

EXPLORING THE APPLICATION OF URBAN FORM PROFILES IN FREIGHT TRIP GENERATION

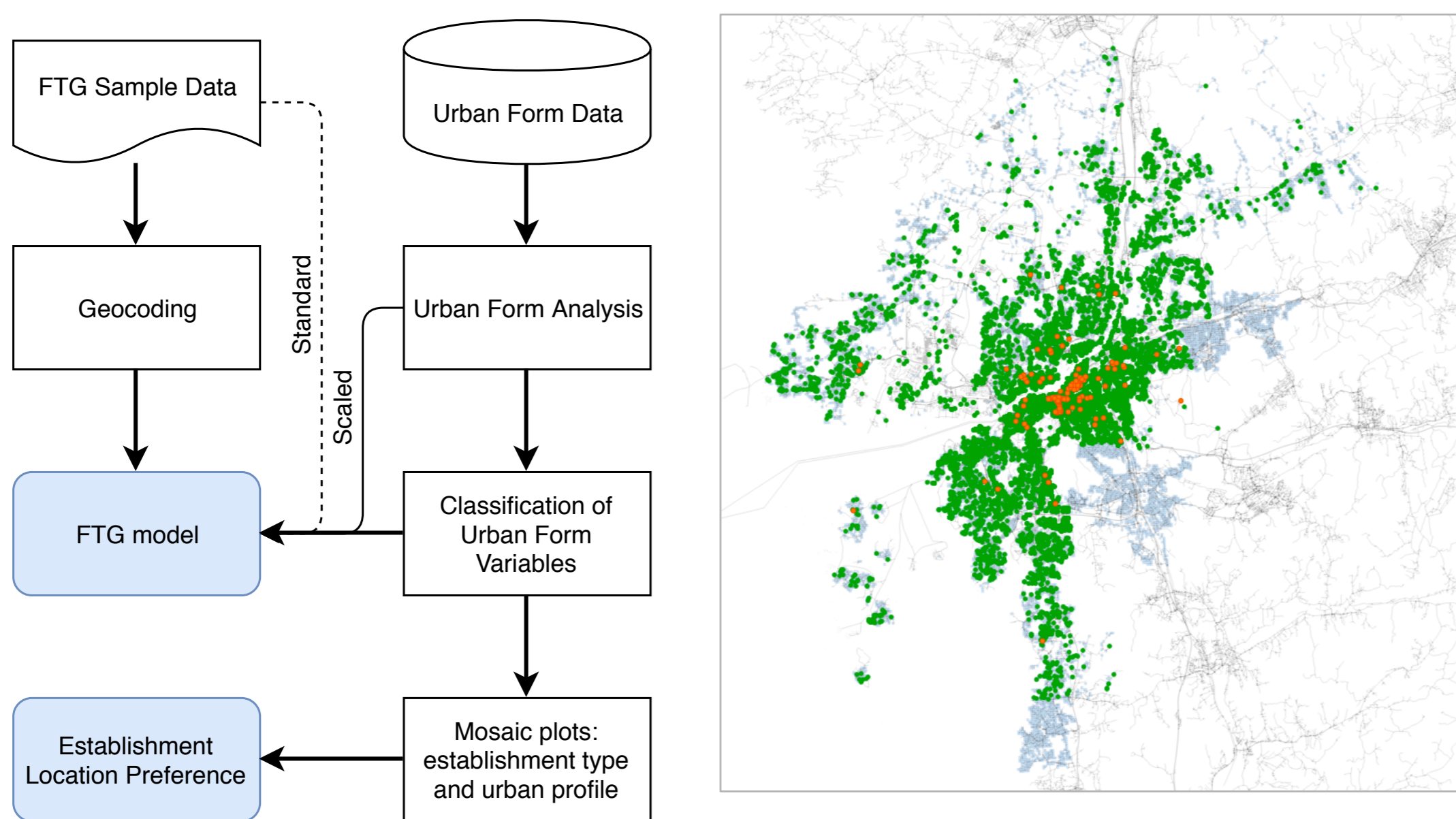
PURPOSE

This research aims to incorporate urban form characteristics in freight trip generation (FTG) models, and thus enable more interaction between practitioners through integration of their instruments and policies. From this perspective, the research addresses two questions:

