



Penn Arts & Sciences  
Data Driven Discovery

# AI for Philadelphia

from citizen reports to illegal dumping hotspots

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Executive Director



PHILADELPHIA  
PARKS &  
RECREATION



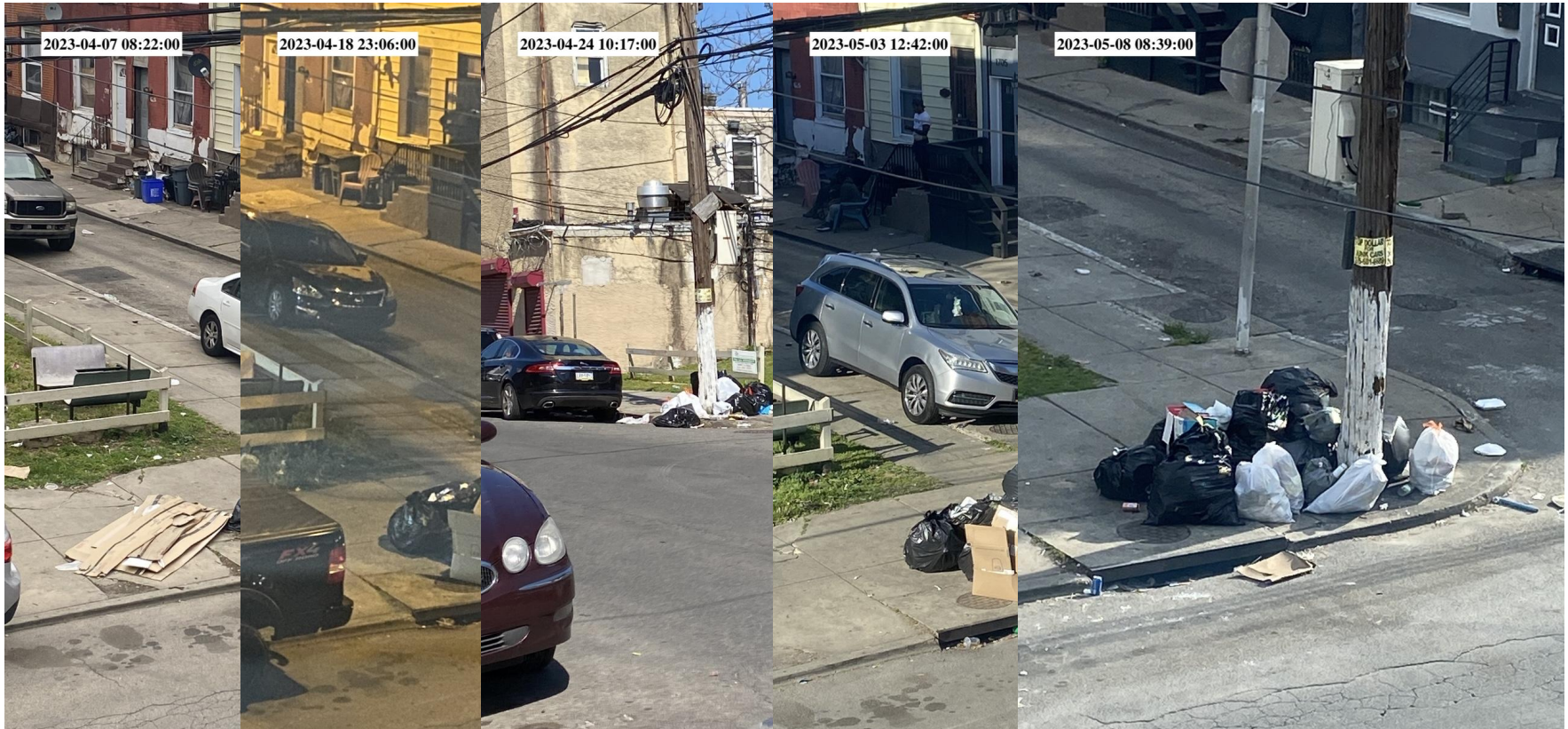
The Water Center  
UNIVERSITY of PENNSYLVANIA



Tookany/Tacony-Frankford  
Watershed Partnership, Inc.

