A GIS Approach to Behavioral, Socioeconomic, and Pollution Patterns in Fresno

Presentation by Kimberly S. Meyer
Mentors: S. Katharine Hammond, Elizabeth M. Noth
STEER 2015

CHAPS
Children's Health & Air Pollution Study

Berkeley
UNIVERSITY OF CALIFORNIA

Introduction

- Location plays a substantial role in exposure assessments
- Knowing where one lives and spends their time is crucial for understanding his/her pollution intake
- If we can distinguish patterns in adolescent behaviors and pollution distributions, we can better implement strategies to reduce overall pollution exposure levels

Project Objectives

1. Identify patterns in time spent at home, school, and in transit for the young adult cohort in Fresno

2. Identify spatial patterns in the locations of extreme cases of economic and racial imbalances in Fresno

3. Create a pollution surface of PAH456 and compare the pollution distribution to the distribution of socioeconomic and racial imbalances

Project Objectives

1. Identify patterns in time spent at home, school, and in transit for the young adult cohort in Fresno

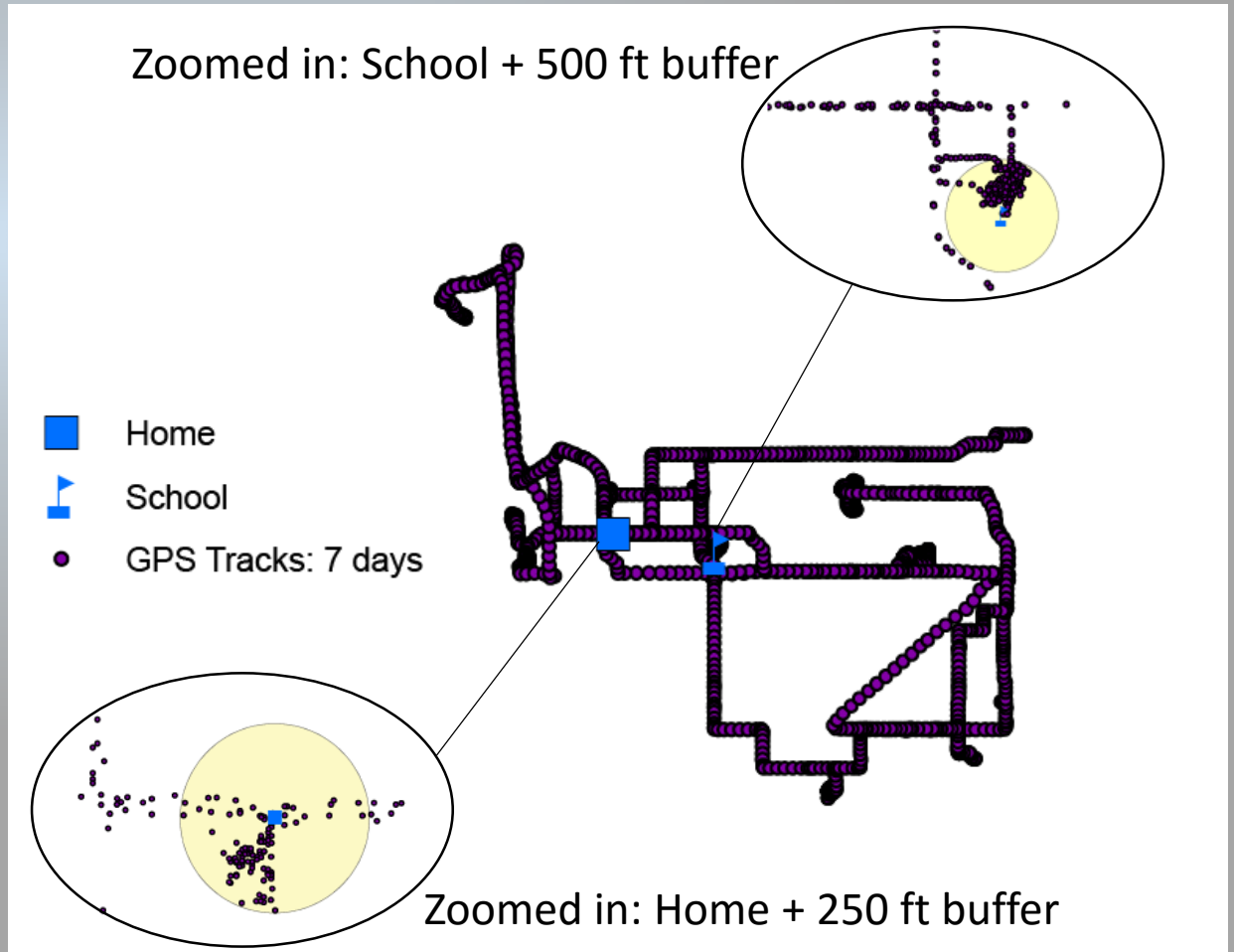
2. Identify spatial patterns in the locations of extreme cases of economic and racial imbalances in Fresno

