

# Exploring Neighborhood Effects on Health Using GIS and Electronic Health Records

Steven Melly, Kari Moore, Christopher Forrest, Ana Diez Roux



## Overview

**Integrate electronic health records, birth records, area-level environmental variables and health plan claims to investigate predictors of pediatric health concerns**



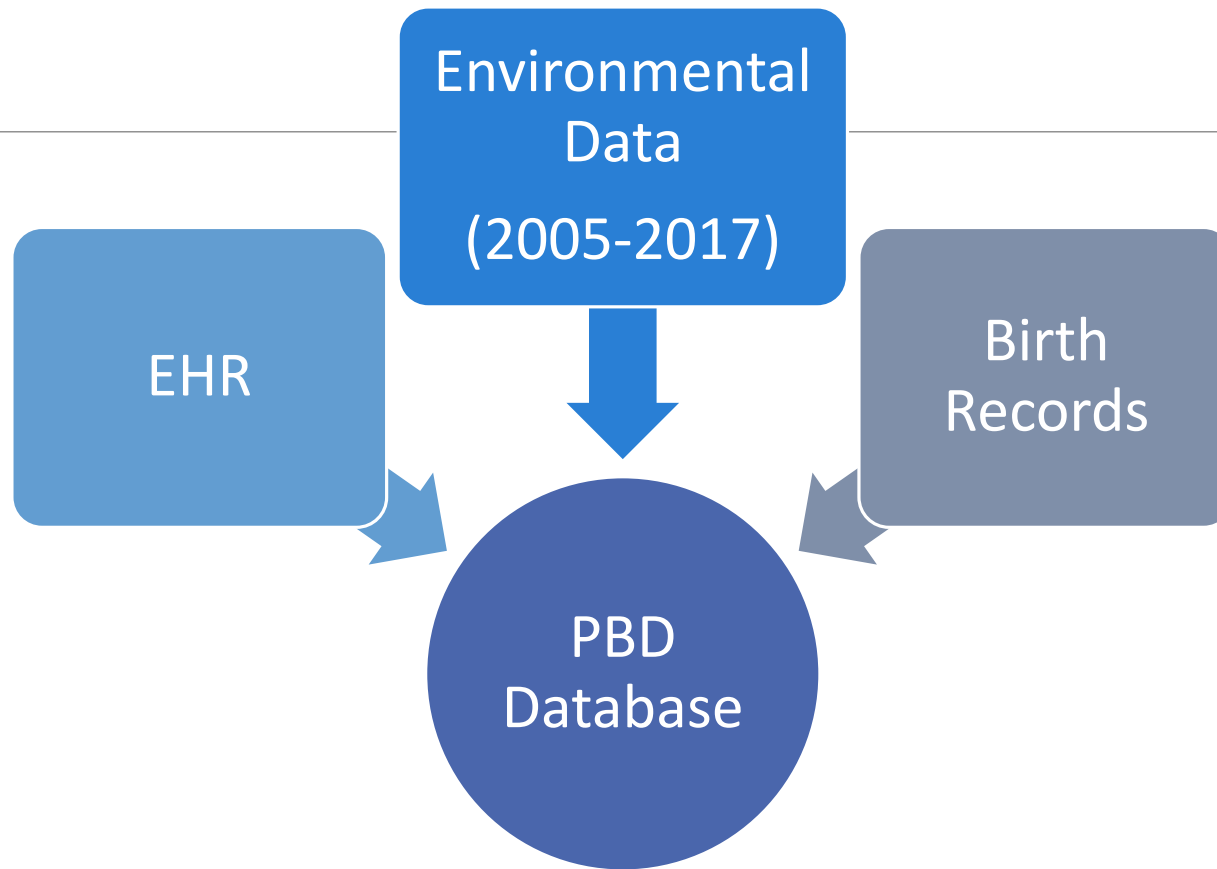


# Health Outcomes Targeted

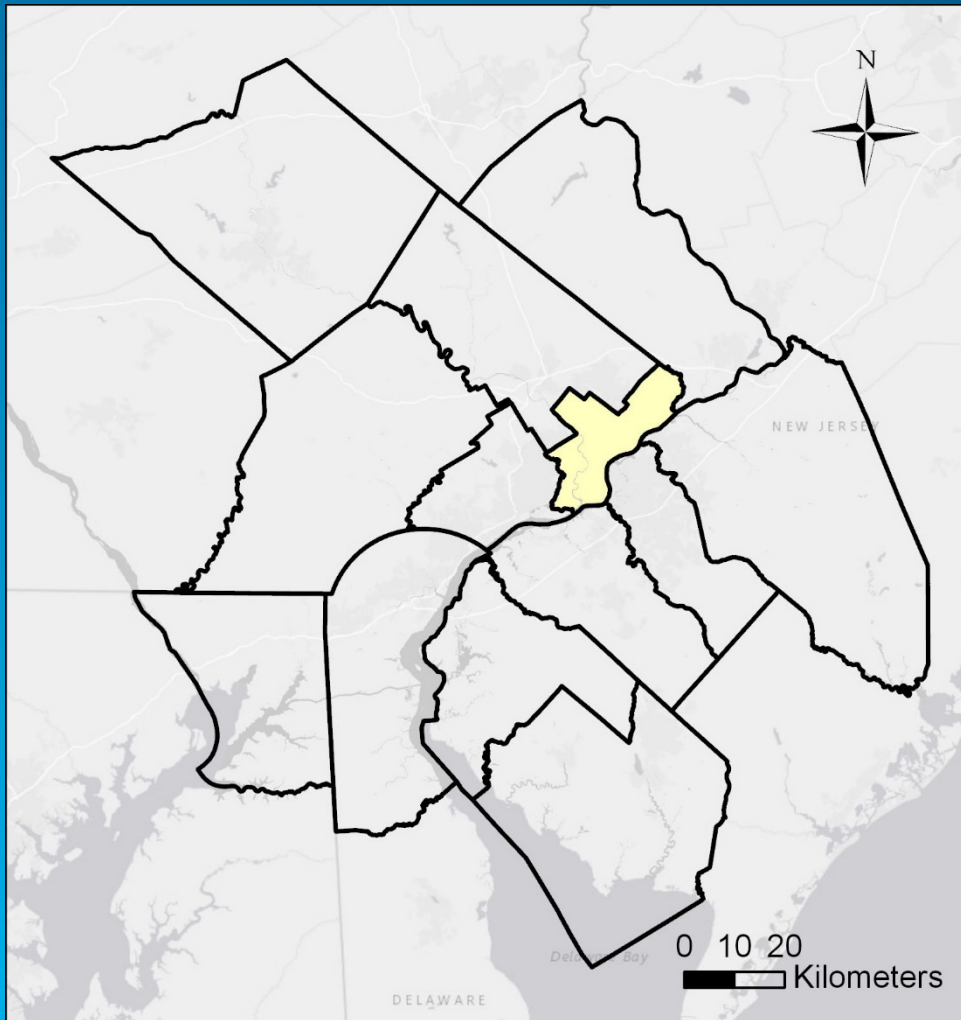
- **Asthma**
- **Obesity**
- **Avoidable hospitalizations**