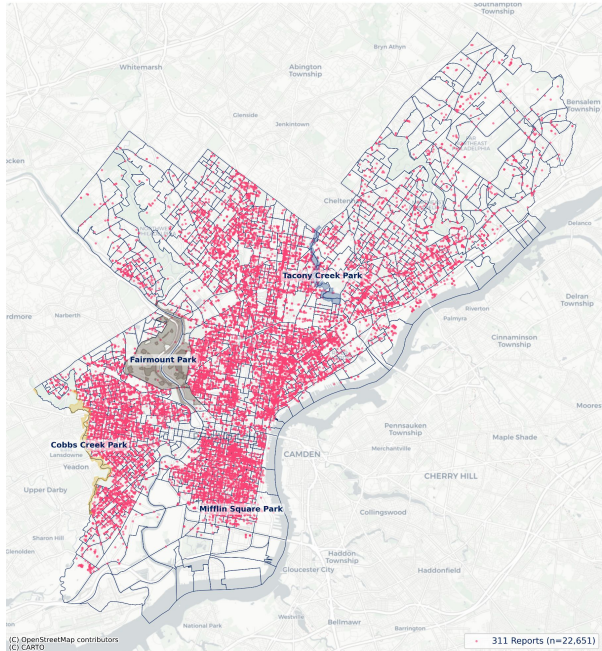
cobbs creek community environmental  
education center

# Why this matters



# Data & Model

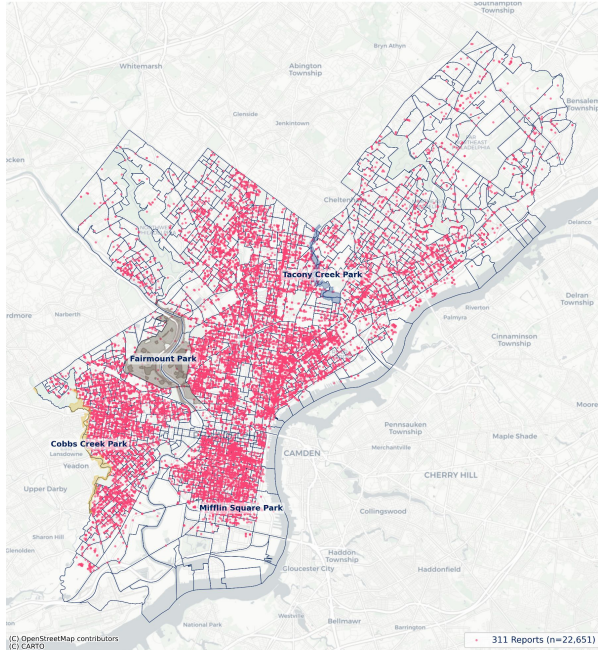
Illegal Dumping 311 Reports  
2025



Data

# Data & Model

Illegal Dumping 311 Reports  
2025



$$\lambda(s, t) = \exp(a_0 + \chi^T(s)w + f_s(S) + f_t(t) + f_{seas}(t)) + \alpha \cdot \sum_{i:t_i < t} f(t - t_i; \beta) \cdot \phi(s - s_i; \sigma)$$

