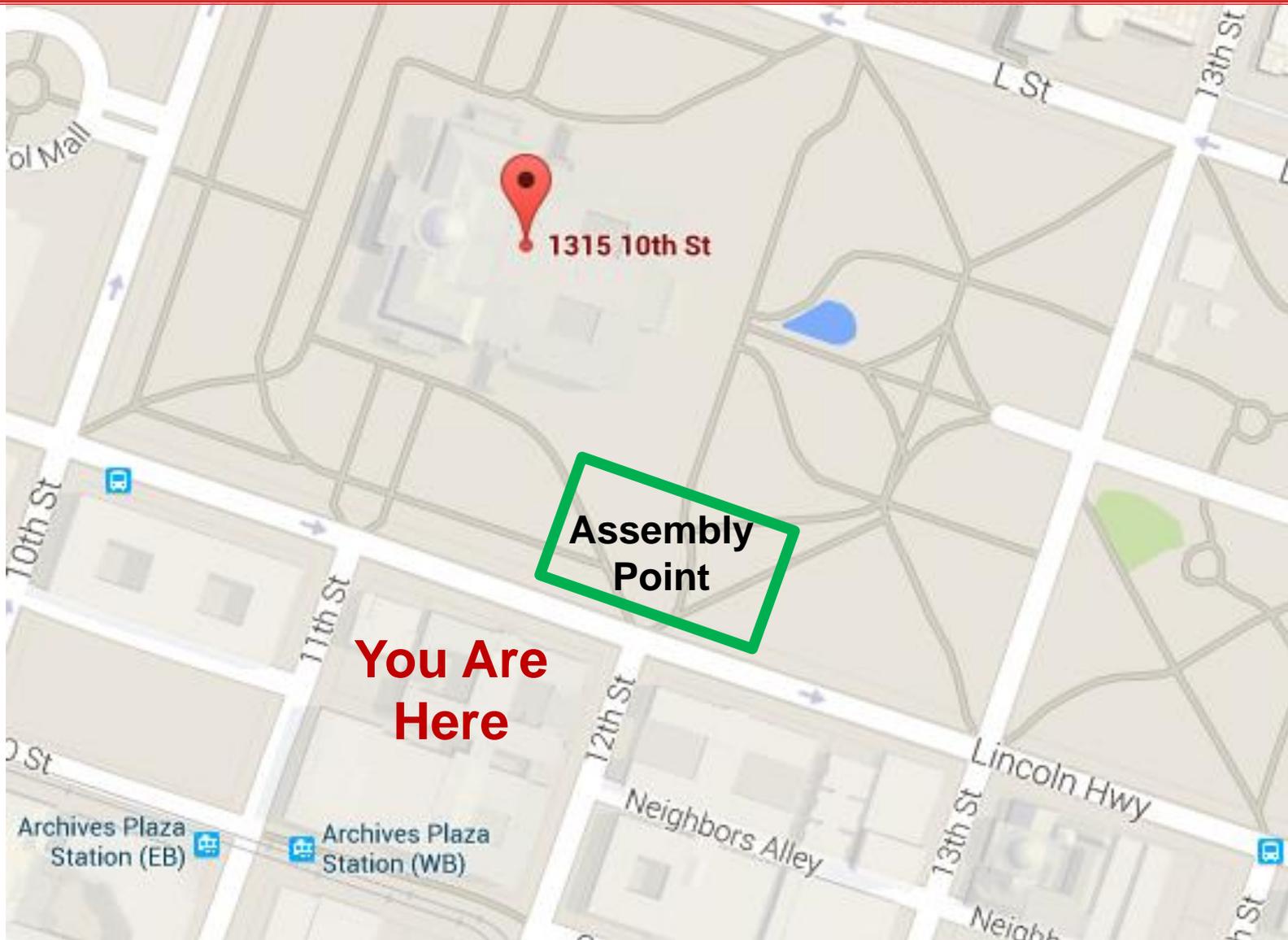
# Research Connection Agenda

<b>Time:</b>	<b>Topic:</b>	<b>Presenter:</b>
10:00 AM	Welcome and Housekeeping	Linda Jones
10:05 AM	Opening Remarks and Introduction	Jim Appleton, Division Chief
10:15 AM	Presentation – Is It Location, Location, Location? Do People Who Live Near Employment Sub-Centers Drive More? Or Less?	Professor Marlon Boarnet
11:10 AM	Q & A	Professor Marlon Boarnet
11:28 AM	Closing	Linda Jones

- **Restrooms**
- **Cell Phones**
- **Evacuation Information**
  - Emergency Exit Locations
- **Email Questions**



# Evacuation Assembly Point





Email Question to:

**[research.connection.event@dot.ca.gov](mailto:research.connection.event@dot.ca.gov)**



# Opening Remarks

**Jim Appleton**  
**Division Chief**

Caltrans Division of Research,  
Innovation and System Information (DRISI)

## **Marlon G. Boarnet**

### **Professor and Department Chair**

Department of Urban Planning and Spatial Analysis  
Sol Price School of Public Policy  
University of Southern California

## Urban Spatial Structure and the Potential for Vehicle Miles Traveled (VMT) Reduction

Marlon G. Boarnet and Xize Wang  
University of Southern California  
June 6, 2016

Let's start with one table and two maps.