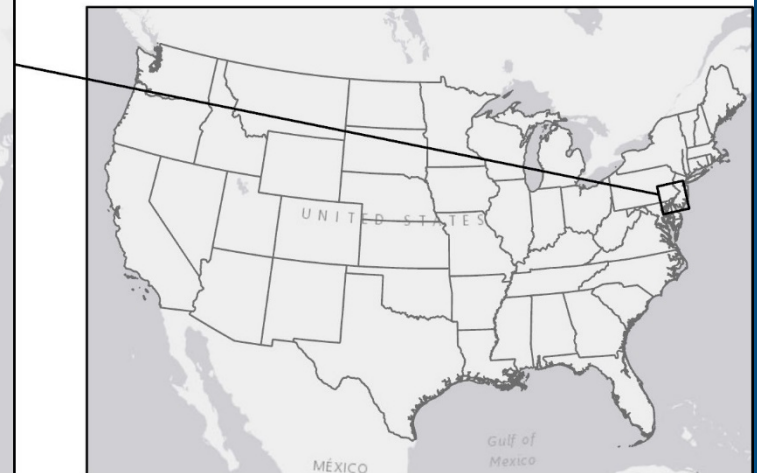
# Data Sources



# Philadelphia Metropolitan Area

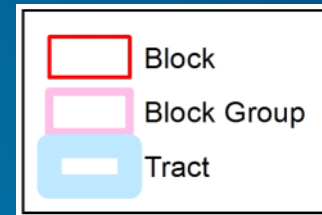


- Philadelphia
- Philadelphia Camden Vineland Combined Statistical Area

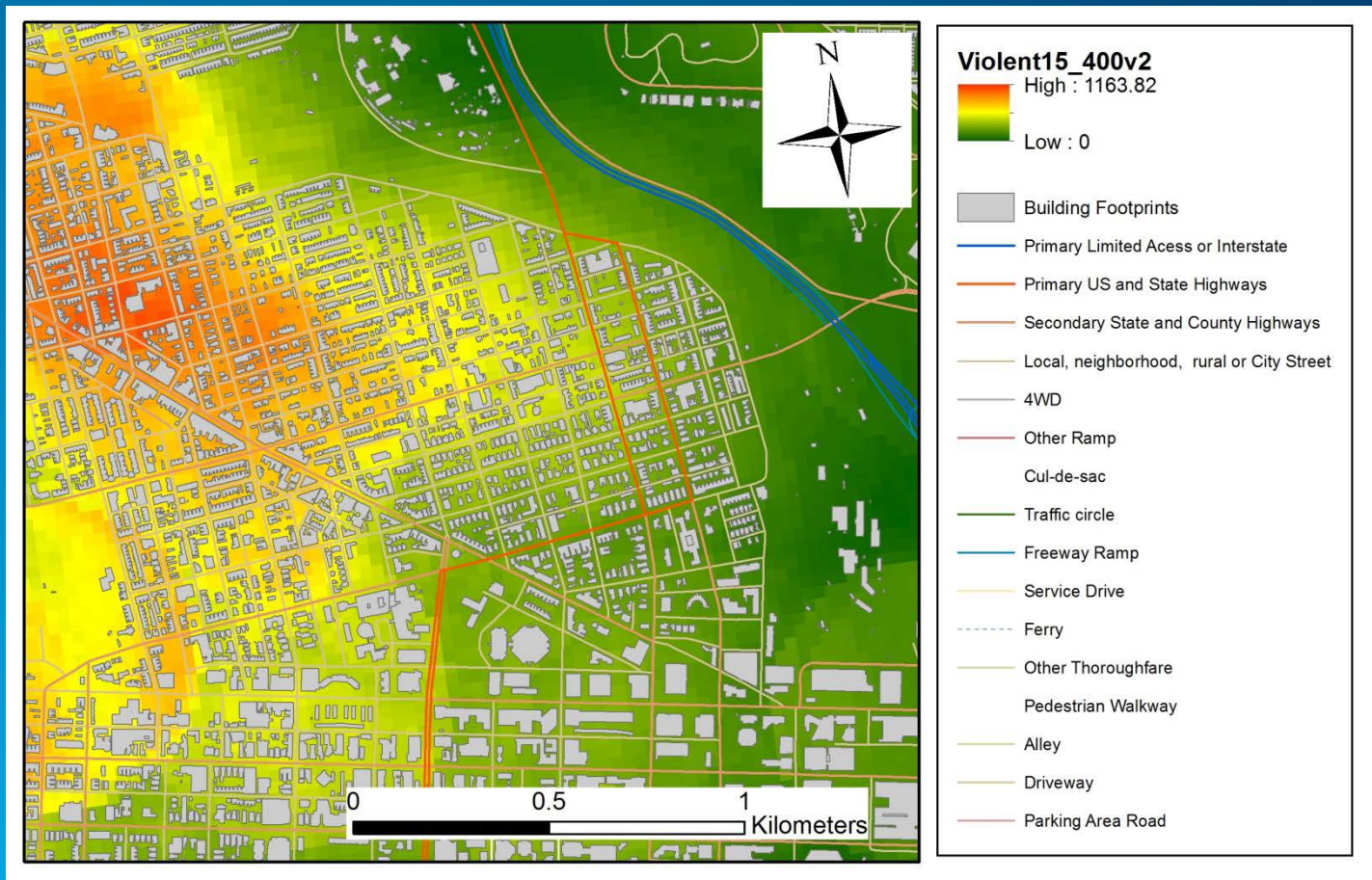




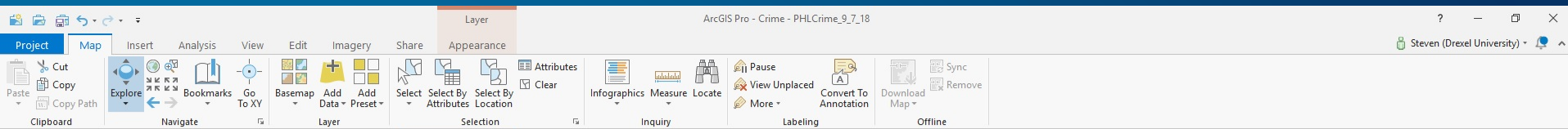
# Area-level environmental variables - Census Tracts



