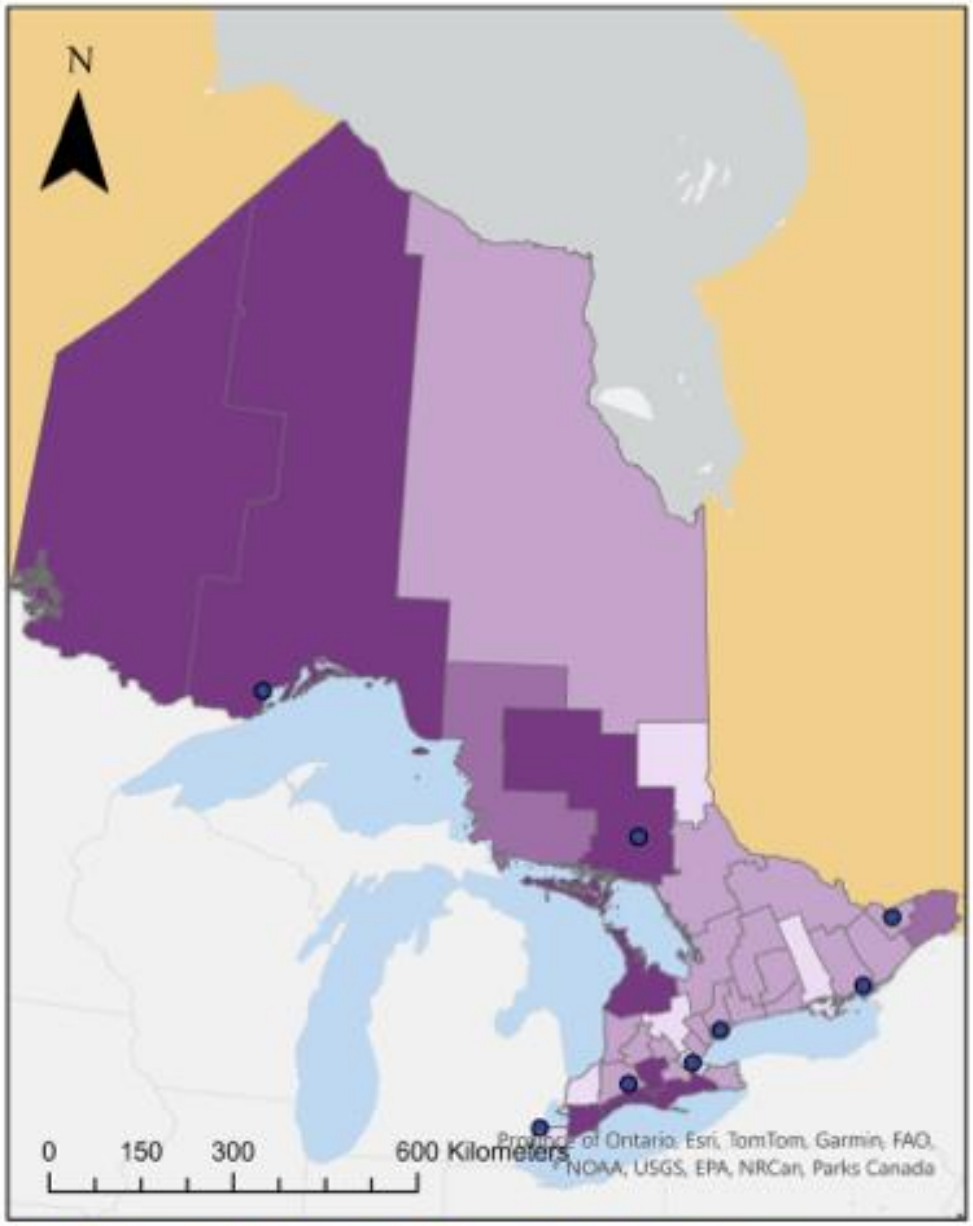