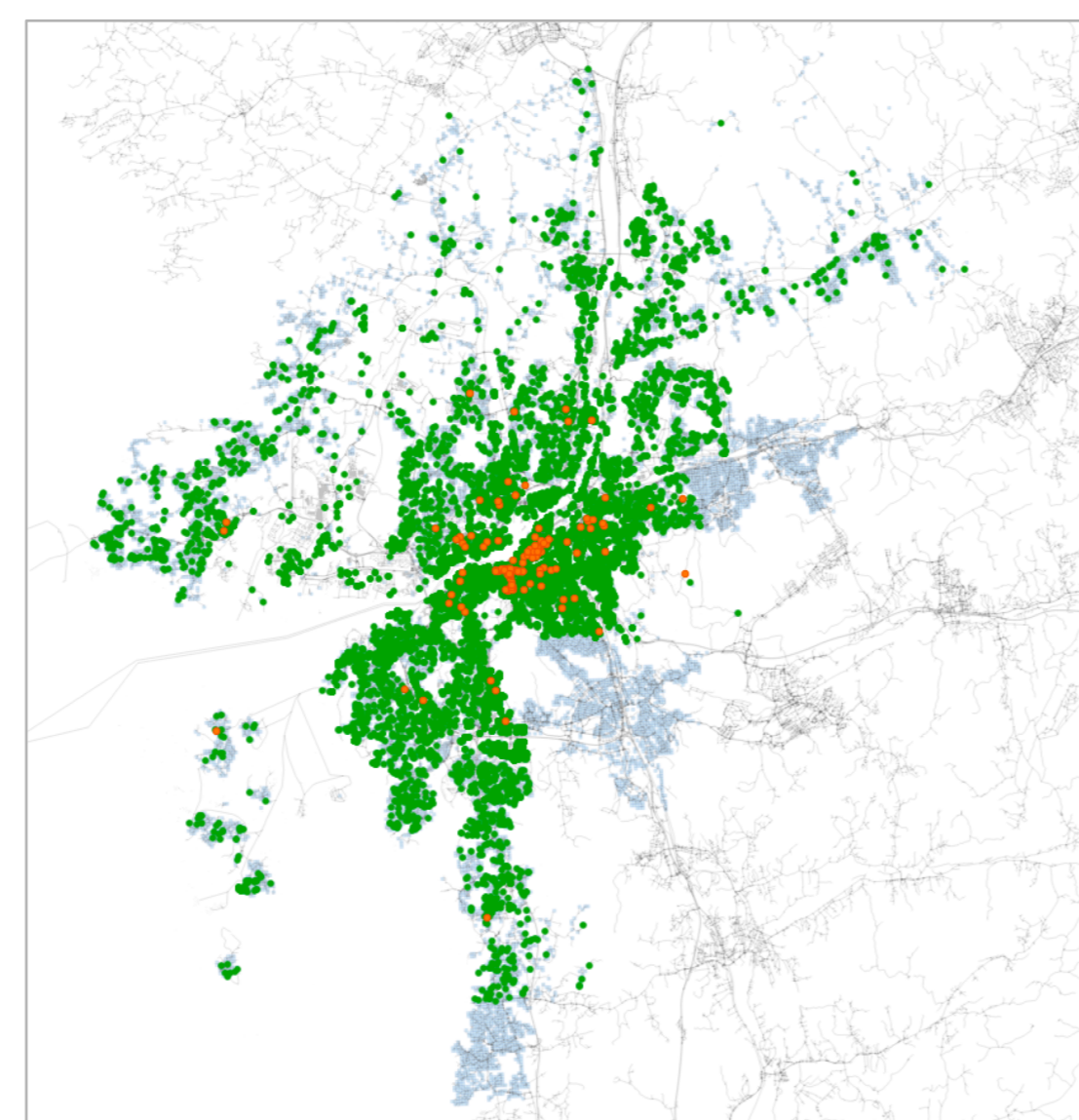
- To what extent does the urban form profile of a location influence the freight trip generation patterns of local establishments?
- How much do the urban form profiles relate to the location preference of different types of establishment?