3. Create a pollution surface of PAH456 and compare the pollution distribution to the distribution of socioeconomic and racial imbalances

Methods: Location-Time Analysis

Children's Health and Air Pollution Study (CHAPS) Young Adult Cohort: Location-Time Analysis Example

Above: GPS monitor CHAPS participants carried for 7 days, continuous location tracker



Methods: Location-Time Analysis

CHAPS Young Adult Cohort: Location-Time Analysis Process

1. Select GPS data during only the 7-day period
2. Decide on appropriate buffer size around home and school
3. GPS points that fall within the buffer become ‘home’ or ‘school’ points
4. For automobile transit: GPS points travelling at speeds greater than 20 mph become ‘transit’
5. Determine the amount of time per day spent in each of the three categories (home, school, transit) and classify the time as a % per day
6. Average the % per day times in each category for the 7-day period

Results: Location-Time Analysis

Sample size: n = 30

- 15 were enrolled in school during this time
- 15 were not enrolled in school during this time

Table 1: Average daily % of time spent while enrolled in school

			Percentage of day spent		
Gender	n	Age Group	At home	At school	In transit
Male	n=3	14-15	61.9%	24.0%	1.9%
	n=2	16-18	62.0%	20.8%	2.0%
	n=2	19-21	49.5%	6.0%	2.8%
Female	n=3	14-15	67.6%	17.1%	1.8%
	n=3	16-18	56.0%	14.0%	2.6%
	n=2	19-21	50.7%	7.4%	3.0%

Table 2: Average daily % of time spent while not enrolled in school

			Percentage of day spent		
Gender	n	Age Group	At home	At school	In transit
Male	n=2	14-15	70.3%	-	1.8%
	n=4	16-18	49.8%	-	3.5%
	n=2	19-21	55.9%	-	5.5%
Female	n=2	14-15	69.7%	-	2.4%
	n=3	16-18	72.4%	-	2.9%
	n=2	19-21	54.7%	-	2.5%

Project Objectives

1. Identify patterns in time spent at home, school, and in transit for the young adult cohort in Fresno

2. Identify spatial patterns in the locations of extreme cases of economic and racial imbalances in Fresno

3. Create a pollution surface of PAH456 and compare the pollution distribution to the distribution of socioeconomic and racial imbalances

Methods: Economic and Racial Imbalances

- Index of Concentration at the Extremes (ICE)[1]