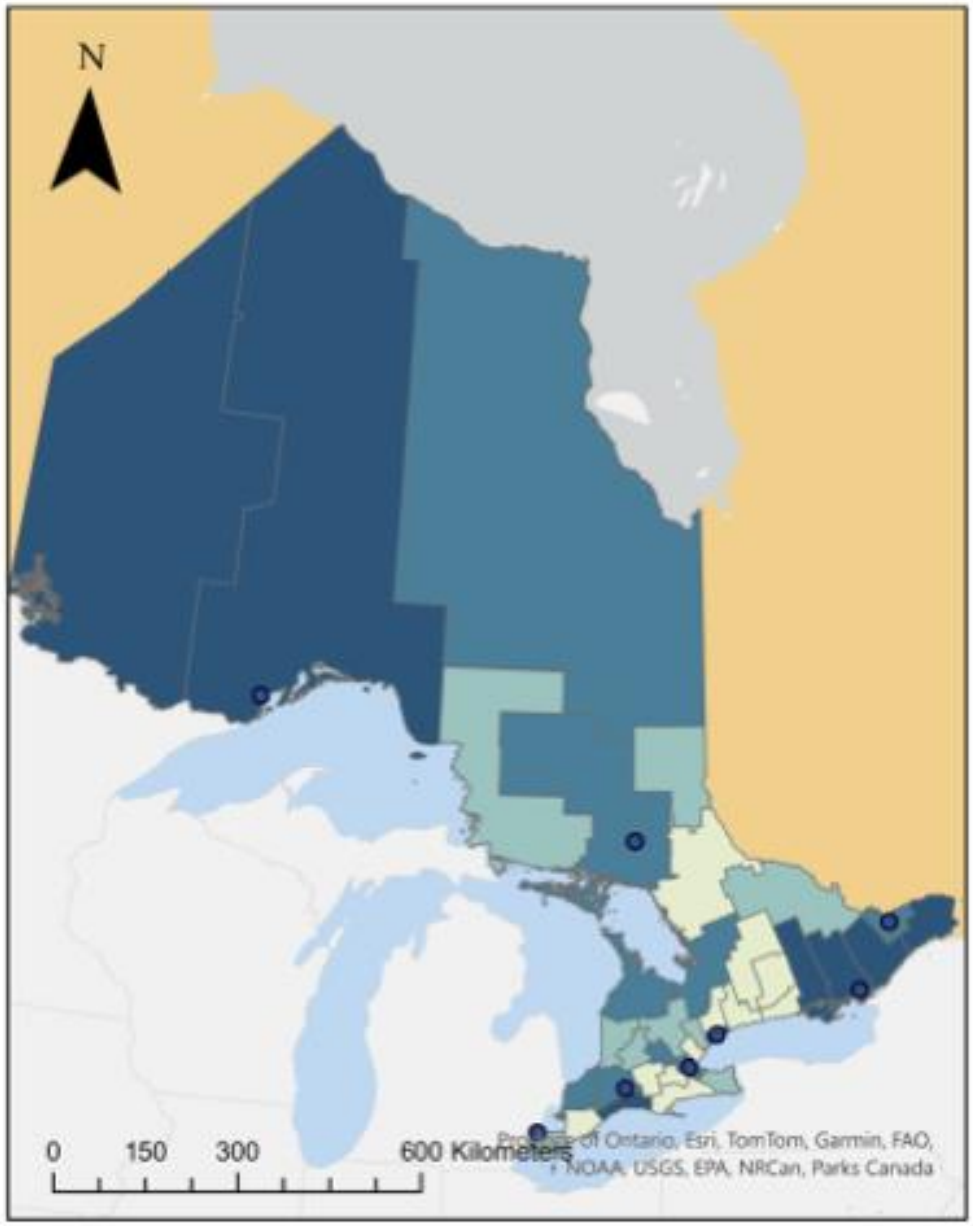
Step 1: Mapping Health Information