# Environmental variables as surfaces









ArcGIS Pro - Crime - Crime16\_17\_400m

Steven (Drexel University)

Project ModelBuilder Insert Analysis View Share Appearance Data Diagram

Clipboard Model View Mode Run Insert Group

Contents

Search

Drawing Order

- PHLCrime\_9\_7\_18
  - Violent Crime Incidents 2016
    - crime\_9\_7\_18\_CT00
    - crime\_9\_7\_18\_CT10
    - crime\_9\_7\_18\_utm18
    - crime\_9\_7\_18
    - CT10\_PHL\_pd
    - CT00\_PHL
    - Drug\_400\_2017
      - Value
        - 2630.04
        - 0
      - Viol\_400\_%YearValue%
        - VALUE
          - ≤122.350366
          - ≤244.700732
          - ≤367.051099
          - ≤489.401465
          - ≤611.751831
          - ≤734.102197
          - ≤856.452563
          - ≤978.80293
          - ≤1,101.153296
          - ≤1,223.503662
        - Drug\_400\_%YearValue%
          - VALUE
            - ≤263.00354
            - ≤526.00708
            - ≤789.01062
            - ≤1,052.01416
            - ≤1,315.0177

Catalog PHLCrime\_9\_7\_18 Crime16\_17\_400m

Yr0517 Iterate Field Values YearValue P

Expression Violent Crime

crime\_9\_7\_18\_utm18 Select Layer By Attribute (2) ViolentCrime Point Density Viol\_400\_%YearValue%

Expression Property Crime

Select Layer By Attribute (5) PropertyCrime Point Density (4) Prop\_400\_%YearValue%

Drug Crime

Select Layer By Attribute (3) DrugCrime Point Density (2) Drug\_400\_%YearValue%

Geoprocessing

Find Tools

Favorites | Toolboxes | Portal

- 3D Analyst Tools
- Analysis Tools
- Aviation Tools
- Business Analyst Tools
- Cartography Tools
- Conversion Tools
- Data Interoperability Tools
- Data Management Tools
- Data Reviewer Tools
- Editing Tools
- Geocoding Tools
- Geostatistical Analyst Tools
- Image Analyst Tools
- Linear Referencing Tools
- Location Referencing Tools
- Maritime Tools
- Multidimension Tools
- Network Analyst Tools
- Server Tools
- Space Time Pattern Mining Tools
- Spatial Analyst Tools
  - Conditional
  - Density
    - Kernel Density
    - Line Density
    - Point Density
  - Distance
  - Extraction
  - Generalization
  - Groundwater
  - Hydrology
  - Interpolation
  - Local
  - Map Algebra
  - Math
  - Multivariate

Catalog Geoprocessing



ArcGIS Pro - Crime - Crime16\_17\_400m

Project | ModelBuilder | Insert | Analysis | View | Share | Appearance | Data | Diagram

Clipboard | Model | Contents | Catalog | PHLCrime\_9\_7\_18 | Crime16\_17\_400m

Drawing Order

- PHLCrime\_9\_7\_18
  - Violent Crime Incidents 2016
    - crime\_9\_7\_18\_CT00
    - crime\_9\_7\_18\_CT10
    - crime\_9\_7\_18\_utm18
    - crime\_9\_7\_18
    - CT10\_PHL\_pd
    - CT00\_PHL
    - Drug\_400\_2017
      - Value
        - 2630.04
        - 0
    - Viol\_400\_1000m
      - VALUE
        - ≤122.350366
        - ≤244.700732
        - ≤367.051099
        - ≤489.401465
        - ≤611.751831
        - ≤734.102197
        - ≤856.452563
        - ≤978.80293
        - ≤1,101.153296
        - ≤1,223.503662
    - Drug\_400\_1000m
      - VALUE
        - ≤263.00354
        - ≤526.00708
        - ≤789.01062
        - ≤1,052.01416
        - ≤1,315.0177

Model Diagram:

```
graph LR; Yr0517((Yr0517)) --> IterateFieldValues{{Iterate Field Values}}; IterateFieldValues --> YearValue((YearValue)); IterateFieldValues --> ExpressionViolentCrime(Expression Violent Crime); ExpressionViolentCrime --> YearValue
```

Expression Violent Crime

Expression Violent Crime

VIOL = 1 And dispatch\_year = %YearValue%

The expression can't be edited in Clause mode.