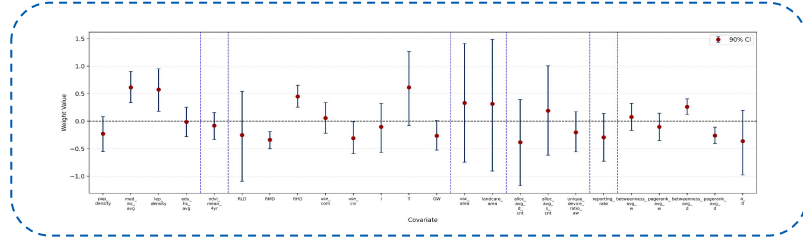
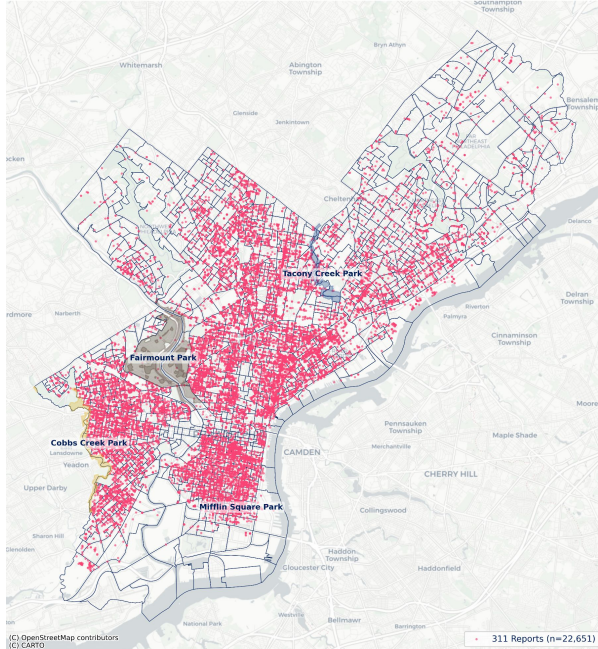
Data



Model

# Data & Model

Illegal Dumping 311 Reports  
2025



$$\lambda(s, t) = \exp(a_0 + \underbrace{\chi^T(s)w}_{\text{location}} + \underbrace{f_s(S)}_{\text{spatial}} + \underbrace{f_t(t)}_{\text{temporal}} + \underbrace{f_{seas}(t)}_{\text{seasonal}}) + \underbrace{\alpha \cdot \sum_{i:t_i < t} f(t - t_i; \beta) \cdot \phi(s - s_i; \sigma)}_{\text{temporal decay}}$$

Data



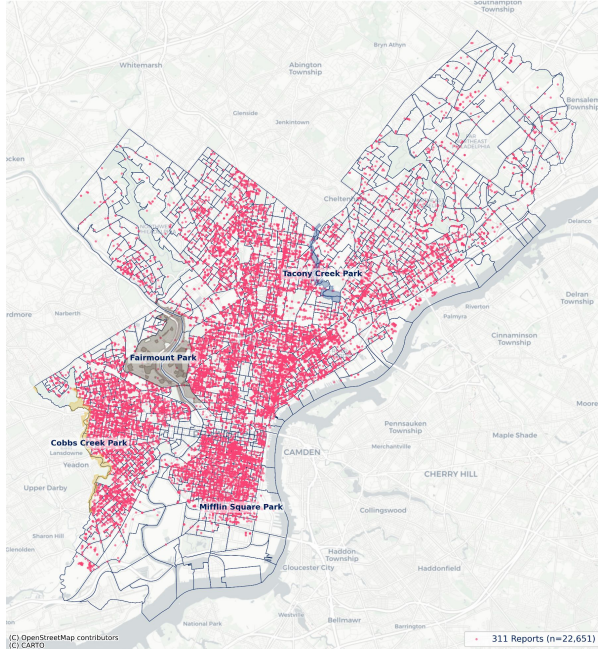
Model



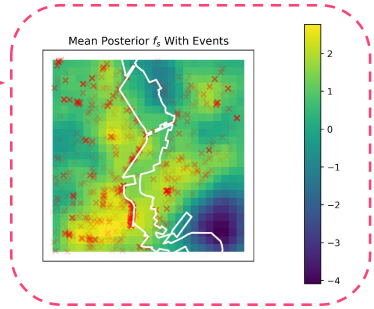
Output

# Data & Model

Illegal Dumping 311 Reports  
2025



$$\lambda(s, t) = \exp(a_0 + \underbrace{\chi^T(s)w}_{\text{Spatial}} + \underbrace{f_s(S)}_{\text{Social}} + \underbrace{f_t(t)}_{\text{Temporal}} + \underbrace{f_{seas}(t)}_{\text{Seasonal}}) + \alpha \cdot \sum_{i:t_i < t} f(t - t_i; \beta) \cdot \phi(s - s_i; \sigma)$$



