Analyzing Accessibility to Transit Stations Using Free and Commercial Geodata

Dennis Zielstra and Hartwig H. Hochmair

Geomatics Program

University of Florida

Fort Lauderdale Research and Education Center

Objective of Study

Quantify the impact of pedestrian-only segments (shortcuts) in a street network on the size of generated service areas around transit stops.

Analysis Steps

1. Comparison of lengths of street networks
   Distinction between
   - different street types (car vs. pedestrian-only)
   - different data sources (proprietary vs. free)
   - different cities (in US and Germany)

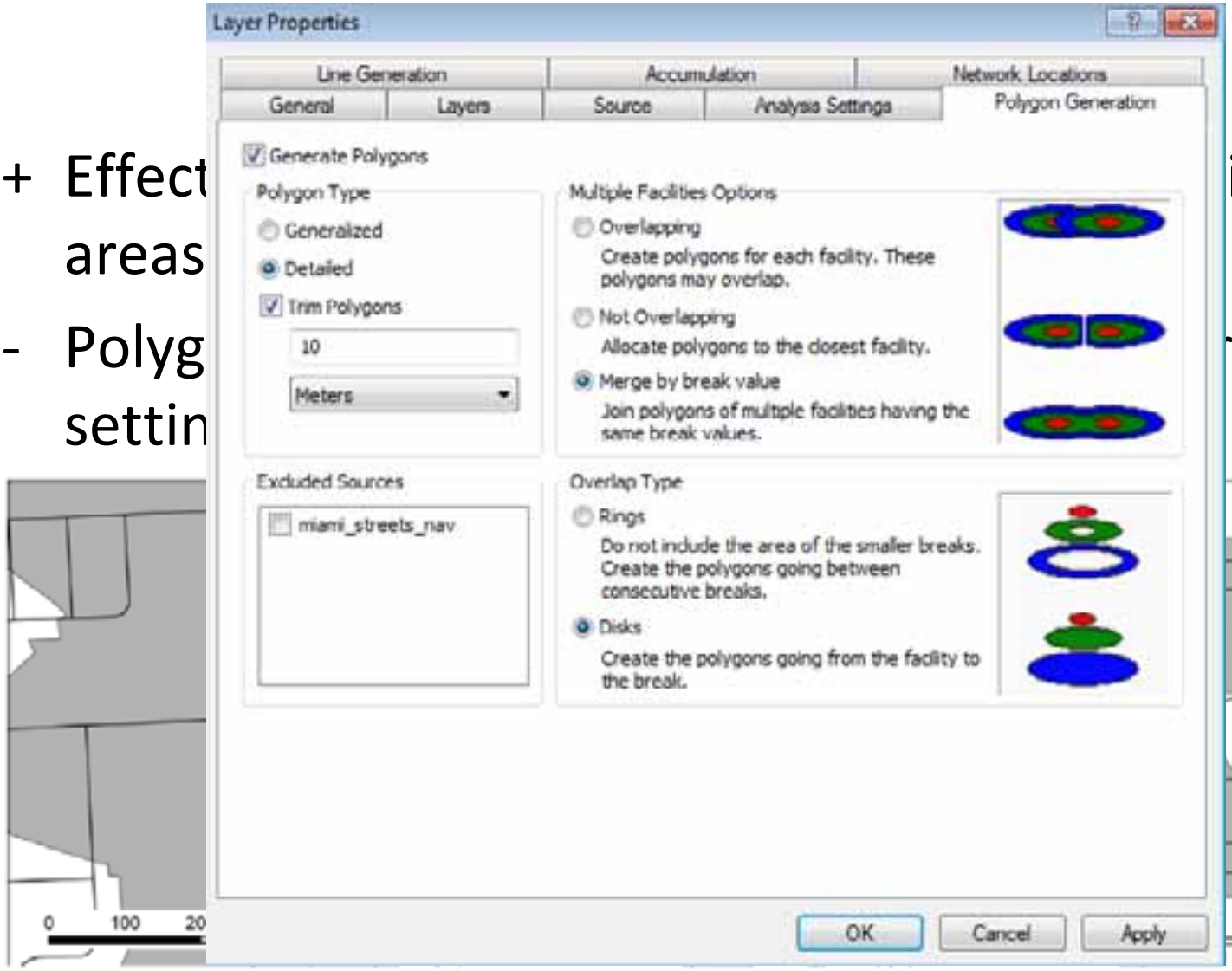
2. Measure impact of different data sources on modeling service areas in different cities