Both male and female infant mortality rates show similar spatial patterns, with northern PHUs generally exhibiting higher rates than southern Ontario. However, male rates are consistently higher than female rates across most PHUs, with the highest male rate reaching 10.8 per 1,000 live births compared to 8.2 for females. Southern Ontario PHUs, particularly those in the Greater Toronto Area, tend to have lower rates for both sexes.





Infant Mortality Rates by Public Health Unit in Ontario

Data Source: Statistics Canada, Health Indicators, 2000
Projection: NAD 1983 UTM Zone 17N
Author: Yisi Xie

Select Cities
Ontario Province
Great Lakes

Female IMR
2.800000 - 5.300000
5.300001 - 6.100000
6.100001 - 6.800000
6.800001 - 10.800000

Male IMR
3.600000 - 5.300000
5.300001 - 6.100000
6.100001 - 6.800000
6.800001 - 10.800000

Step 2: Detecting Spatial Clusters

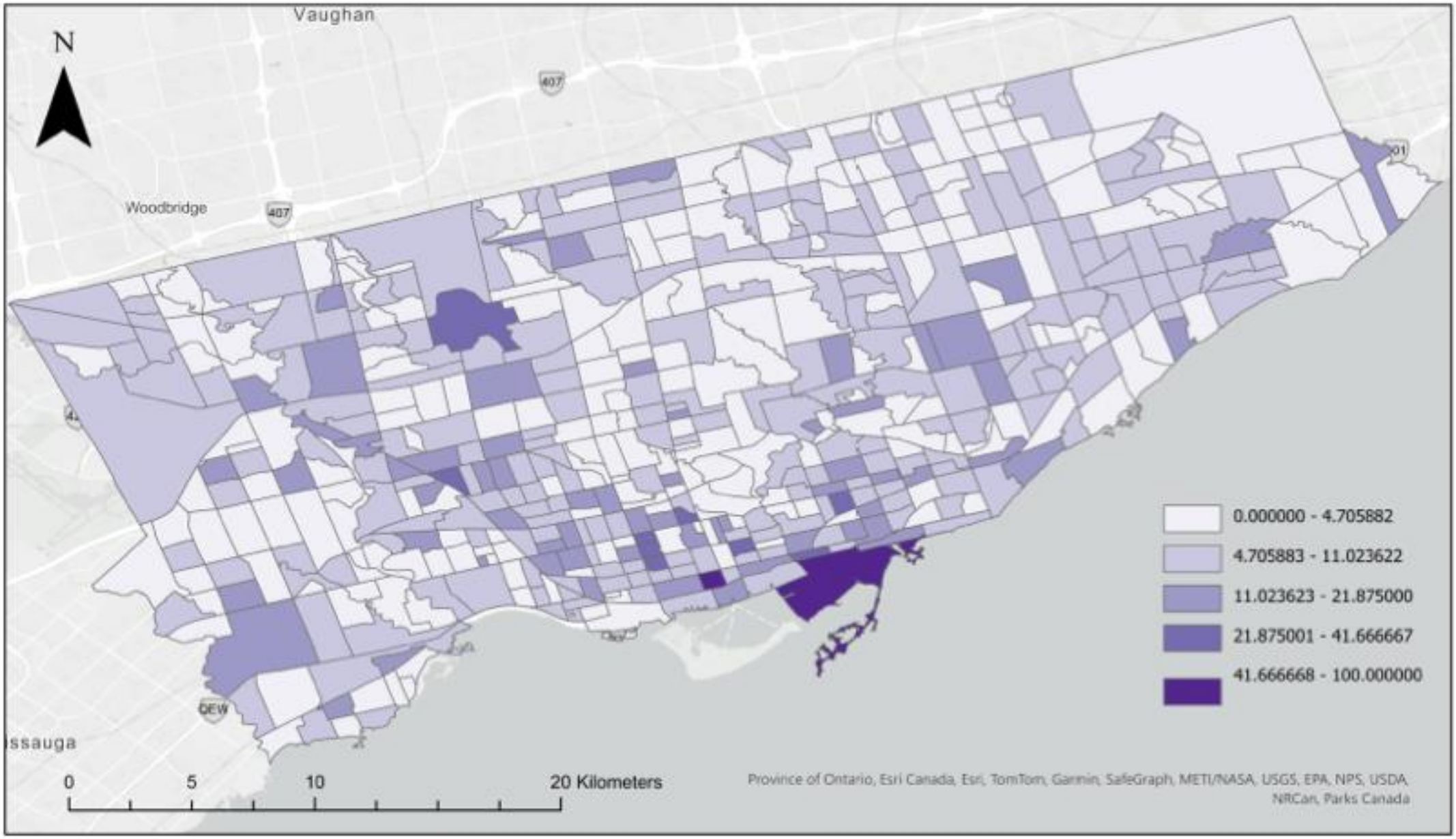
What is the purpose of a spatial weights matrix? Describe two analytical approaches for specifying a spatial weights matrix.