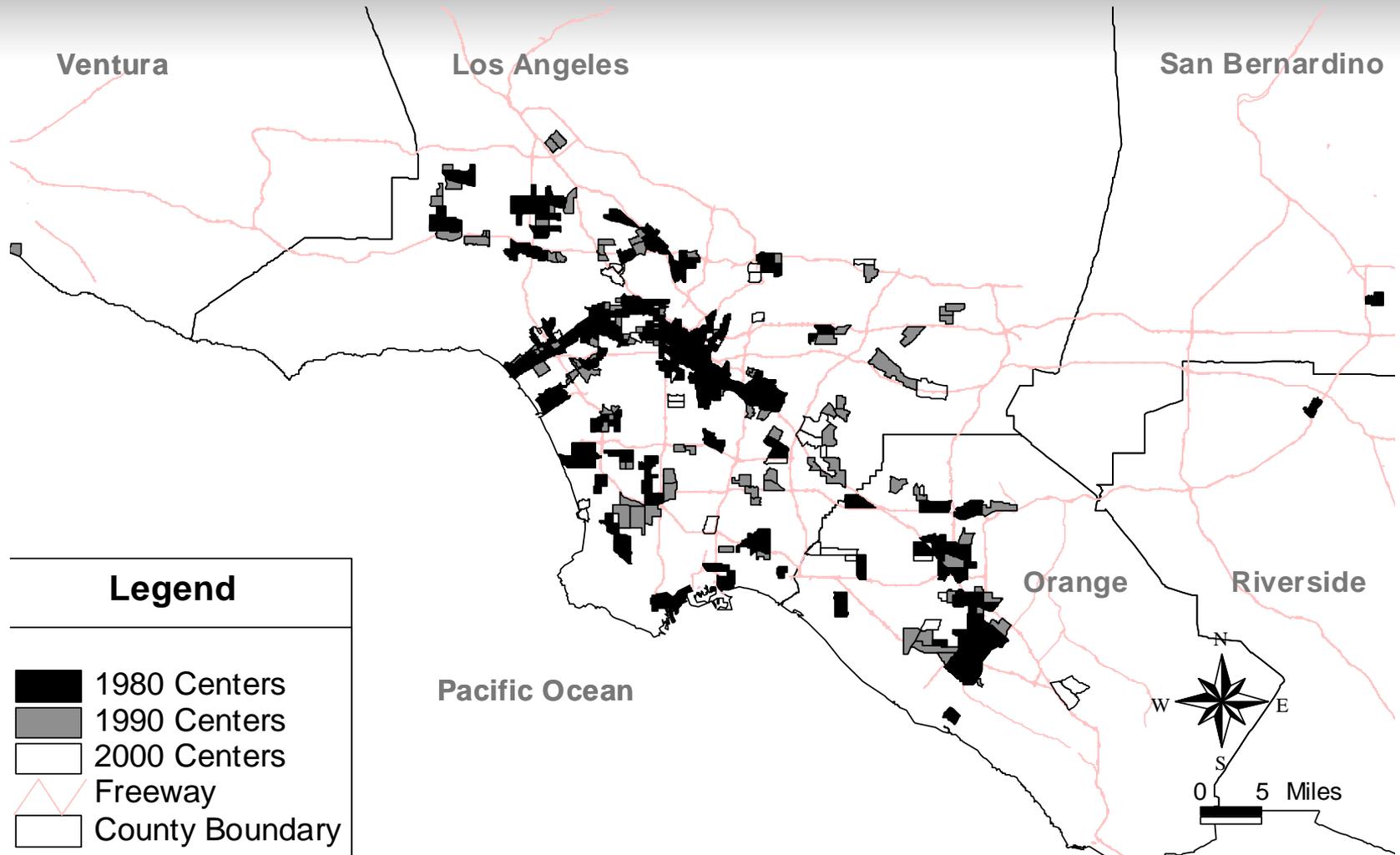
<b>Land Use Variable</b>	<b>Elasticity range from Salon et al. (2012)</b>	<b>Elasticity estimate from Ewing and Cervero (2010)</b>
<b>Population density</b>	-0.08 to -0.19	-0.04
<b>Land use mix</b>	-0.02 to -0.10	-0.09
<b>Intersection density</b>	0 to -0.19	-0.12
<b>Regional accessibility to jobs</b>	-0.03 to -0.25	-0.20

Note: All land use variables are measured near the survey household's residence, usually within ¼ or ½ mile or in geographies corresponding to census block groups or tracts.

Sources: Salon, et al., "How Do Local Actions Affect VMT? A Critical Review of the Empirical Evidence," Transportation Research Part D, 2012

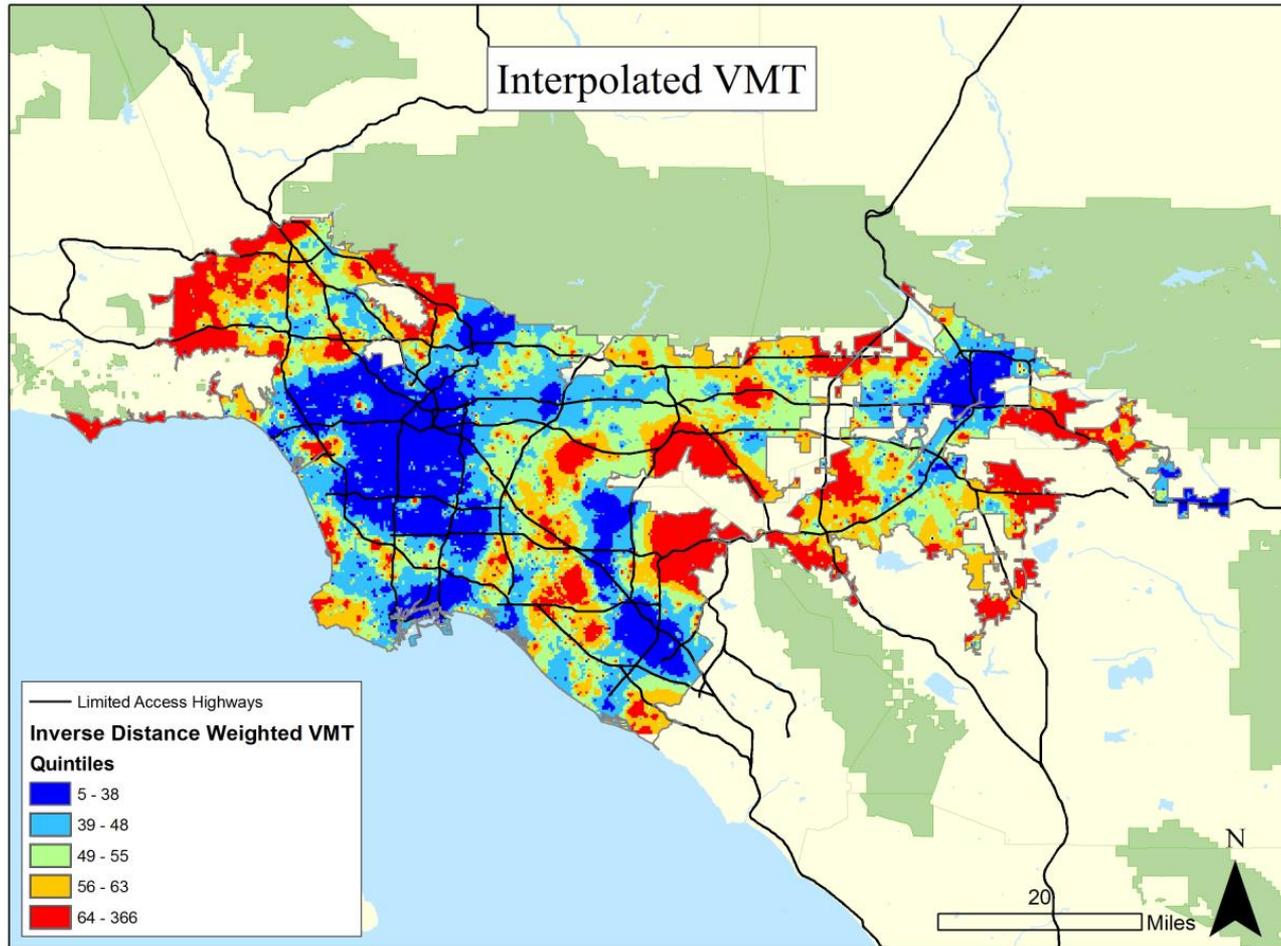
Ewing and Cervero, "Travel and the Built Environment: A Meta-Analysis," J. Am. Plan. Assoc., 2010.