Service Area Generation

- Used to:
  - visualize spatial accessibility for pedestrians to transit systems
  - analyze the potential ridership
- Common standard measures of walking distance to transit stations:
  - 400 meters (0.25 miles) around bus stops
  - 800 meters (0.5 miles) around rail stations

+ Effect … ice areas

- Polyg … rious settin



No trim distance | 10 m trim distance | 30 m trim distance

Using Street Segments

+ Total length of street segments reached within threshold distance (e.g. 400m or 800m)

+ Independent of trim distance

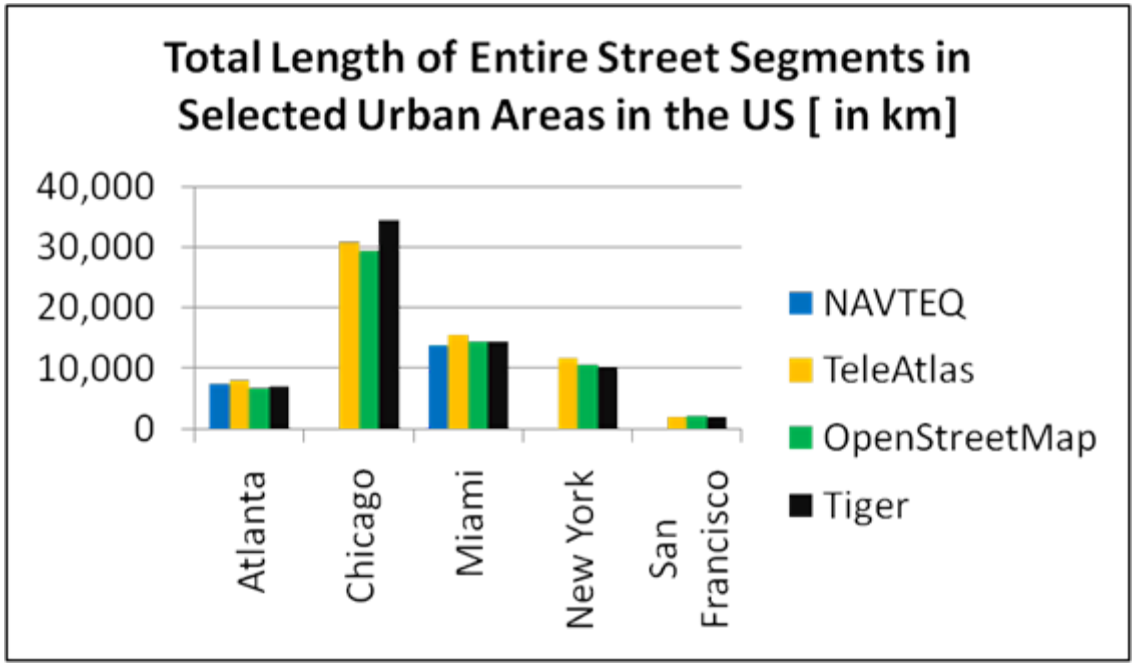
+ Better suited for quantitative comparisons of service areas

+ No need to remove inaccessible areas (e.g. water bodies)