OK

## Point Density

### Parameters | Environments

Input point features

crime\_9\_7\_18\_utm18:1

Population field

NONE

## Point Density

### Parameters | Environments

Output Coordinate System

NAD\_1983\_UTM\_Zone\_18N

Geographic Transformations

Extent

Default

Snap Raster

NLCD11\_MetroPHL

Cell Size

Maximum of Inputs

Mask

PhiladelphiaPlanningDistricts201302.shp

Output CONFIG Keyword

Auto Commit

1000

Tile Size

Width

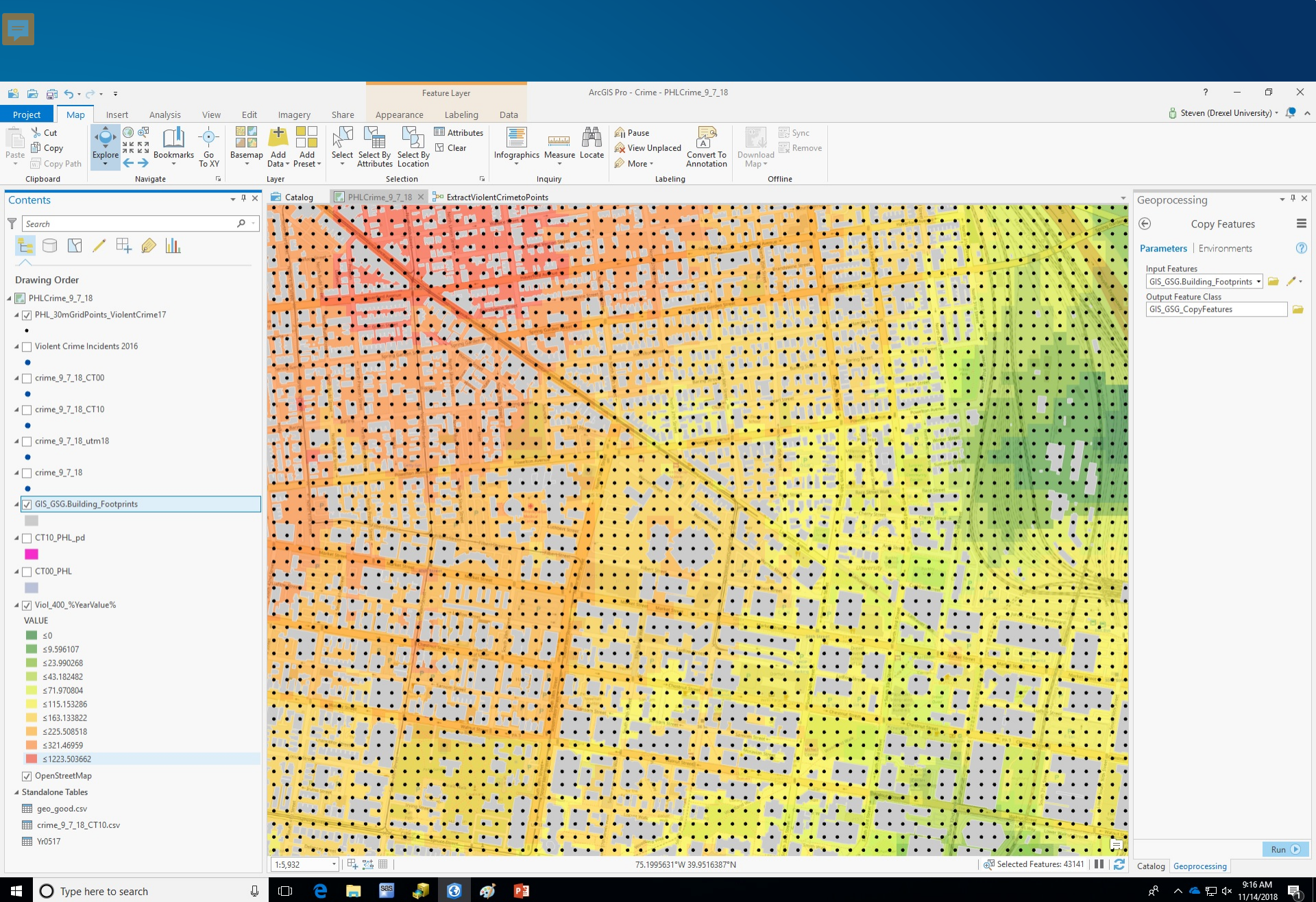
128

Height

128

OK





ArcGIS Pro - Crime - ExtractViolentCrimeToPoints

Steven (Drexel University)

Project ModelBuilder Insert Analysis View Share Appearance Data Diagram

Clipboard Model Auto Layout View Select Select All Pan Validate Run Tools Variable Iterators Utilities Logical Label Group UnGroup