# Los Angeles MSA Employment Sub-Centers, 1980 - 2000



Source: Guiliano, Agarwal, and Redfearn, "METROPOLITAN SPATIAL TRENDS IN EMPLOYMENT AND HOUSING: LITERATURE REVIEW," background paper for TRB committee on "Land Use, VMT, and Energy," May, 2008.

2001 Mean HH  
VMT, diary  
period, = 47.81  
miles

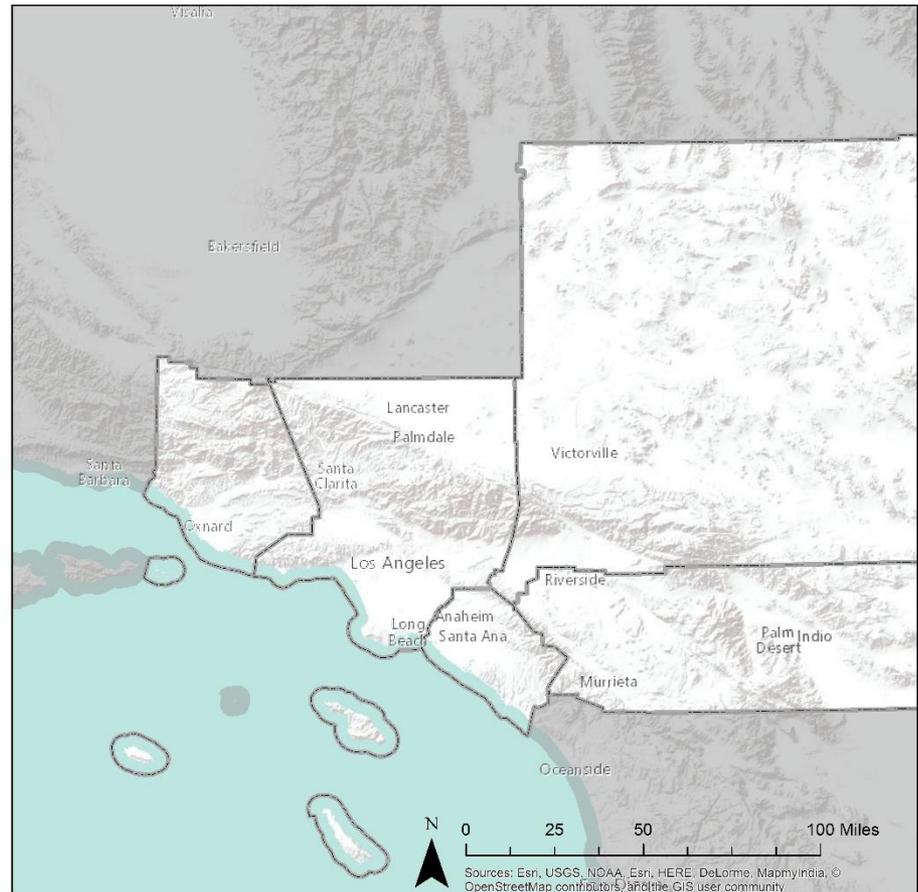


Source: Boarnet, Marlon G., Houston, Douglas, Ferguson, Gavin, & Spears, Steven. (2011). Land Use and Vehicle Miles of Travel in the Climate Change Debate: Getting Smarter than Your Average Bear. In Yu-Hung Hong & Gregory Ingram (Eds.), *Climate Change and Land Policies* (pp. 151-187). Cambridge, MA: Lincoln Institute of Land Policy.

- GHG emission reduction goals in California
  - AB 32 and SB 375
- Vehicle miles traveled (VMT) as an important indicator of GHG emission
- How urban spatial structure impacts VMT?
- Gravity measures for accessibility matters:
  - 0.2 and higher elasticity
  - But, what else?