Data



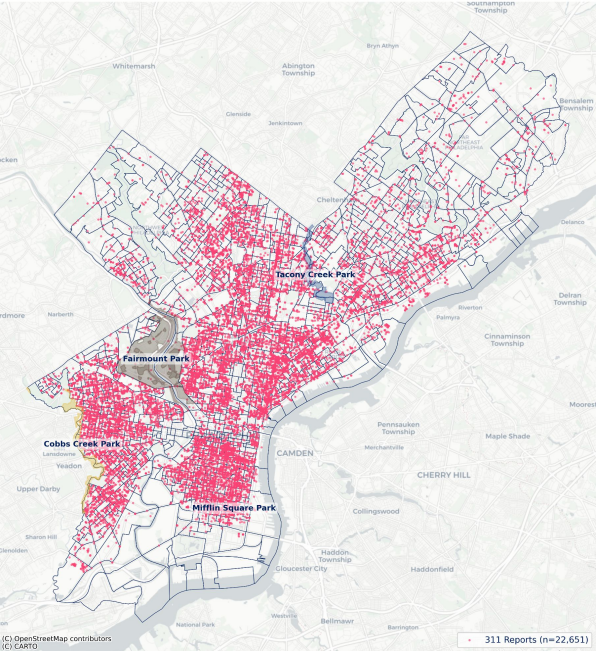
Model



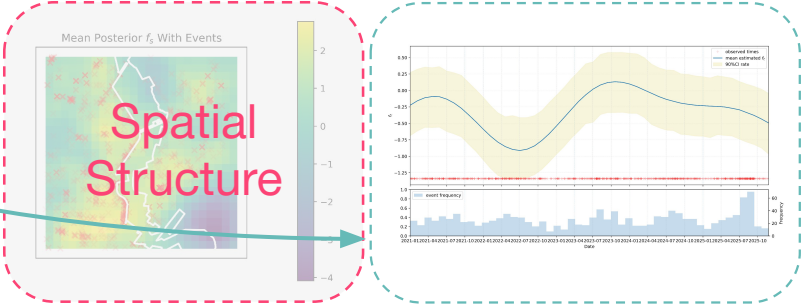
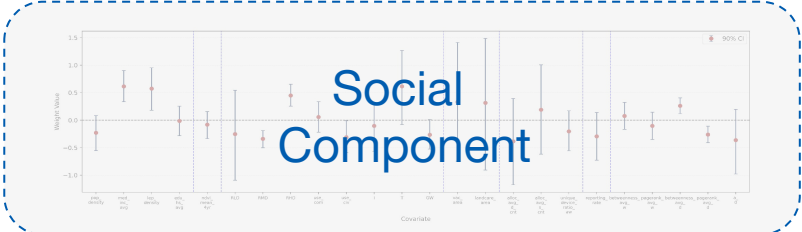
Output

# Data & Model

Illegal Dumping 311 Reports  
2025



$$\lambda(s, t) = \exp(a_0 + \chi^T(s)w + f_s(S) + f_t(t) + f_{seas}(t)) + \alpha \cdot \sum_{i:t_i < t} f(t - t_i; \beta) \cdot \phi(s - s_i; \sigma)$$