Contents

Search

Drawing Order

- ☐ CT10\_PHL\_pd
- ☐ CT00\_PHL
- ☐ Drug\_400\_2017
  - Value
    - ≤0
    - ≤10.313864
    - ≤30.941593
    - ≤72.19705
    - ≤2630.0354
- ☒ Viol\_400\_YearValue%
  - VALUE
    - ≤0
    - ≤9.596107
    - ≤23.990268
    - ≤43.182482
    - ≤71.970804
    - ≤115.153286
    - ≤163.133822
    - ≤225.508518
    - ≤321.46959
    - ≤1223.503662
- ☐ Drug\_400\_YearValue%
  - VALUE
    - ≤263.00354
    - ≤526.00708
    - ≤789.01062
    - ≤1,052.01416
    - ≤1,315.0177
    - ≤1,578.02124
    - ≤1,841.02478
    - ≤2,104.02832
    - ≤2,367.03186
    - ≤2,630.0354
- ☒ Prop\_400\_YearValue%
  - VALUE
    - ≤294.03877
    - ≤508.077520

Catalog PHLCrime\_9\_7\_18 ExtractViolentCrimeToPoints

Viol16\_400 Viol12\_400 Viol08\_400 PHL\_30mGrid... (2)

Viol15\_400 Viol11\_400 Viol07\_400

Viol14\_400 Viol10\_400 Viol06\_400

Viol13\_400 Viol09\_400

Extract Multi Values to Points

PHL\_30mGridPoints\_ViolentCrime06\_16

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- Multidimension Tools
- Network Analyst Tools
- Server Tools
- Space Time Pattern Mining Tools
- Spatial Analyst Tools
  - Conditional
  - Density
  - Distance
  - Extraction
    - Extract by Attributes
    - Extract by Circle
    - Extract by Mask
    - Extract by Points
    - Extract by Polygon
    - Extract by Rectangle
    - Extract Multi Values to Points
    - Extract Values to Points
    - Sample
  - Generalization
  - Groundwater

Catalog Geoprocessing Symbology

Type here to search

4:02 PM 11/13/2018



# Drexel team prepares data for longitudinal analysis

Attribute table from  
Drexel's geodatabase



pointid	b4violkm16	b4violkm15	b4violkm14	b4violkm13	b4violkm12	b4violkm11	b4violkm10	b4violkm09	b4violkm08	b4violkm07	b4violkm06
1000001	3.98	3.98	0.00	0.00	1.99	1.99	1.99	5.97	0.00	0.00	1.99
1000002	3.98	3.98	1.99	0.00	1.99	1.99	1.99	7.96	1.99	0.00	1.99
1000003	3.98	3.98	1.99	0.00	1.99	1.99	1.99	7.96	1.99	0.00	1.99
1000004	3.98	3.98	1.99	0.00	1.99	1.99	1.99	7.96	1.99	0.00	1.99
1000005	3.98	1.99	1.99	0.00	1.99	1.99	1.99	5.97	0.00	0.00	1.99