A spatial weights matrix defines the spatial relationships between geographic units, quantifying which areas are considered neighbors and to what degree. It is essential for spatial autocorrelation analysis as it formalizes the concept of spatial dependency.

Two approaches:

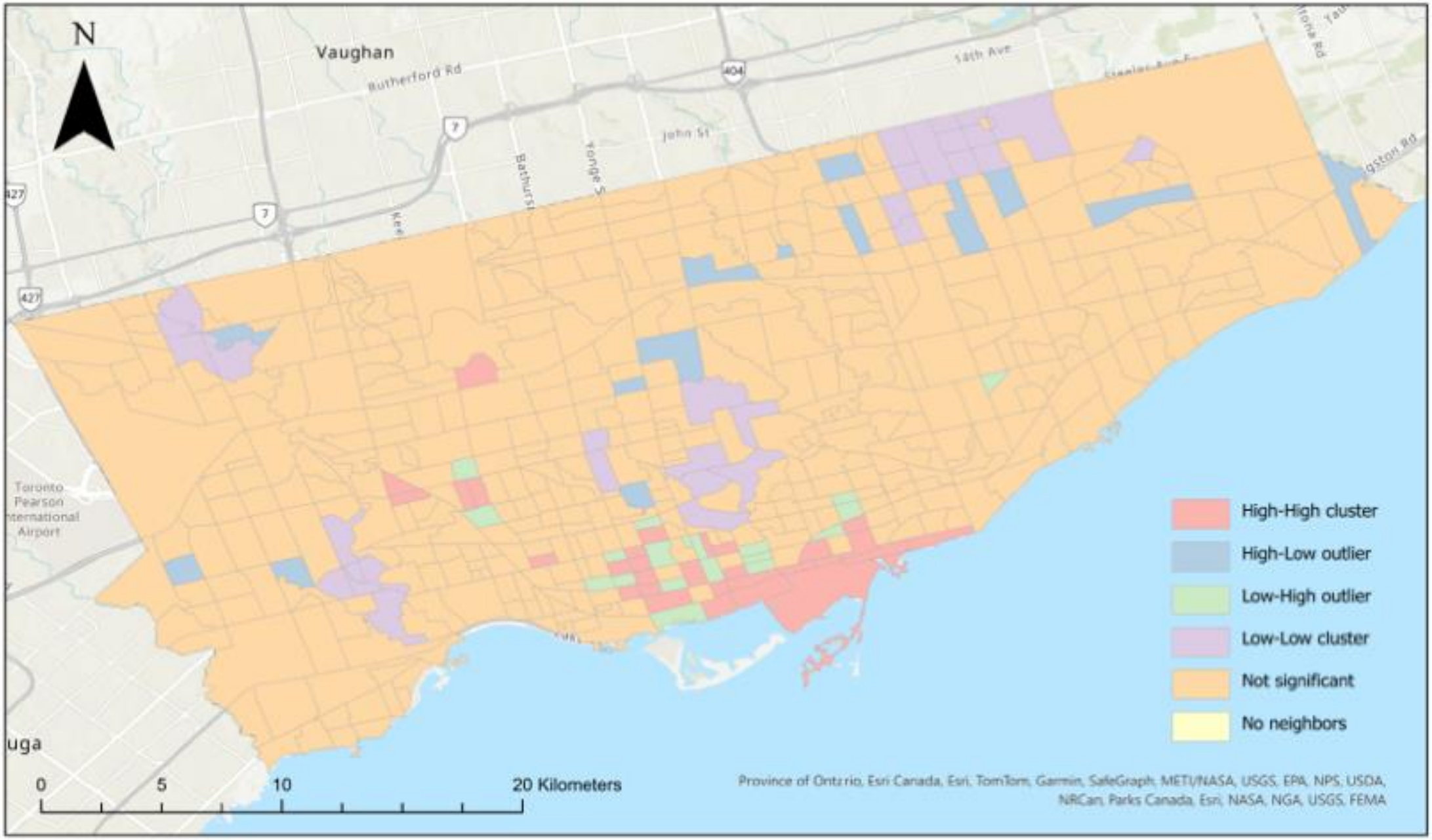
1. Contiguity-based: Areas that share a border or vertex are defined as neighbors (e.g., Queen or Rook contiguity). Each neighboring pair receives a weight of 1, non-neighbors receive 0.