Data Sets Used for Different Cities

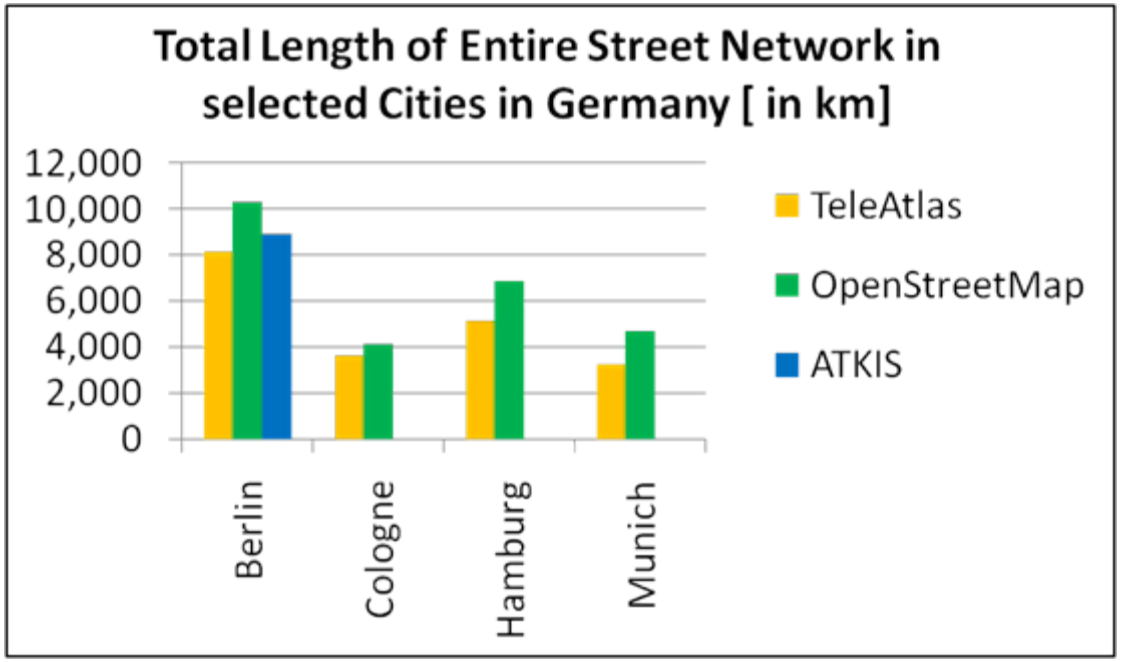
		Commercial		Free		Area [km^2]	# Bus	# Metro/ Rail
		NAVTEQ	Tele atlas	OSM	Tiger			
US	Atlanta	√	√	√	√	879	9419	38
	Chicago		√	√	√	3047	11800	381
	Miami	√	√	√	√	988	11679	27
	New York		√	√	√	774	12462	493
	San Francisco		√	√	√	122	8066	166
					ATKIS			
Germany	Berlin		√	√	√	891	3358	1203
	Cologne		√	√		405	645	326
	Hamburg		√	√		755	2931	333
	Munich		√	√		310	1375	673

Street Network Length Comparisons (US)



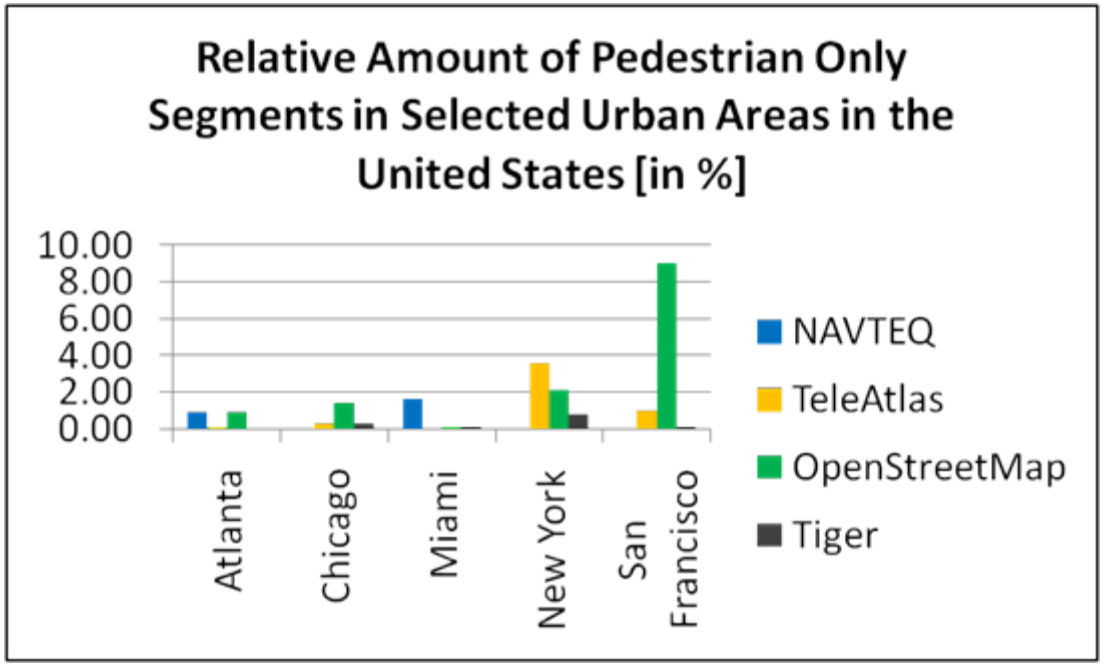
- Differences of street lengths are small for US cities

Street Network Length Comparison (Germany)