Data



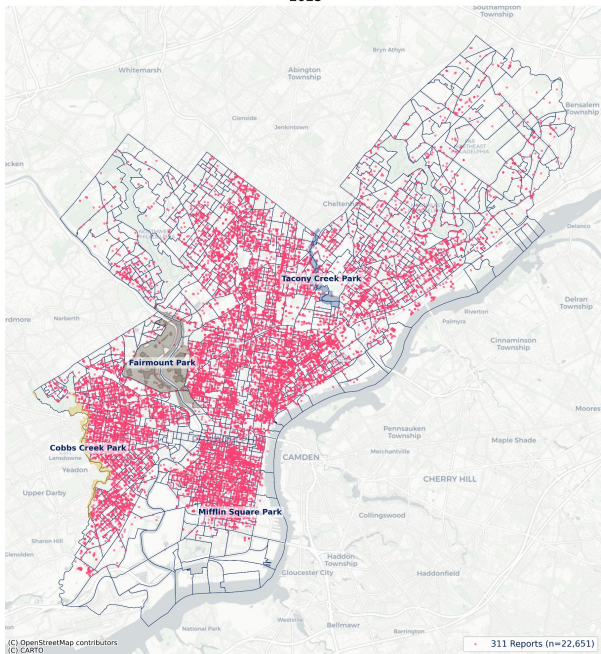
Model



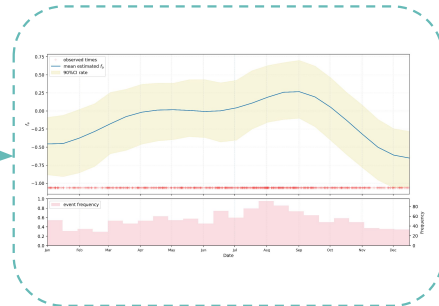
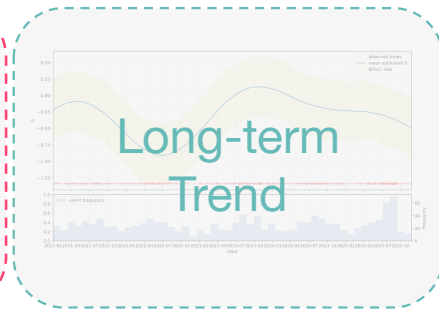
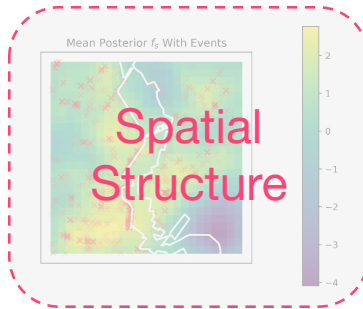
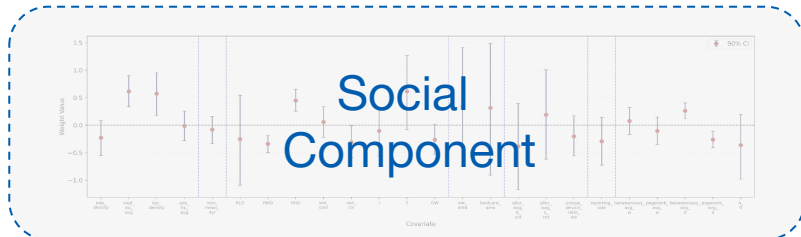
Output

# Data & Model

Illegal Dumping 311 Reports  
2025



$$\lambda(s, t) = \exp(a_0 + \underbrace{\chi^T(s)w}_{\text{Spatial Structure}} + \underbrace{f_s(S)}_{\text{Spatial Structure}} + \underbrace{f_t(t)}_{\text{Long-term Trend}} + \underbrace{f_{seas}(t)}_{\text{Long-term Trend}}) + \alpha \cdot \sum_{i:t_i < t} f(t - t_i; \beta) \cdot \phi(s - s_i; \sigma)$$