RESEARCH APPROACH

The research employs a hybrid quantitative methodology combining elements from spatial morphology and freight transportation engineering to explore the application of urban form on FTG, using Gothenburg (Sweden) as a case study, with data from primary and secondary sources, namely: road network, population data, detailed establishments' data, and a sample of FTG data.



1. Modelling methods used

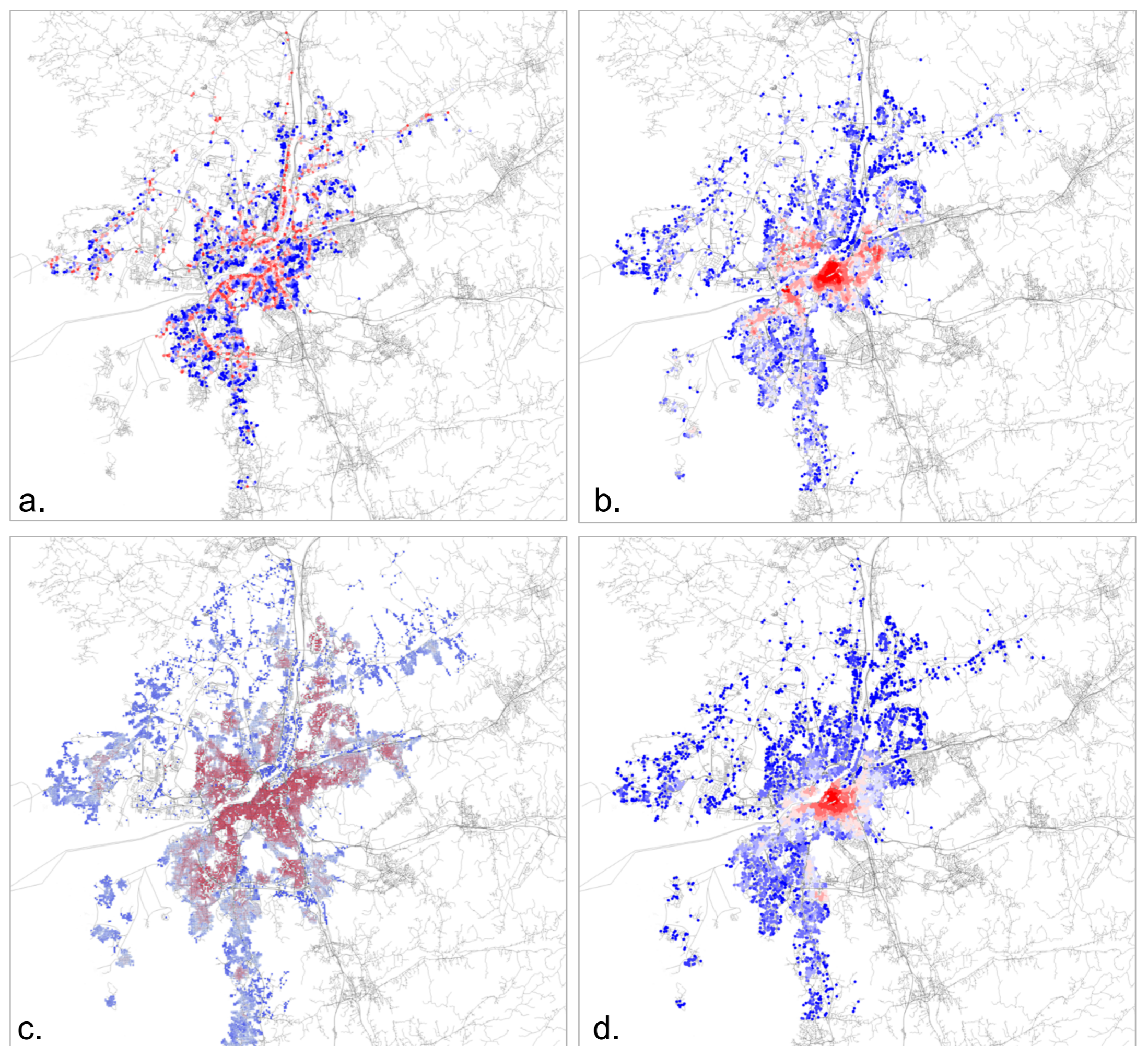


2. Spatial data model: road network (grey), population (blue), establishments (green), FTG sample data (orange)

3. Establishment and urban form variables considered

Variable type	Variable	Description
Establishment (14,799 business establishments in the Gothenburg metropolitan area)	Address	Registered street address of the establishment
	Postcode	Postcode of the establishment location
	Commercial sector	food services', 'health care services', 'manufacturing', 'offices', 'public services and education', 'retail of non-perishable products', 'retail of perishable products', 'transportation and storage', 'wholesale'
Site (address point of the establishment linked to the nearest road segment)	Number of employees	Median of class ranges in registry
	Road class	Road class of the address (0 to 9), where 0 is the top level (motorway) and 9 is the lowest level (mostly unpaved local roads)
	Road load class	Classification of the weight allowed on the road dependent on vehicle type: Weight Class 1 (BK1) (highest); Weight Class 2 (BK2); Weight Class 3 (BK3)
	Road width	Recorded road width in metres
	Distance to main road	Distance in meters to the nearest road of class 0 to 4
	Distance to top load road	Distance in metres to the nearest road of class BK1
	Closeness	Network centrality (general accessibility) of the road segment of the address
Neighbourhood (surrounding area within 800m distance along the network)	Betweenness	Network centrality (path hierarchy) of the road segment of the address
	Street connectivity	Total road segment length
	Population density	Sum of population registered in 100m cells, within 800m buffer
	Establishments	Count of all establishments within 800m walk, along the road
	Offices, retail, etc.	Count of all establishments in this sector within 800m walk, along the road

RESULTS