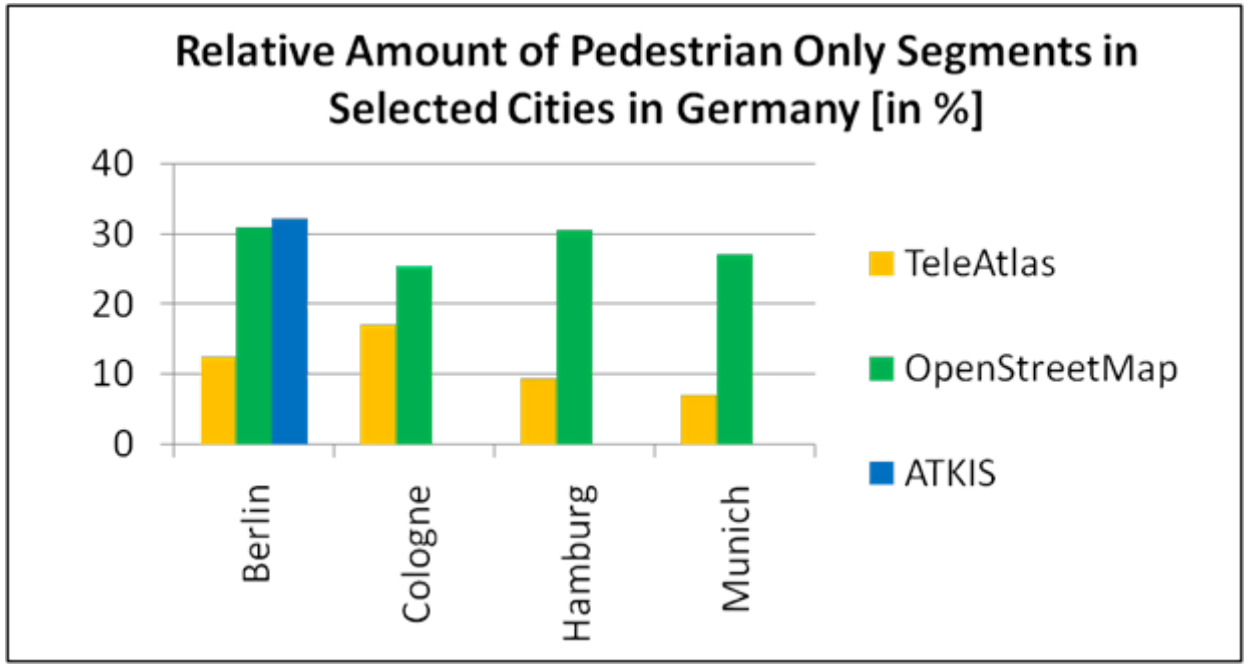
- Total lengths higher for OpenStreetMap than for TeleAtlas
- Differences range between 13% for Cologne and 44% for Munich

Pedestrian Data Length Comparison (US)



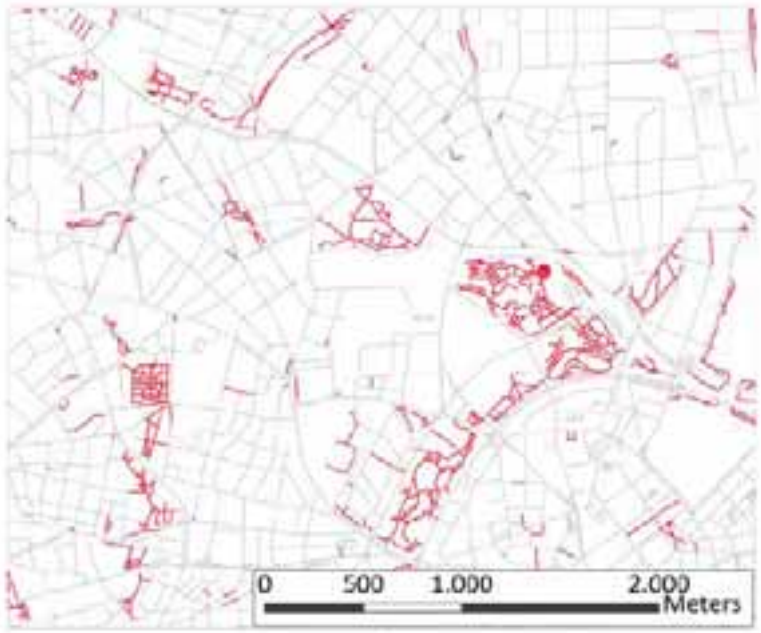
- Portion of pedestrian-only segments relative to total segment lengths is small for US cities (between 0.03 % and 8.97 %
- No clear pattern on which data source provides the best coverage for pedestrian-only data