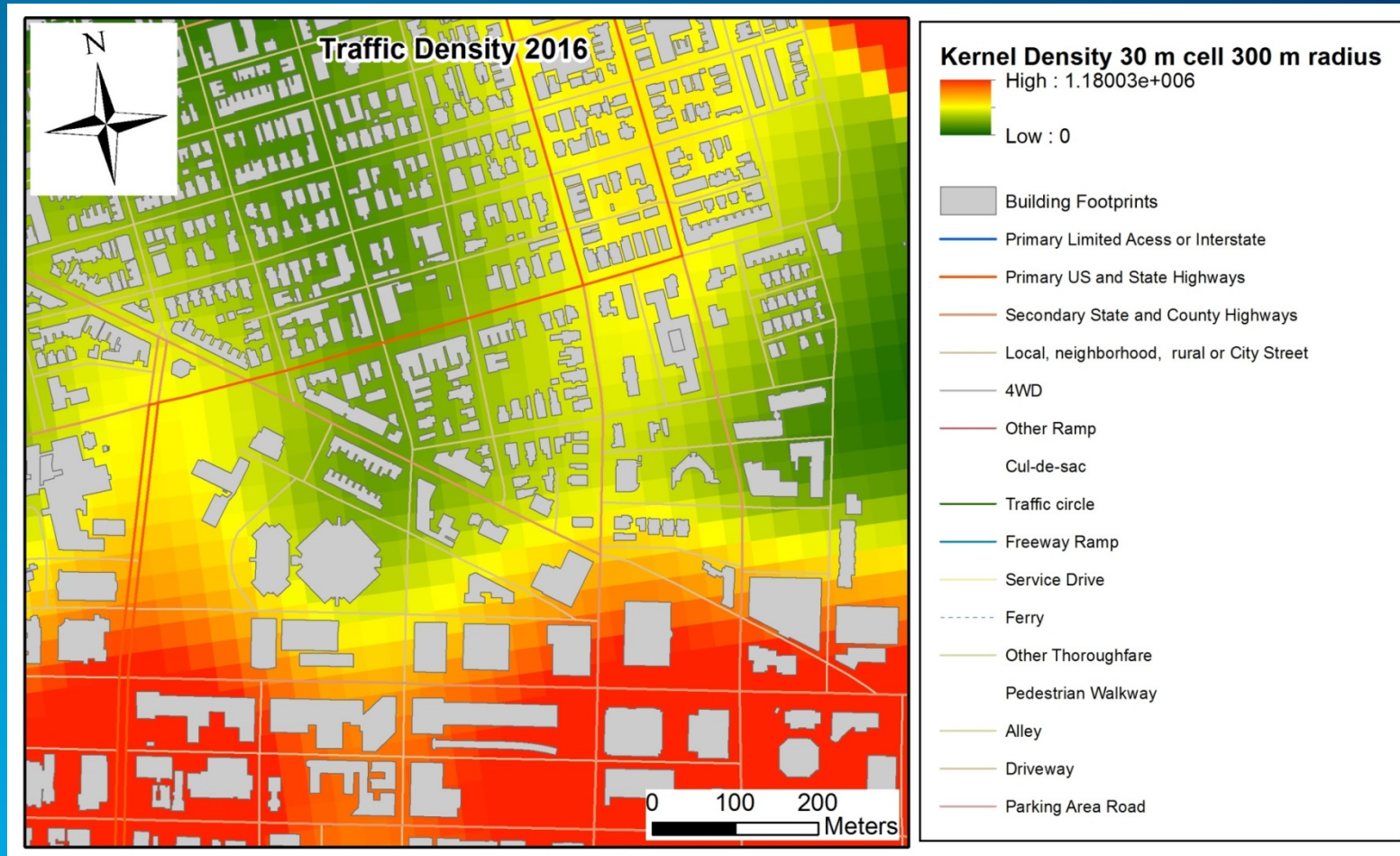
Use point id for location nearest to  
patient's home address to link to  
health data on CHOP server



# Built and Social Environment Measures Included

Air Pollution	Racial/Ethnic Composition	Access to Public Transportation
Traffic	Socioeconomic Composition	Access to Health Care
Weather	Crime	Walkability
Allergens	Social cohesion	Bike/Pedestrian Safety
Green space	Housing	Food Environment
Physical Activity Amenities	Blight	Access to Child Care

# Air Pollution: Density of Traffic on Major Roads



# Density of Traffic Residential Neighborhood





# Built Environment: Physical Activity & Obesity

ArcGIS Pro - PhysActPHL\_3\_1 - phys\_act\_amenities

Project | Map | Insert | Analysis | View | **Edit** | Imagery | Share | View | Appearance | Labeling | Data

Clipboard: Cut, Copy, Paste, Copy Path  
Manage Edits: Map Topology, Status, Error Inspector  
Snapping: Snapping  
Features: Create, Modify, Delete  
Selection: Select, Attributes, Clear  
Tools: Move, Annotation, Vertices, Reshape, Merge  
Elevation: No surfaces, Manage Quality, Data Re...

Contents

Search

Drawing Order

- Physical Activity Amenities
  - Schools\_PHL\_District\_7\_6\_17
  - phys\_act\_amenities
  - Land\_Use\_14\_Recreation\_Civic\_400mSc
- PHL\_PPR\_Park\_Boundaries2016
- Philadelphiamagery2005
- Philadelphiamagery2008
- Philadelphiamagery2009
- Philadelphiamagery2011\_Leafon
- Philadelphiamagery2012
- Philadelphiamagery2014
- Philadelphiamagery2015
- Philadelphiamagery2010
- Philadelphiamagery2016
- World Imagery

Catalog

Physical Activity Amenities | School Parcels | Schools

1:336 | 75.2388476°W 39.9640602°N | Selected Features: 1

phys\_act\_amenities

Field: Add | Delete | Calculate | Selection: Zoom To | Switch | Clear | Delete | Copy