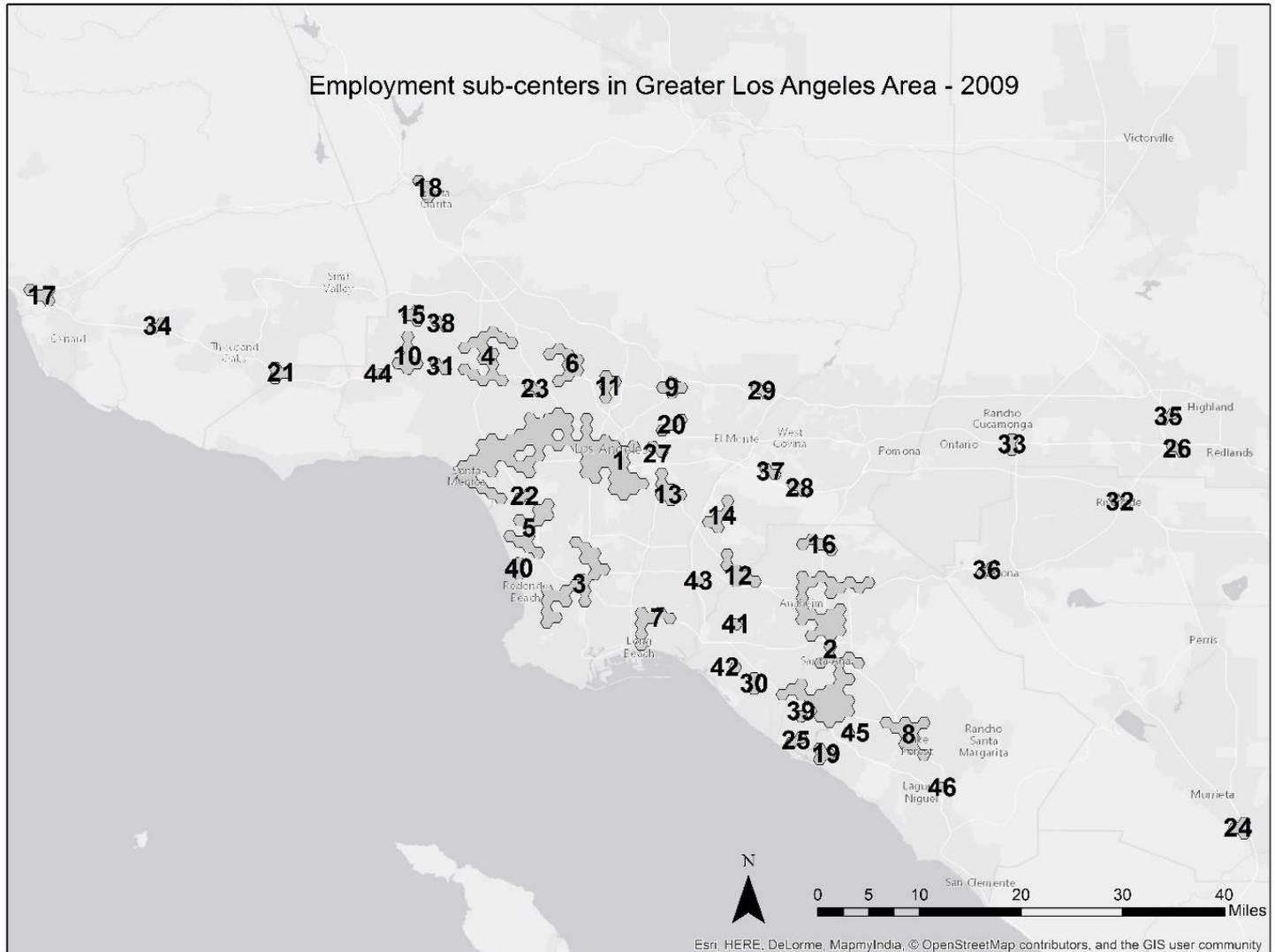
- Southern California is very sub-centered. Does effect of accessibility on VMT vary for jobs in or not in sub-centers?
- Does the effect vary in the core vs. periphery?
- Does the effect vary near vs. far? Here we use a 5-mile threshold.
- What is the VMT effect if we “move” a household from a neighborhood with high accessibility to jobs to one with low accessibility to jobs?

- Defining Greater Los Angeles Area
- Los Angeles Combined Statistical Area (CSA)
- Los Angeles, Orange, Riverside, San Bernardino and Ventura Counties
- Demographics:
  - Population: 17,877,006, 48% of California
  - Cities: 176
  - Unincorporated places: 348



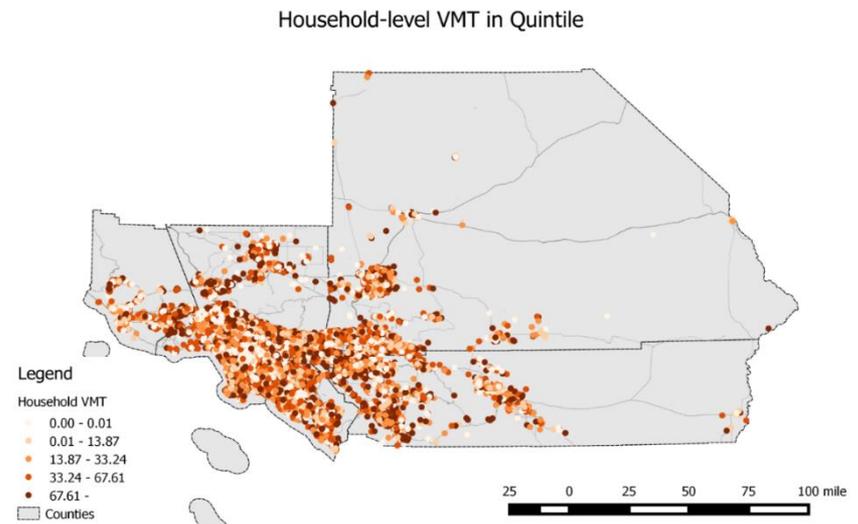
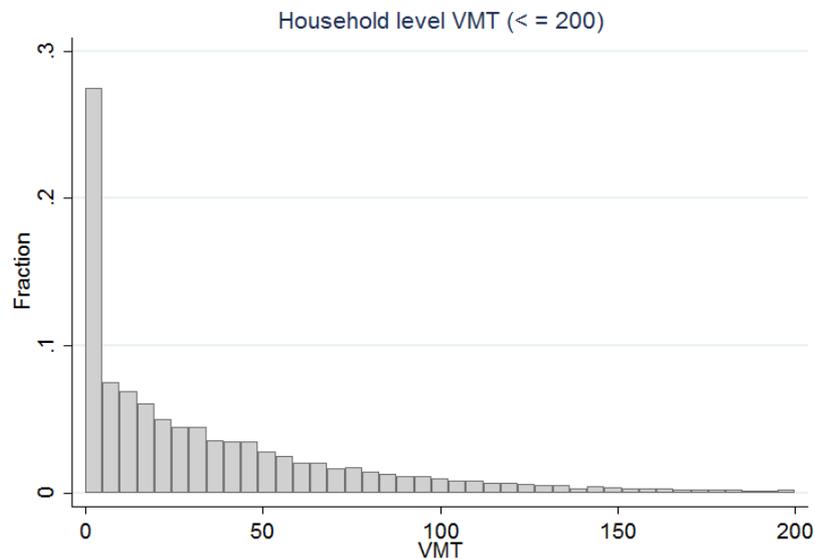
- Identify employment sub-centers:
  - “95<sup>th</sup> percentile - 10k” method (Giuliano et al., 2015)
  - 2009 National Establishment Time Series (NETS)
  - Divide the region into 34,527 1-square-mile hexagons
  - Each hexagon within a center has employment density larger than 95<sup>th</sup> percentile of Los Angeles CSA (1,115 jobs per square mile)
  - Employment sub-centers have no less than 10,000 jobs

Reference: Giuliano, G., Hou, Y., Kang, S., & Shin, E.-J. (2015). *Accessibility location, and employment center growth*. Los Angeles, CA: METTRANS Transportation Center.