$$ICE = (A_i - P_i)/ T_i$$

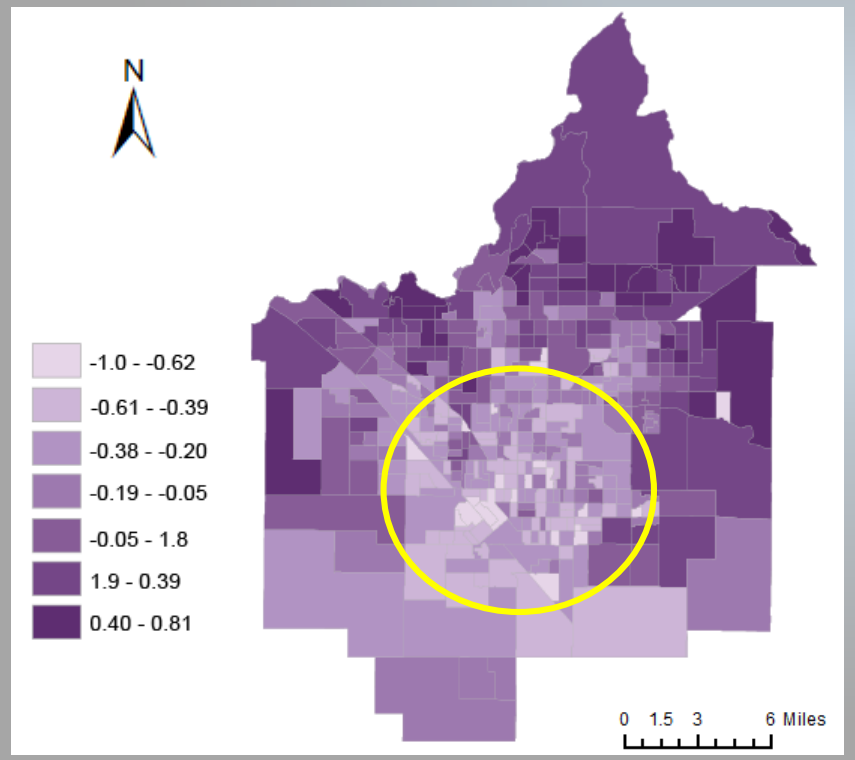
	Case 1: Socioeconomics[2]	Case 2: Ethnicity[2]
A_i = high extreme	Affluent (80th income percentile)	White
P_i = low extreme	Poor (20th income percentile)	Hispanic/latino
T_i = total population		

[1]N Krieger, et al. "Black Carbon Exposure, Socioeconomic and Racial/ethnic Spatial Polarization, and the Index of Concentration at the Extremes (ICE)." *Health & Place* 34 (2015)

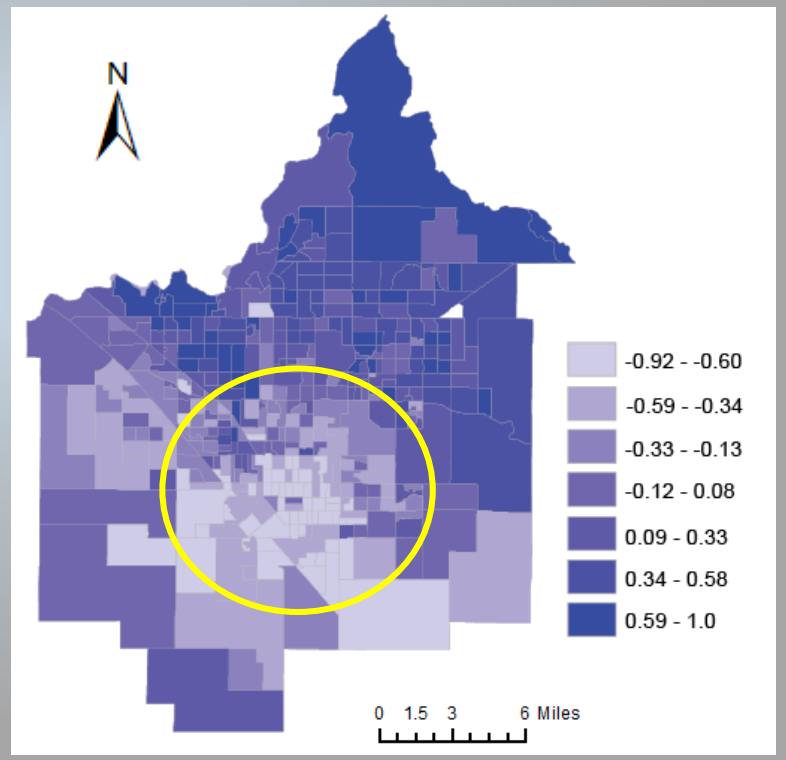
[2]2011 community survey: U.S. Census Bureau; American Community Survey, 2011 American Community Survey 5-Year Estimates; using American FactFinder; <http://factfinder2.census.gov>

Results: Economic and Racial Imbalances

ICE: Income
(highest income quantile vs lowest income quantile)



ICE: Race/ethnicity
(white vs Hispanic/latino)



ICE ranges from -1 to 1, with the negative values representing areas of concentrated low extremes and positive values representing areas of concentrated high extremes