CE	EDITSOUR_1	EDITOR	phys_act	court_cnt	amenity_sm	EarliestYr	LatestYr	Field	X_UTM	Y_UTM	Longitude	Latitu
<Null>	KD	1	1	1	Playground Equipme...	2009	2016	1	479600.7511	4423805.6751	-75.238855	39.964

1 of 1804 selected

Filters: 100%

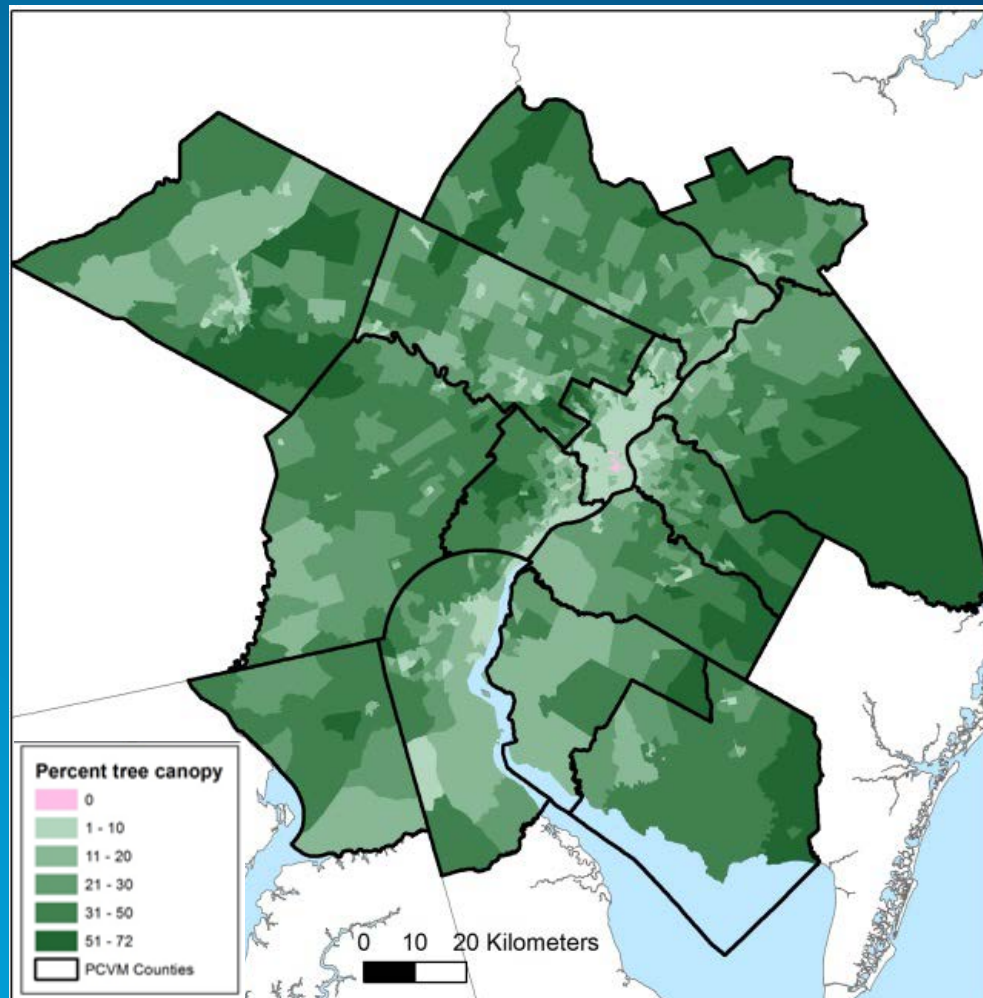
Catalog | Rematch Addresses

Type here to search

1:49 PM 1/23/2019



## National – Tree Canopy from Satellite



National Land Cover 2011  
mrlc.gov

## Ongoing Work and Next Steps

- Analysis of environmental factors with health records
- Machine learning to predict pediatric health outcomes
- Link to other Electronic Health Records
- Expand geographic scope
- Update and expand on environmental and social measures
- Automate processes



## **It takes a team: Clinicians, Public Health Researchers, Students**



### **With our approach:**

- **Work was distributed to several students and staff**
- **Health outcomes kept separate from environmental data**
- **Patient privacy was protected**



# Acknowledgements

- Funded by PA Department of Health Commonwealth Universal Research Enhancement Program (CURE)
- Urban Health Collaborative, Dornsife School of Public Health, Drexel University

[drexel.edu/urbanhealthcollaborative](http://drexel.edu/urbanhealthcollaborative)