Data



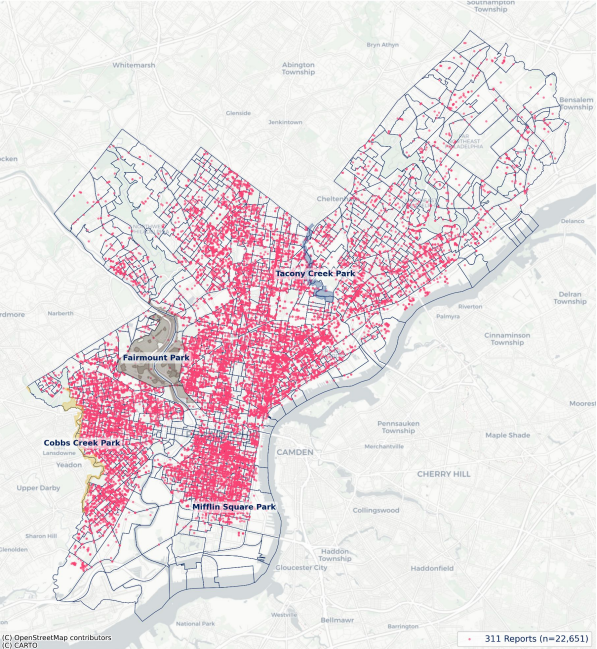
Model



Output

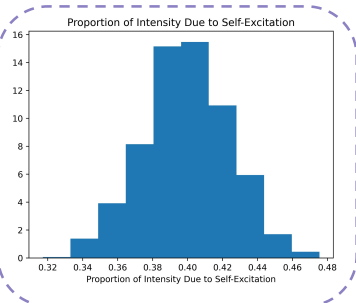
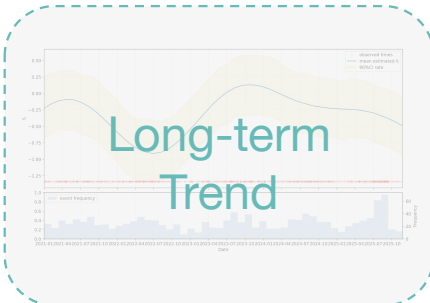
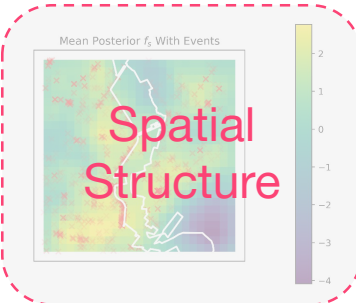
# Data & Model

Illegal Dumping 311 Reports  
2025



$$\lambda(s, t) = \exp(a_0 + \underbrace{\chi^T(s)w}_{\text{Spatial Structure}} + \underbrace{f_s(S)}_{\text{Spatial Structure}} + \underbrace{f_t(t)}_{\text{Long-term Trend}} + \underbrace{f_{seas}(t)}_{\text{Seasonal Pattern}})$$

$$+ \alpha \cdot \sum_{i:t_i < t} f(t - t_i; \beta) \cdot \phi(s - s_i; \sigma)$$



Data



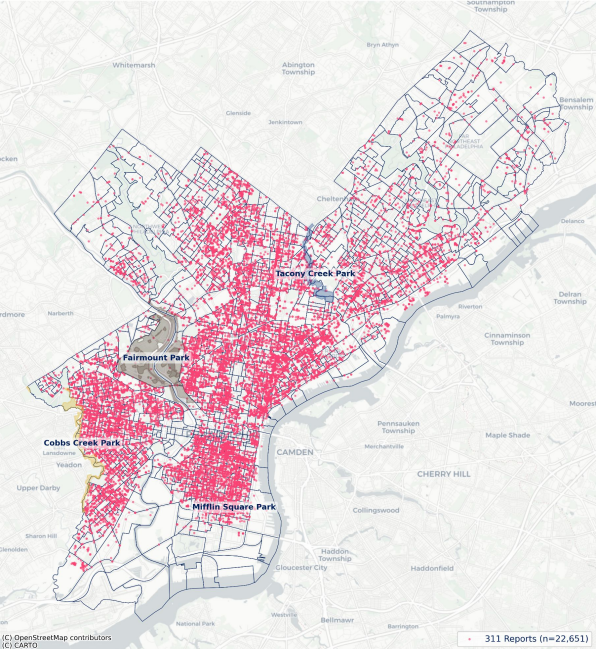
Model



Output

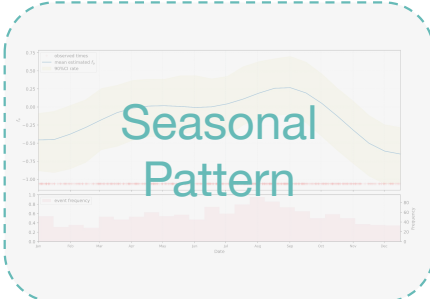
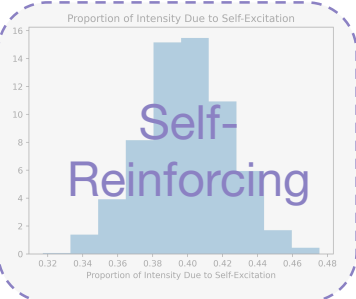
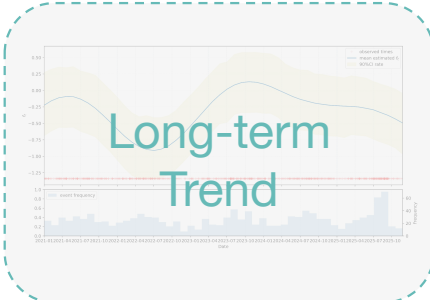
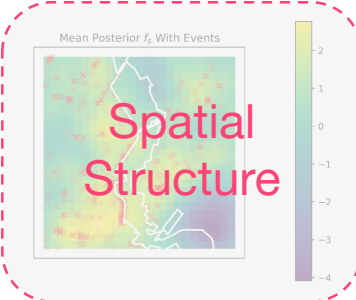
# Data & Model