- 46 employment sub-centers in LA CSA
  - 3,331,205 total jobs, 39.8% of the total CSA
- Sub-center #1: downtown Los Angeles – Wilshire Corridor – Santa Monica
  - 1,107,139 total jobs, 13.2% of total jobs in LA CSA
- Sub-center #2: Anaheim – Irvine – Santa Ana
  - 605,284 total jobs, 7.2% of total jobs in LA CSA
- 37 of the 46 centers are located in Los Angeles and Orange Counties

- Sample of study:
  - California Household Travel Survey, 2012
  - 13,475 households in Los Angeles CSA

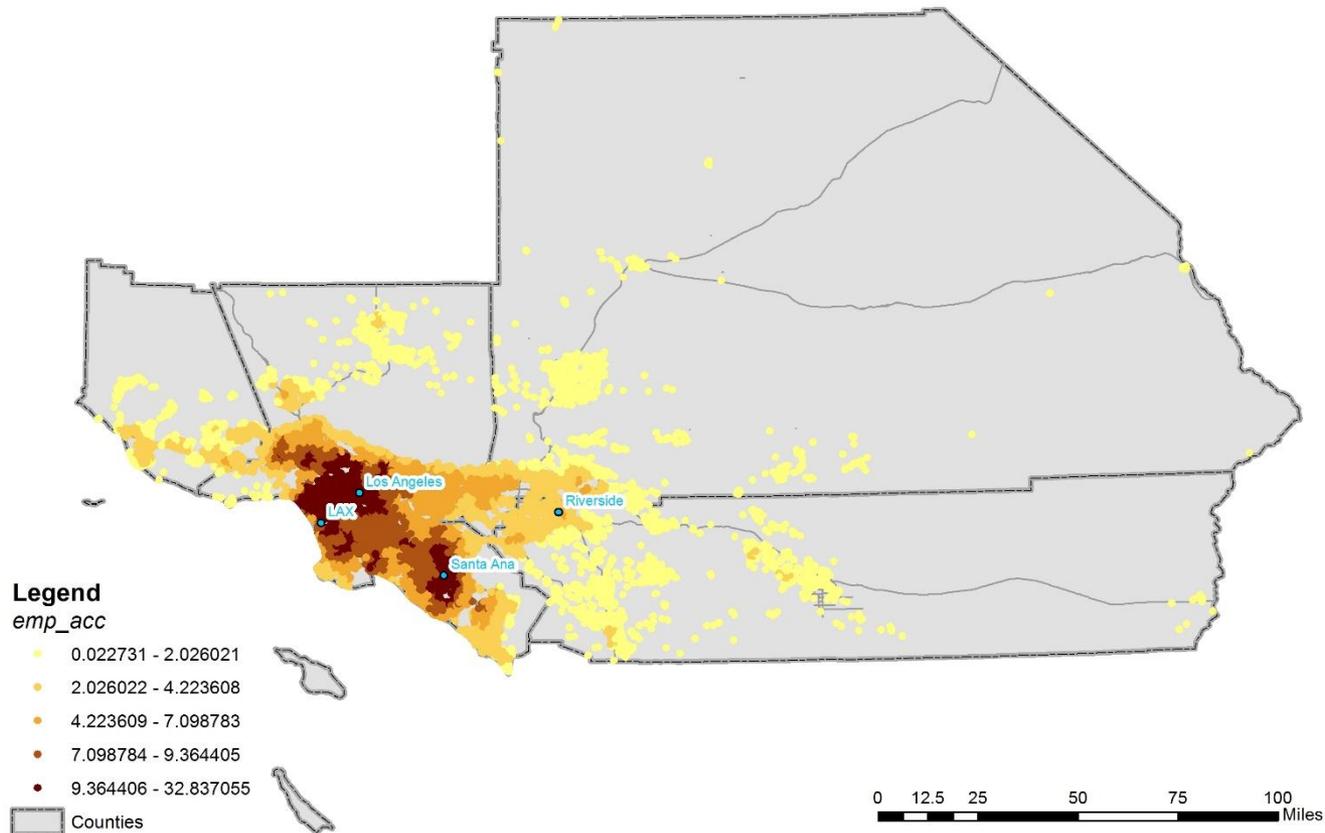


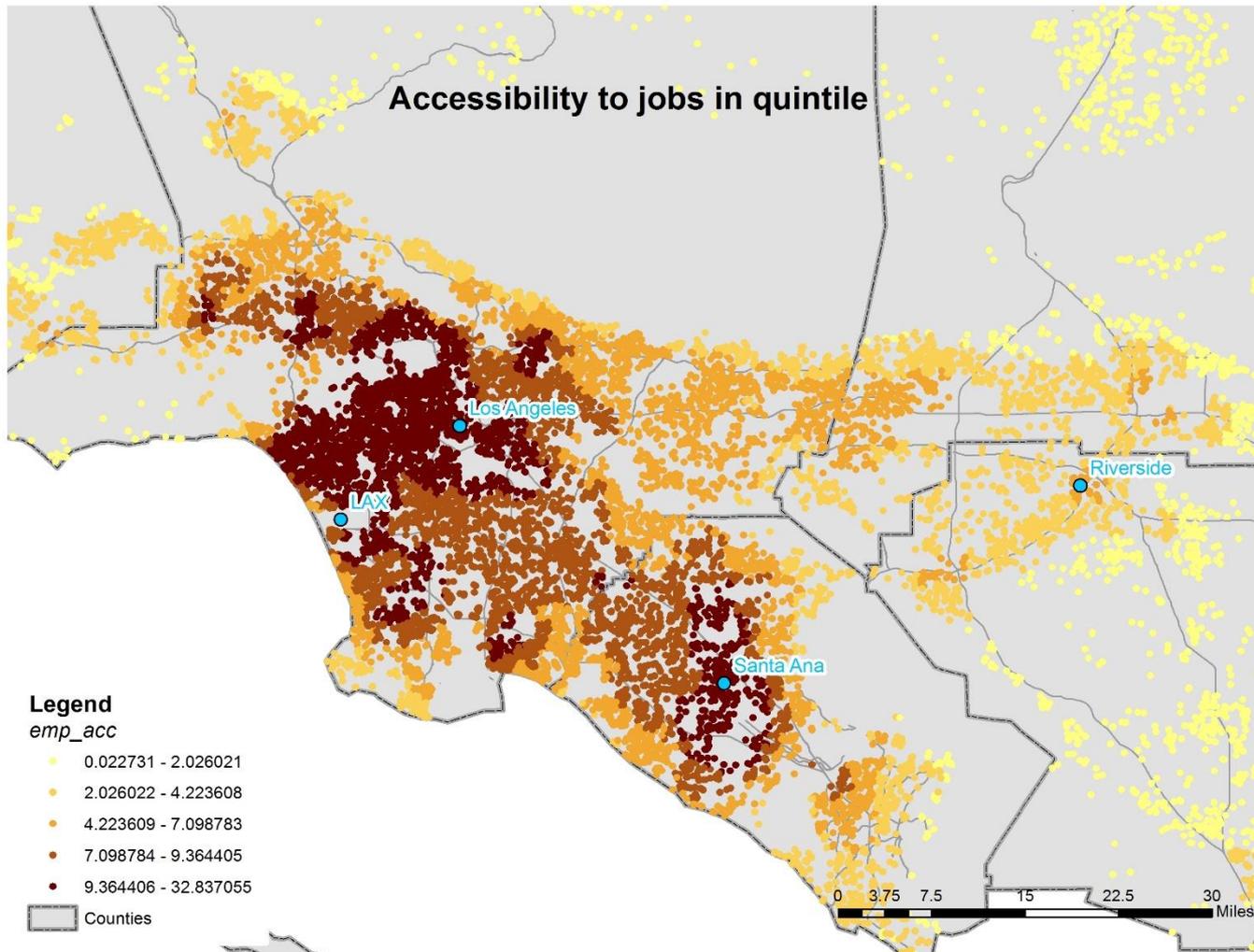
- Job accessibility

$$acc_i = \sum_{j \neq i} \frac{E_j}{D_{ij}^2} + \frac{E_i}{D_0^2}$$

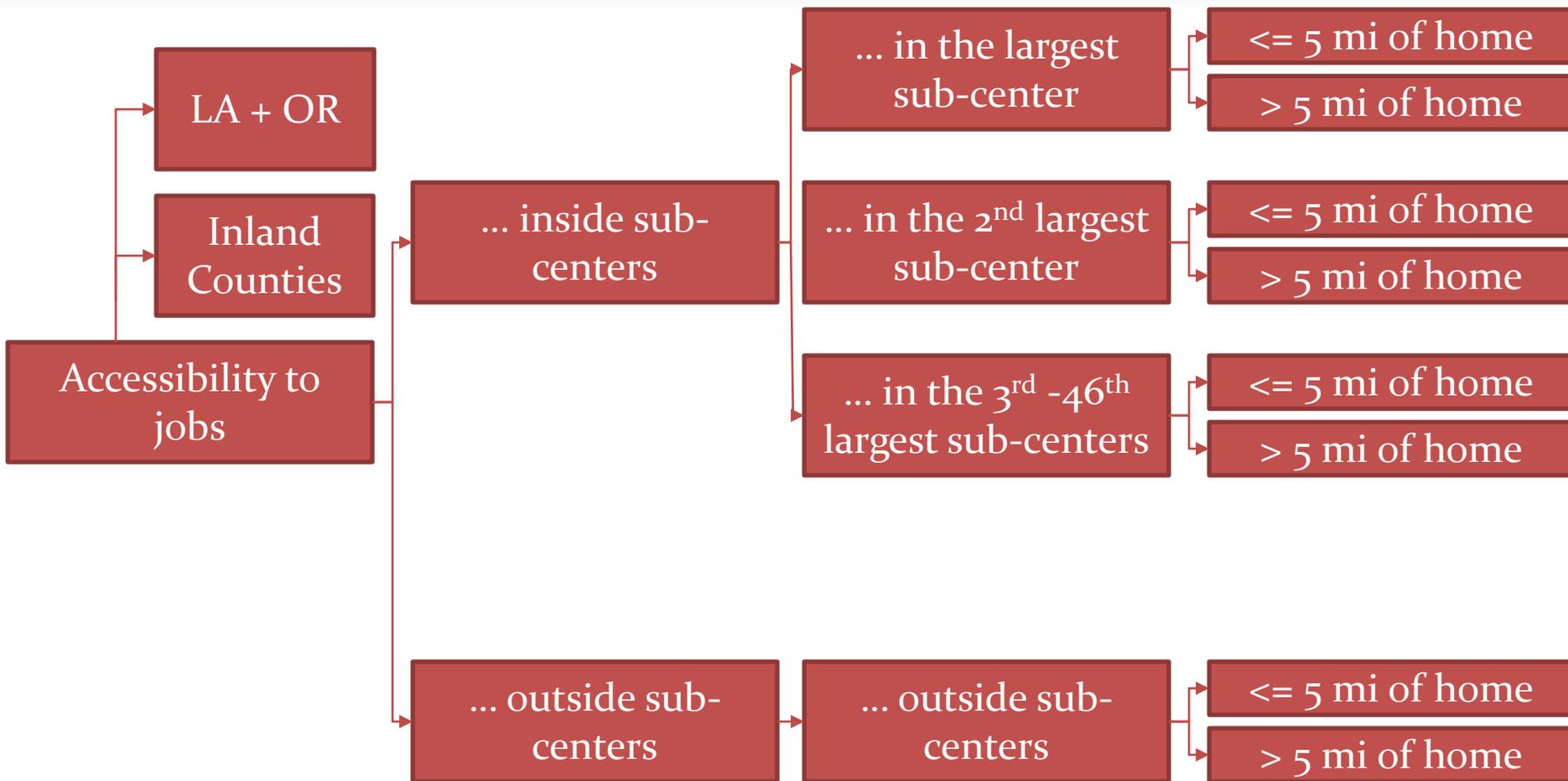
- $acc_i$ : a quadratically damped job accessibility index for hexagon  $i$ ;
- $E_j$ : number of jobs inside hexagon  $j$ ;
- $D_{ij}$ : distance (in miles) between centroids of hexagon  $i$  and hexagon  $j$ ;
- $E_i$ : number of jobs inside hexagon  $i$ ;
- $D_0$ : 1 mile, in other words, we assume that jobs within a hexagon are accessible from within that hexagon with no damping. (The distance between centroids of two adjoining hexagons is 1.075 miles).

## Accessibility to jobs in quintile





# Closer look at accessibility



- Dependent variable: household VMT
- Key independent variable: accessibility of jobs (divided by 10,000)
- Control variables:
  - household vehicle holdings, household income, household size, residential density (census tract level) and flag for coastal counties.
- Model
  - Tobit regression due to left censoring
- Sample:
  - 2012 California Household Travel Survey
  - 13,475 households in Los Angeles CSA

Elasticity: 1% change of accessibility is associated with x% change of VMT.

$$e = \frac{1}{n} \sum_i me_i * \frac{accessibility_i}{VMT}$$

$e$  – elasticity

$me_i$  – marginal effect for household  $i$ :

- for Tobit

$n$  – number of observations

Reference: Boarnet, M. G., Houston, D., Ferguson, G., & Spears, S. (2011). Land use and vehicle miles of travel in the climate change debate: getting smarter than your average bear. In Y.-H. Hong & G. Ingram (Eds.), *Climate Change and Land Policies* (pp. 151-187). Cambridge, MA: Lincoln Institute of Land Policy.