2. Distance-based: Neighbors are defined by a threshold distance or K-nearest neighbors (KNN). Areas within a specified distance are considered neighbors, useful when spatial units vary greatly in size.



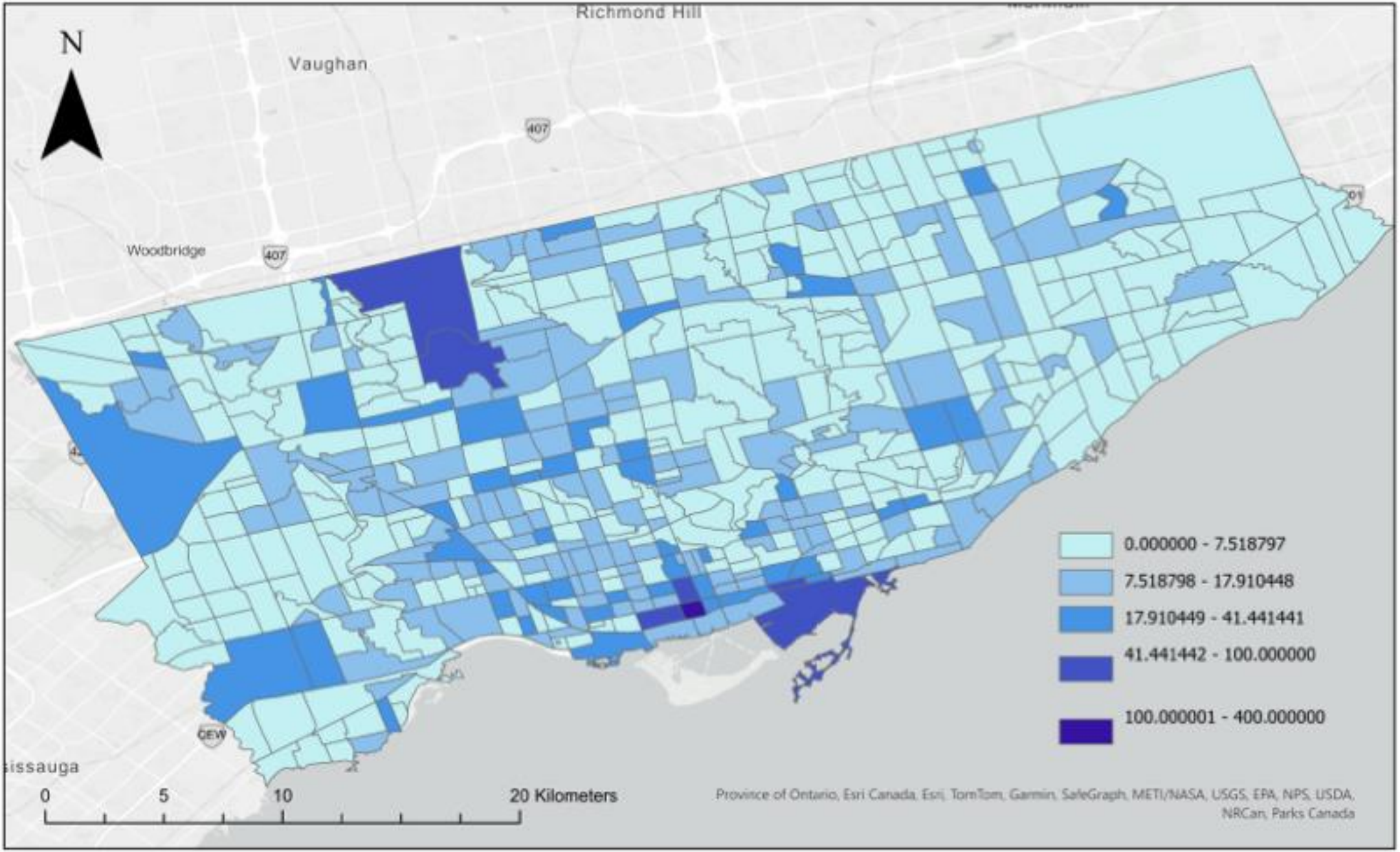
Child Pedestrian-Motor Vehicle Collision Rate (per 1,000 children)