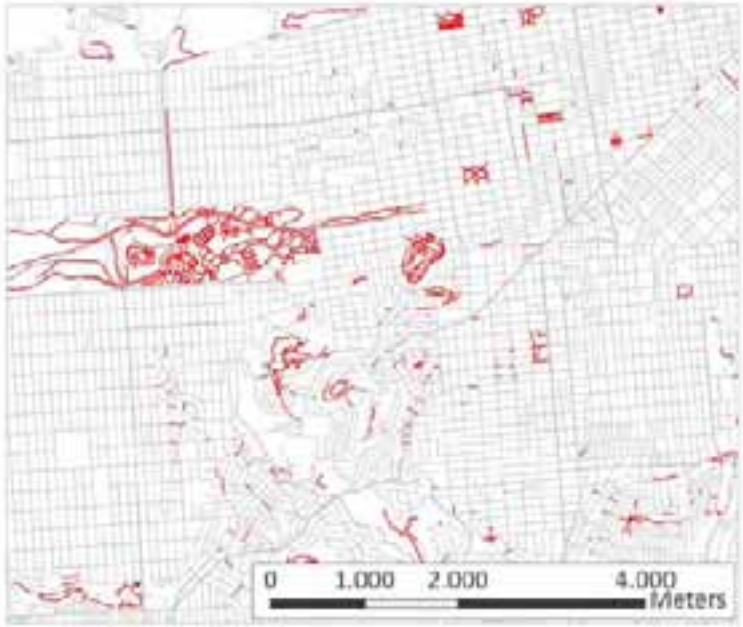
Pedestrian Data Length Comparisons (Germany)



- Generally higher percentage of pedestrian-only segments for all three data sets
- OSM has between 3.2 (Berlin) and 5.6 (Munich) times as many pedestrian-only data as Tele Atlas

Visualization of pedestrian-only segments





- Hamburg*:*
Distribution of pedestrian-only segments relatively homogenous.

- San Francisco*:*
Pedestrian-only paths more concentrated around parks and the bay area.

Effect of pedestrian-only segments for generation of service areas

San Francisco

Berlin

Service areas generated on the car network

Service areas generated on the combined car and pedestrian network

Car segment

Pedestrian only segment

Bus Stops

Relative growth of service area when integrating pedestrian-only segments (in %)

		NAVTEQ		Tele Atlas		OSM		TIGER	
		Bus	Metro	Bus	Metro	Bus	Metro	Bus	Metro
US	Atlanta	4.6	18.8	0.7	0.8	2.9	11.3	3.7	5.5
	Chicago	-	-	0.3	0.5	8.1	20.6	0.8	0.9
	Miami	4.5	2.9	0.2	0.2	0.3	0.0	0.4	0.0
	New York	-	-	1.7	2.6	9.3	8.1	1.6	2.1
	San Francisco	-	-	3.0	3.2	18.5	17.1	0.5	0.5
Mean		*4.5*	*10.7*	*1.2*	*1.4*	*7.8*	*11.5*	*1.4*	*1.8*
								ATKIS	
Germany	Berlin	-	-	11.5	21.4	59.4	76.8	20.3	21.3
	Cologne	-	-	8.2	4.7	70.2	84.8	-	-
	Hamburg	-	-	13.5	16.3	94.9	111.3	-	-
	Munich	-	-	7.4	6.9	98.7	117.2	-	-
Mean				*10.2*	*12.3*	*80.8*	*97.5*		

Conclusions

1. Pedestrian-only segments increase service areas around transit facilities up to 20% in US cities, and up to 117% in German cities.

2. The integration of pedestrian-only segments can lead to a more realistic assessment of service areas.

3. The maximum growth rates for US and Europe found for OSM data analysis were in cities where NAVTEQ data were not available.

Conclusions (cont.)

4. Some urban street networks do not provide a significant number of shortcuts that facilitate transit access for pedestrians

5. OSM data provide a free and relatively comprehensive option for cities

Future Work

- Expand analysis with more cities and datasets
- Analyze different city sizes
- Include population data to assess potential ridership
- Analyze impact of data on shortest route calculations for pedestrians

References

Further details related to results of this analysis can be found in the following publications:

- Zielstra, D. and Hochmair, H. H. (accepted). A Comparative Study of Pedestrian Accessibility to Transit Stations Using Free and Proprietary Network Data. Transportation Research Record: Journal of the Transportation Research Board, 2011.

- Zielstra, D. and Zipf, A. OpenStreetMap Data Quality Research in Germany. Sixth international conference on Geographic Information Science (GIScience), Zurich, Switzerland, 2010.