# 1) Accessibility to all jobs

*Table 8: Regression Models for Accessibility to All Jobs*

	<b>All counties Model 1</b>	<b>Coastal counties Model 2</b>	<b>Inland counties Model 3</b>
Accessibility to all jobs	-0.815*** [-1.041,-0.588]	-0.854*** [-1.103,-0.606]	-1.414* [-2.920,0.093]
<i>elasticity</i>	<b>-0.249</b>	<b>-0.347</b>	<b>-0.140</b>
Pseudo R-square	0.025	0.028	0.018
N	13475	9361	4114

Note: Control variables not shown, 95% confidence interval in brackets, \* p<0.10, \*\* p<0.05, \*\*\* p<0.01

## 2) Accessibility to center and non-center jobs

*Table 9: Regression Models for Accessibility to Jobs Inside and Outside Employment Sub-Centers*

	All counties Model 4	Coastal counties Model 5	Inland counties Model 6
Accessibility to jobs in the sub-centers	-0.722*** [-0.975,-0.468]	-0.784*** [-1.037,-0.531]	-2.4 [-6.739,1.939]
<i>Elasticity</i>	-0.111	-0.174	
Accessibility to jobs outside sub-centers	-1.258*** [-1.843,-0.673]	-1.863*** [-2.623,-1.104]	-1.149 [-3.009,0.711]
<i>elasticity</i>	-0.191	-0.347	
Pseudo R-square	0.025	0.029	0.018
N	13475	9361	4114

Note: Control variables not shown, 95% confidence interval in brackets, \* p<0.10, \*\* p<0.05, \*\*\* p<0.01

# 3) Accessibility to jobs in 1<sup>st</sup>, 2<sup>nd</sup>, other centers and non-centers

*Table 10: Regression Models for Accessibility to Jobs from Different Employment Sub-Centers*

	All counties Model 7	Coastal counties Model 8	Inland counties Model 9
Accessibility to jobs in the largest sub-center	-0.640*** [-0.911,-0.368]	-0.697*** [-0.960,-0.433]	-2.808 [-54.075,48.459]
<i>Elasticity</i>	<b>-0.047</b>	<b>-0.076</b>	
Accessibility to jobs in the second-largest sub-center	-0.926*** [-1.602,-0.251]	-1.128*** [-1.772,-0.485]	79.091*** [33.593,124.589]
<i>Elasticity</i>	<b>-0.017</b>	<b>-0.029</b>	<b>0.140</b>
Accessibility to jobs in the 3rd - 46th largest sub-center	-1.196*** [-1.841,-0.552]	-1.418*** [-2.058,-0.778]	-2.266 [-6.754,2.222]
<i>Elasticity</i>	<b>-0.075</b>	<b>-0.123</b>	
Accessibility to jobs outside sub-centers	-1.041*** [-1.678,-0.405]	-1.640*** [-2.423,-0.858]	-3.146*** [-5.429,-0.862]
<i>elasticity</i>	<b>-0.158</b>	<b>-0.305</b>	<b>-0.260</b>
Pseudo R-square	0.025	0.029	0.018
N	13475	9361	4114

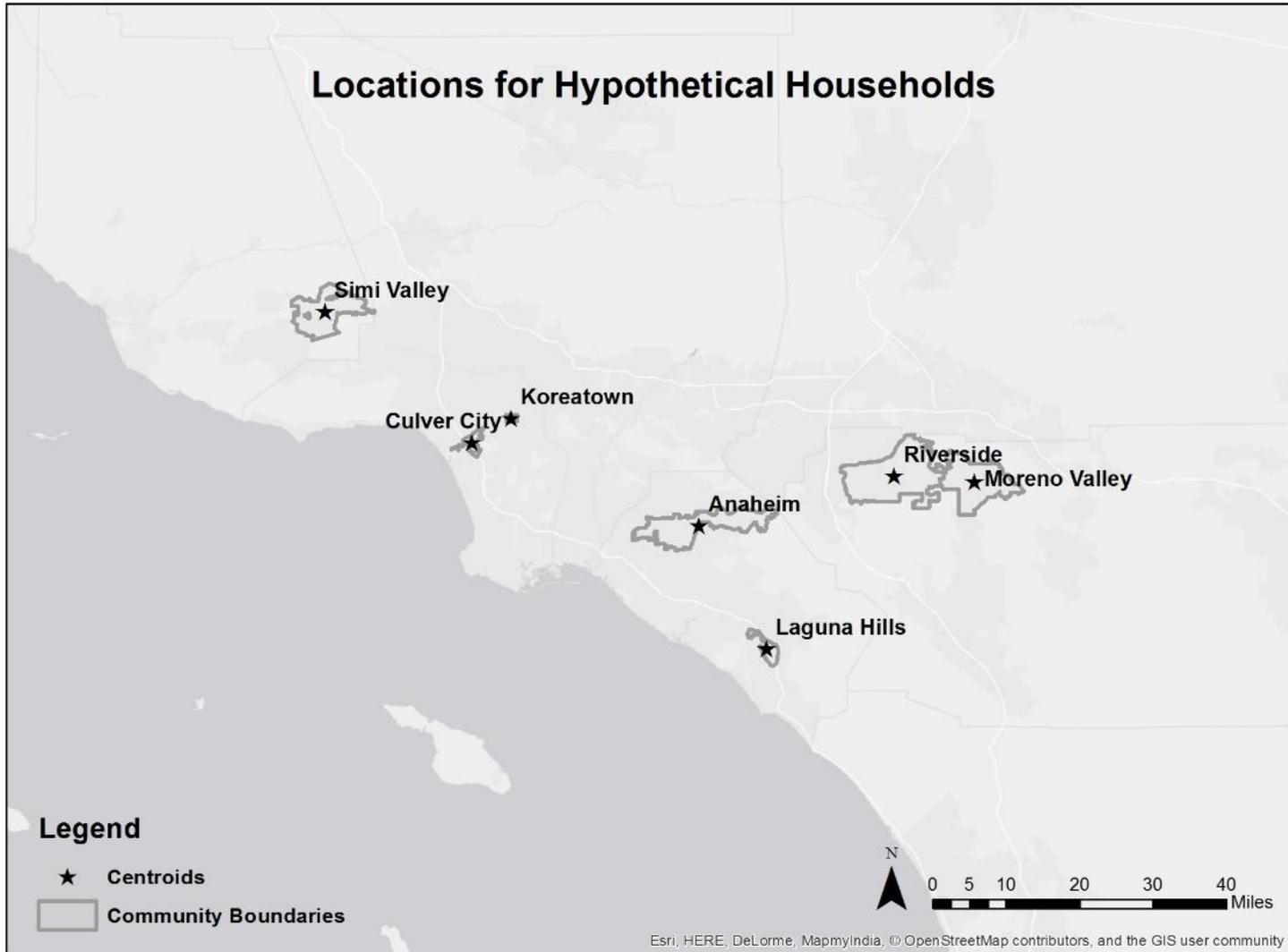
Note: Control variables not shown, 95% confidence interval in brackets, \* p<0.10, \*\* p<0.05, \*\*\* p<0.01