Data Source: Toronto Police Services; Statistics Canada, 2016 Census
Projection: NAD 1983 UTM Zone 17N



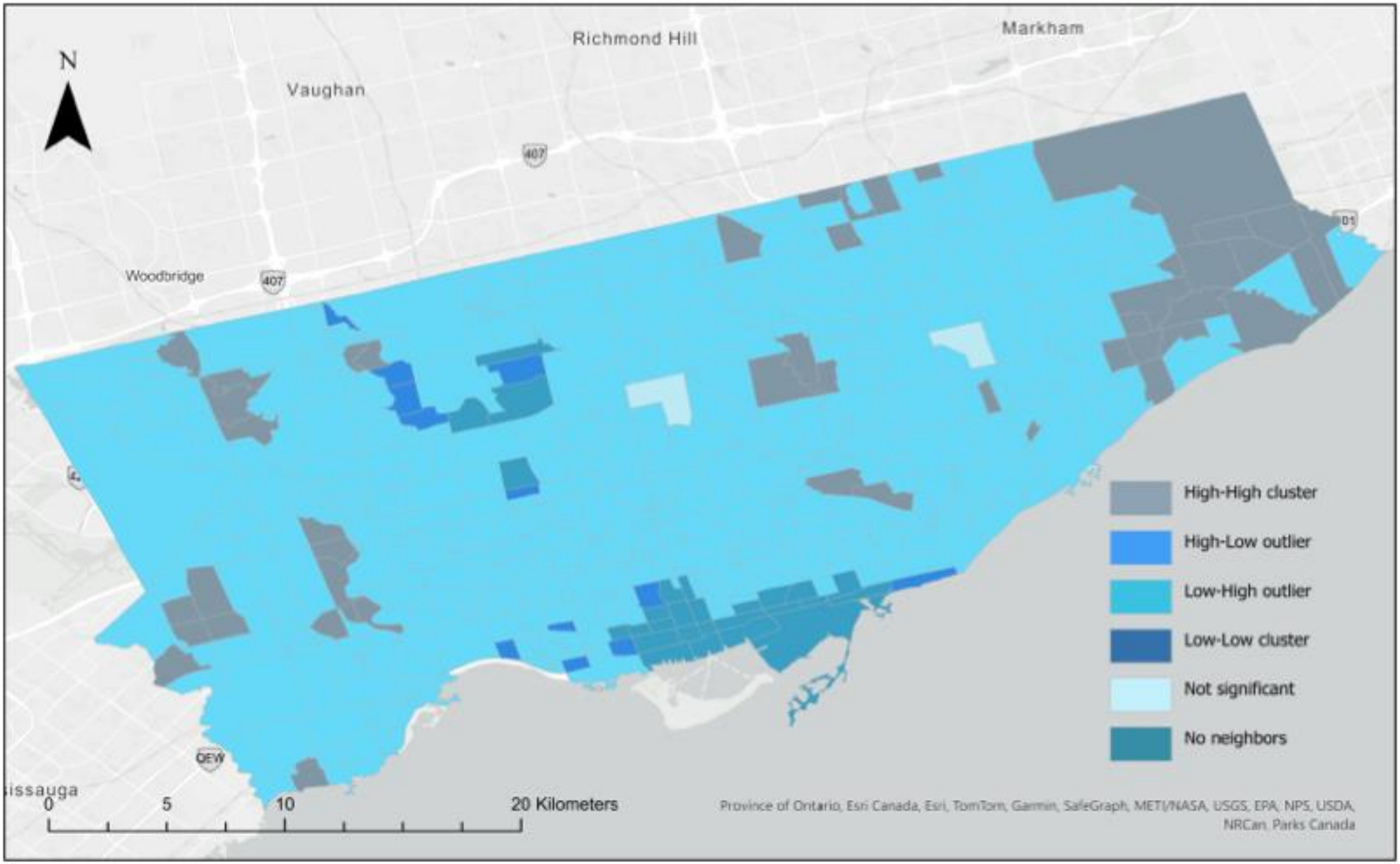
Local Spatial Autocorrelation of Child Collision Rate (LISA)