4. Example urban form variables (red – high; blue - low) : distance to main road (a), network connectivity (b), population density (c), office density (d).

5. Urban profile of establishment sector locations

Establishment sector	Site location	Neighbourhood
Food services	Central location, close to main road	High connectivity, high density
Health care services	Central location, close to main road	High connectivity, high density
Manufacturing		Low connectivity, low density
Offices	Central location	High connectivity, high density
Public services and education	Peripheral location	Low connectivity, low density (but less so)
Retail non-perishable products	Central location	High connectivity, high density
Retail perishable products	Higher load road, close to main road	-
Transportation and storage	Peripheral location	Low connectivity, low density
Wholesale	Higher load road	Low connectivity, low density

6. Comparison of FTG models (standard, with scaled, and with categorical urban form variables)

FTG	Retail perishable			Food services			Retail non-perishable		
	Standard	W/ scaled form variables	W/ form variables	Standard	W/ scaled form variables	W/ form variables	Standard	W/ scaled form variables	W/ form variables
Constant		5.67 (0.99)			2.30 (1.11)	4.36 (2.65)		-7.22 (-1.85)	
t-stat									
ln(emp)	13.45 (5.29)	11.78 (5.00)	29.77 (7.96)	3.75 (6.02)	2.84 (2.22)	2.75 (2.28)	6.11 (4.06)	6.18 (3.24)	7.53 (3.57)
n	54	40	54	43	43	43	70	70	70
R2	0.64	0.64	0.74	0.58	0.36	0.32	0.35	0.21	0.39
RMSE	14.11	10.51	12.59	4.83	4.22	4.34	8.98	8.90	8.87
AIC	440.1		433.6	258.5		252.2	506.9		504.2

CONCLUSIONS

- Different types of establishment concentrate on specific urban profiles, indicating a preference for specific site and neighbourhood characteristics.
- Location reflects directly on FTG of some sectors, namely retail of non-perishable goods.
- The use of categorical urban form variables describing individual spatial characteristics improves the FTG model.
- The method provides a higher resolution spatial analysis with disaggregate variables of urban form for the estimation of FTG at different locations.
- The method is sensitive to transformations of urban form introduced by urban design and development projects, offering an integrated tool for spatial planning of the city.