Illegal Dumping 311 Reports  
2025



$$\lambda(s, t) = \exp(a_0 + \underbrace{\chi^T(s)w}_{\text{Spatial Structure}} + \underbrace{f_s(S)}_{\text{Spatial Structure}} + \underbrace{f_t(t)}_{\text{Long-term Trend}} + \underbrace{f_{seas}(t)}_{\text{Seasonal Pattern}})$$

$$+ \alpha \cdot \sum_{i:t_i < t} f(t - t_i; \beta) \cdot \phi(s - s_i; \sigma)$$



Data

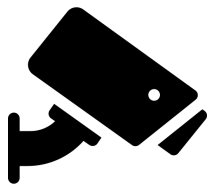
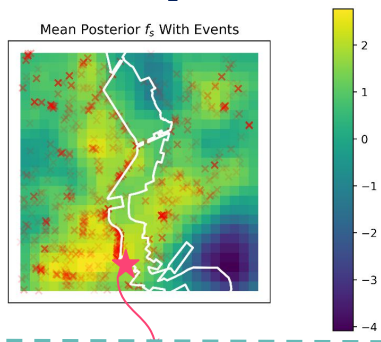


Model




Output

# Example: Tacony Park (Whitaker Gateway)



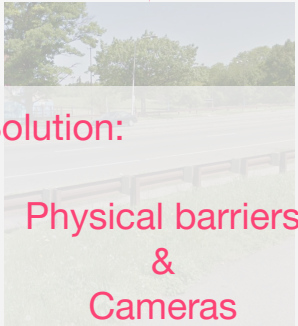
# Example: Tacony Park (Whitaker Gateway)

Mean Posterior  $f_s$  With Events

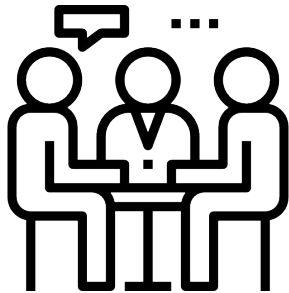
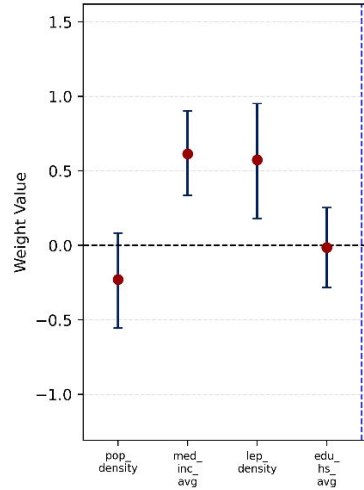



**Spatial Structure**

**Solution:**

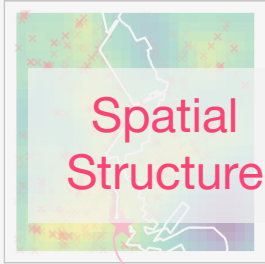


**Physical barriers  
&  
Cameras**



# Example: Tacony Park (Whitaker Gateway)

Mean Posterior  $f_s$  With Events



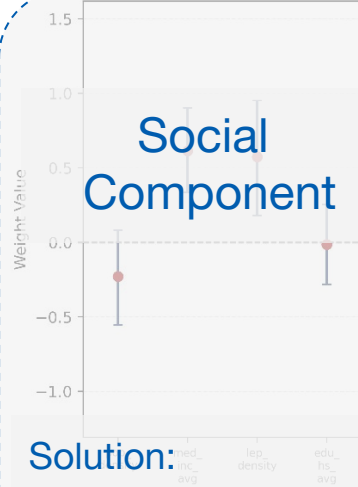
Spatial Structure

Solution:

Physical barriers  
&  
Cameras



Social Component

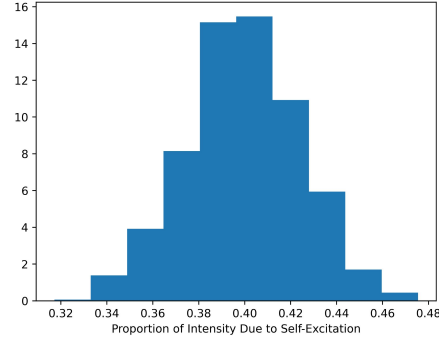


Solution:

Community meeting




Proportion of Intensity Due to Self-Excitation



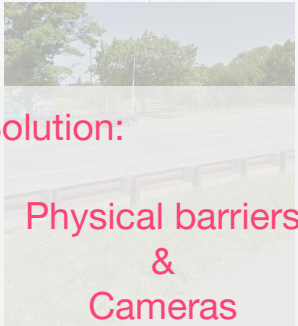
# Example: Tacony Park (Whitaker Gateway)

Mean Posterior  $f_s$  With Events




**Spatial Structure**

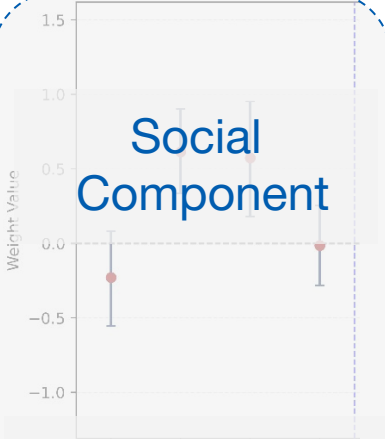
**Solution:**



**Physical barriers & Cameras**

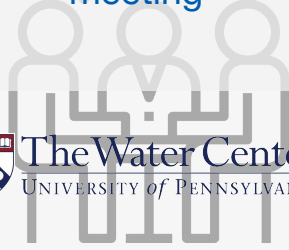


Weight Value




**Social Component**

**Solution:**



**Community meeting**



Proportion of Intensity Due to Self-Excitation

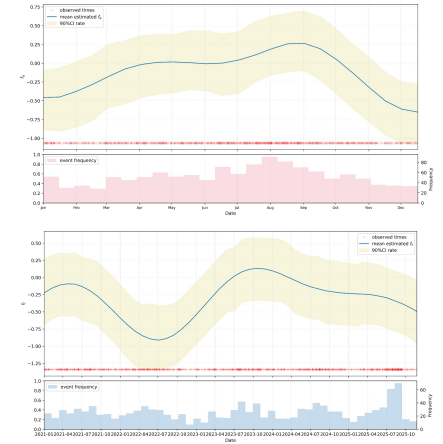


**Self-reinforcing**

**Solution:**



**Park ambassador**



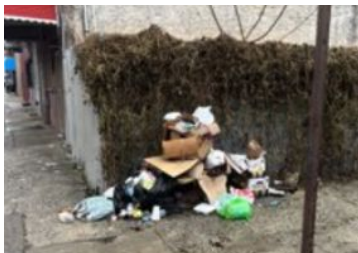
**Tookany/Tacony-Frankford Watershed Partnership, Inc.**

# What's next: LLM-powered trash classification

Credit: Terhi Nurminen



furniture\_bulky, 0.98  
trash\_bags, 0.95  
loose\_litter, 0.90



trash\_bags, 0.95  
cardboard\_boxes, 0.95  
loose\_litter, 0.90



tires, 1.00  
loose\_litter, 0.70



trash\_bags, 0.95  
tires, 0.90  
loose\_litter, 0.85



**Gemini:**  
trash\_bags, 0.95  
cardboard\_boxes, 0.90  
loose\_litter, 0.75

**Manual:**  
trash\_bags  
cardboard\_boxes