**Table 11: Regression Models for Accessibility to Jobs from Different Employment Sub-Centers with 5-Mile Break Points**

	All counties Model 10	Coastal counties Model 11	Inland counties Model 12	Coastal counties Model 13
Accessibility to jobs <b>within 5 miles</b> of residence and in the <b>largest sub-center</b> <i>elasticity</i>	-0.567*** [-0.927,-0.208] <b>-0.0309</b>	-0.433** [-0.782,-0.083] <b>-0.0349</b>	0 [0.000,0.000]	-0.449** [-0.798,-0.100]
Accessibility to jobs <b>beyond 5 miles</b> of residence and in <b>the largest sub-center</b> <i>Elasticity</i>	-1.123 [-4.448,2.201]	-1.015 [-4.127,2.096]	-16.26 [-142.425,109.905]	
Accessibility to jobs <b>within 5 miles</b> of residence and in the <b>second-largest sub-center</b> <i>Elasticity</i>	-1.309*** [-2.125,-0.493] <b>-0.015</b>	-1.237*** [-1.997,-0.477] <b>-0.021</b>	0 [0.000,0.000]	-1.304*** [-1.996,-0.612]
Accessibility to jobs <b>beyond 5 miles</b> of residence and in <b>the second-largest sub-center</b> <i>Elasticity</i>	-1.073 [-6.583,4.437]	-3.2 [-8.630,2.230]	24.045 [-42.612,90.701]	
Accessibility to jobs <b>within 5 miles</b> of residence and in the <b>3rd - 46th largest sub-centers</b> <i>Elasticity</i>	-1.026*** [-1.777,-0.275] <b>-0.0428</b>	-1.167*** [-1.887,-0.446] <b>-0.0684</b>	-2.212 [-6.848,2.423]	-1.200*** [-1.873,-0.526]
Accessibility to jobs <b>beyond 5 miles</b> of residence and in <b>the 3rd - 46th largest sub-centers</b> <i>Elasticity</i>	-9.457** [-17.100,-1.814] <b>-0.196</b>	-12.257*** [-20.610,-3.905] <b>-0.345</b>	-7.797 [-78.111,62.516]	-9.992*** [-15.655,-4.330]
Accessibility to jobs <b>within 5 miles</b> of residence and <b>outside sub-centers</b> <i>Elasticity</i>	-2.355*** [-3.500,-1.210] <b>-0.234</b>	-1.628** [-2.903,-0.353] <b>-0.195</b>	-4.738*** [-7.440,-2.035] <b>-0.271</b>	-1.411** [-2.560,-0.262]
Accessibility to jobs <b>beyond 5 miles</b> of residence and <b>outside sub-centers</b> <i>elasticity</i>	5.694*** [2.141,9.247] <b>0.302</b>	2.705 [-1.182,6.592]	8.926 [-3.400,21.253]	
Pseudo R-square	0.025	0.029	0.018	0.029
N	13475	9361	4114	9361

Note: Control variables not shown, 95% confidence interval in brackets, \* p<0.10, \*\* p<0.05, \*\*\* p<0.01

- Access to non-centered jobs has larger elasticity
- Access to jobs within five miles has larger elasticity (generally, short-distance access matters more)
- Access to tertiary (2<sup>nd</sup> through 46<sup>th</sup>) centers and non-centered jobs, beyond five miles can have larger elasticity (as can non-centered job access in coastal counties)
- Patterns most evident in coastal counties (Los Angeles and Orange)



- Moving a hypothetical household from Moreno Valley to Koreatown, Los Angeles is associated to the biggest (46.6%) drop in household VMT.

*Table 12: Policy Simulation for Hypothetical Household in Seven Locations*

Community	Model 12 Prediction	Model 13 Prediction	Model 10 Prediction	% Reduction from Moreno Valley (Model 10 prediction)	Number of Vehicles	Household Income	Number of people	Residential Density (in 1,000)
Simi Valley	.	41.87	38.55	11.8%	1.85	\$50,000 to \$74,999	2.67	9.09
Culver City	.	35.39	33.61	23.1%	1.85	\$50,000 to \$74,999	2.67	6.65
Laguna Hills	.	41.69	38.85	11.1%	1.85	\$50,000 to \$74,999	2.67	4.88
Anaheim	.	36.38	36.84	15.7%	1.85	\$50,000 to \$74,999	2.67	8.18
Moreno Valley	42.37	.	43.7	0.0%	1.85	\$50,000 to \$74,999	2.67	2.13
Riverside	38.8	.	41.05	6.1%	1.85	\$50,000 to \$74,999	2.67	4.61
Koreatown, Los Angeles	.	23.17	23.32	46.6%	1.85	\$50,000 to \$74,999	2.67	70.45

- Does effect of accessibility on VMT vary for jobs in or not in sub-centers?
  - Yes. Non-centered jobs have larger association with VMT.
- Does the effect vary in the core vs. periphery?
  - Yes. Households in coastal counties are generally more sensitive to job accessibility. Also commute direction creates a pattern in inland counties.
- Does the effect vary near vs. far?
  - Yes. Job access within 5 miles from home has larger association with VMT, from Centers 1 and 2.
- What happens if we simulate household moves?
  - Moreno Valley → Koreatown: 46.6% reduction in VMT
  - Simi Valley → Koreatown: 39.5% reduction in VMT
  - Simi Valley → Culver City: 15.5% reduction in VMT

## Policy Implications

- Job access matters in these ways:
  - Not as much in peripheral counties
  - In coastal counties, access to tertiary employment sub-centers (3<sup>rd</sup> through 46<sup>th</sup>) and non-centered jobs is more important for VMT reduction
  - Job access is most important in places with existing good but not exceptional job access
  - Short distances, usually 5 miles or less
- Smart growth on the periphery may not reduce VMT
- Regional geography matters for VMT, more than neighborhood?

## Thank you, questions?

Full report: <http://ncst.ucdavis.edu/project/usc-ct-to-005/>

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Twitter: @Marlon\_Boarnet

# Thank you

Professor Boarnet's presentation  
will be posted on line at  
<http://www.dot.ca.gov/researchconn/>.