Data Source: Toronto Police Services; Statistics Canada, 2016 Census
Projection: NAD 1983 UTM Zone 17N



Senior Pedestrian-Motor Vehicle Collision Rate (per 1,000 seniors)

Data Source: Toronto Police Services; Statistics Canada, 2016 Census
Projection: NAD 1983 UTM Zone 17N



Local Spatial Autocorrelation of Senior Collision Rate

Data Source: Toronto Police Services; Statistics Canada, 2016 Census
Projection: NAD 1983 UTM Zone 17N

Report:

Global Moran's I analysis indicates statistically significant spatial clustering for both child ($I = 0.120$, $Z = 5.25$, $p < 0.001$) and senior ($I = 0.119$, $Z = 7.10$, $p < 0.001$) pedestrian-motor vehicle collision rates in Toronto. Both groups show positive spatial autocorrelation, meaning high-rate areas tend to be surrounded by other high-rate areas.

The child LISA map reveals High-High clusters concentrated in the downtown core and eastern waterfront, suggesting these areas present elevated collision risks for children. Low-Low clusters are found in northern and western residential areas.

The senior LISA map shows a distinct pattern, with High-High clusters concentrated in the northeastern part of the city, particularly around Scarborough. This differs from the child pattern, suggesting different risk environments for each age group. The broader spatial extent of significant clustering in seniors may reflect their greater vulnerability as pedestrians citywide.

Additional Questions:

Q1. CMAUID 535 refers to the Census Metropolitan Area code for Toronto, assigned by Statistics Canada. PRUID 35 refers to the province code for Ontario.

Q2. t would not be appropriate to conduct this analysis for the employed adult labour force. Unlike children and seniors who largely reside and travel within their home census tract, employed adults commute across the city. Their collision risk is tied to their workplace and commuting routes rather than their residential CT, creating a spatial mismatch between where they live and where collisions occur. This would introduce significant ecological fallacy into the analysis.

Q3.

1. Are child pedestrian collision hotspots spatially associated with proximity to schools and playgrounds in Toronto?

2. Do senior collision clusters correspond to areas with lower density of pedestrian infrastructure such as crosswalks and traffic signals?
3. Has the spatial pattern of pedestrian collisions shifted between 2016 and more recent years following urban development and Vision Zero policy implementation in Toronto?