Project Objectives

1. Identify patterns in time spent at home, school, and in transit for the young adult cohort in Fresno

2. Identify spatial patterns in the locations of extreme cases of economic and racial imbalances in Fresno

3. Create a pollution surface of PAH456 and compare the pollution distribution to the distribution of socioeconomic and racial imbalances

Methods: Pollution Distribution

Fresno Asthmatic Children's Environment Study (FACES)[3]

- Modeled the sum of 4-, 5- and 6-ring PAHs (PAH456) using a land use regression model

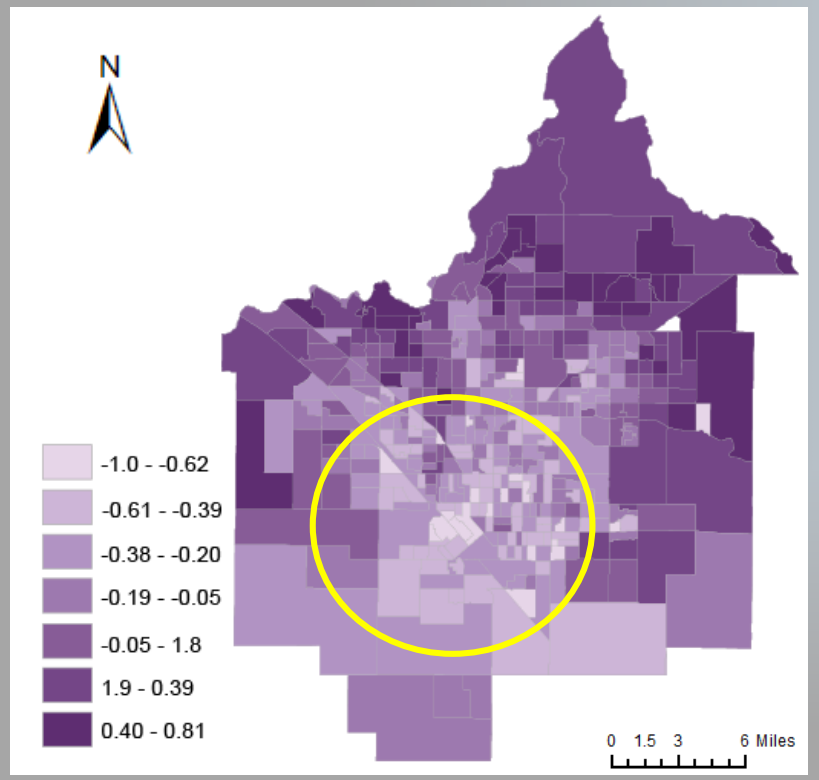
To create a PAH456 surface:

Interpolate the modeled PAH456 values

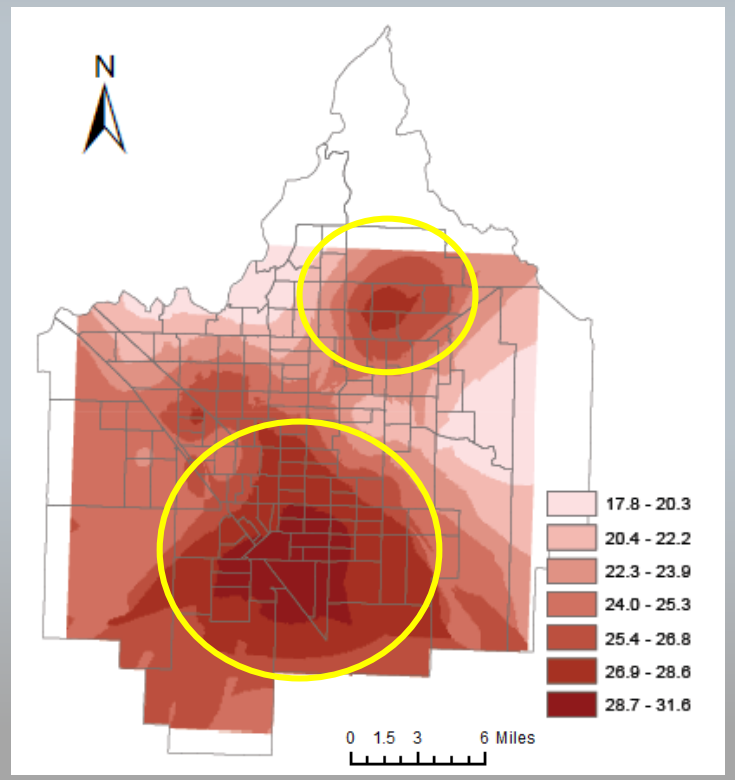
[3]Noth, E. M., Hammond, S. K., Biging, G. S., & Tager, I. B. (2011). A spatial-temporal regression model to predict daily outdoor residential PAH concentrations in an epidemiologic study in Fresno, CA. *Atmospheric Environment*, *45*(14), 2394-2403.

Results: Pollution Distribution

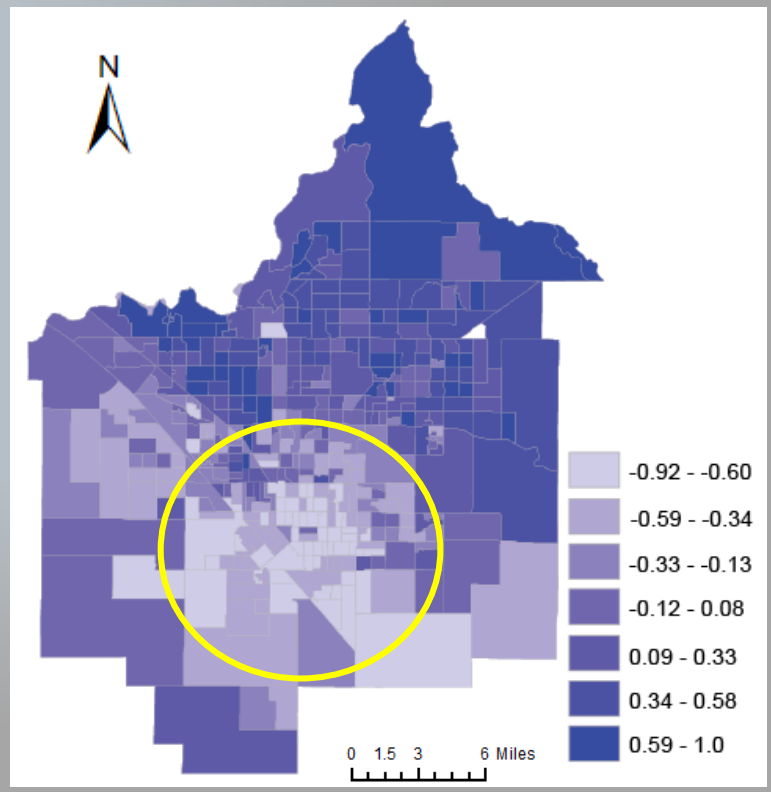
ICE income distribution:



PAH 456 distribution:



ICE ethnic distribution:



Conclusion

- Air pollution exposure is *not* geographically even
- Poor, non-white communities experience *greater vulnerability* to air pollution exposure
- Children/adolescents spend a great deal of their time at home
  - Thus, location of one's home plays a significant role in determining pollution exposure levels

Acknowledgements

- A *very special* thank you to Dr. Hammond and Dr. Noth for their guidance and support on this project

- A *very special* thank you to the STEER program for this opportunity

Data acknowledgements:

CHAPS- The author gratefully acknowledges the funders of this research. This work was performed as part of the University of California, Berkeley/Stanford Children's Environmental Health Center, funded by NIEHS 1P20ES018173 and EPA RD-83459601-0

FACES- (Fresno Asthmatic Children's Environment Study) California Air Resources Board, 2000-2005 (Contracts Nos. 99-322 and 99-323), The statements and conclusions in this presentation are those of the author and not necessarily those of the California Air Resources Board. The mention of commercial products, their source or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products.

PAH data- The initial PAH work was supported by US Environmental Protection Agency Office of Transportation and Air Quality (1A-0418-NBSX; 2A-0540-NASX). The analysis of the home intensive filters and the modeling analysis was supported by Mickey Leland National Urban Air Toxics Research Program. The research described was funded by the Mickey Leland National Urban Air Toxics Research Center (NUATRC), an organization jointly funded by the United States Environmental Protection Agency (EPA) and private industry sponsors. The contents of do not necessarily reflect the views of NUATRC, or its sponsors, nor do they necessarily reflect the views and policies of the EPA or any of the private industry sponsors.