

Geografski informacioni sistemi

OSM, PostGIS QGIS, OpenLayers i SUMO

Andrija Tošić 1711

Setup

- homebrew: postgresql, qgis, pgadmin4, beekeeper-studio, timescaledb
- <https://download.geofabrik.de/europe-serbia-latest.osm.pbf> (184 MB)
- CREATE DATABASE osm;
- CREATE EXTENSION postgis;
- osm2pgsql -c -d osm -U postgres -H localhost projects/gis/srbia-latest.osm.pbf

Uvežene tabele

The screenshot shows a database management interface with two main panes. The left pane displays a tree view of entities under the 'public' schema, with 1307 total entities. The right pane shows a detailed view of a table's columns.

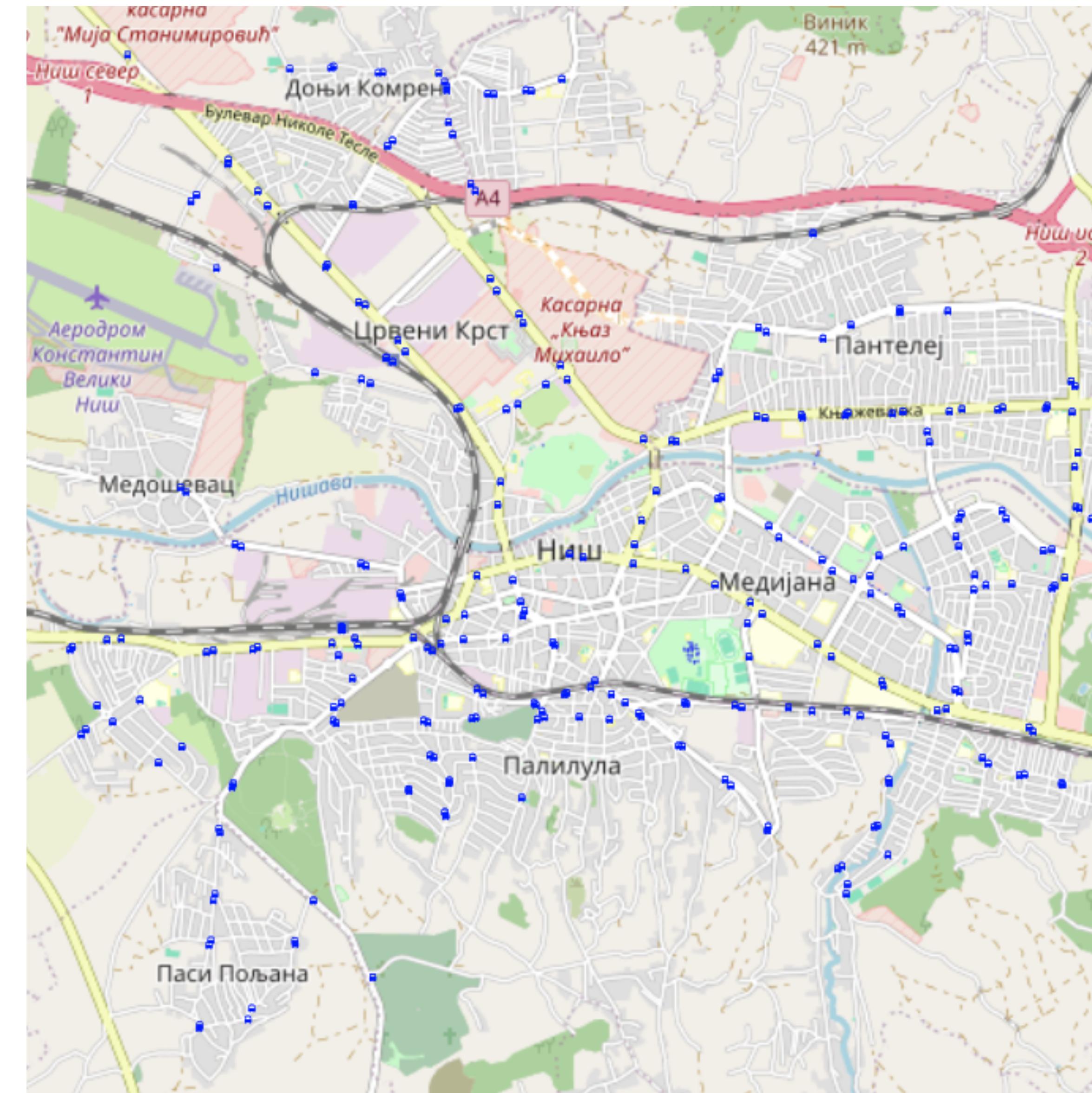
Entities (1307)

- public
 - emission_output
 - fcd_output
 - fcd_output_old
 - osm2pgsql_properties
 - planet_osm_line
 - planet_osm_point
 - planet_osm_polygon
 - planet_osm_roads

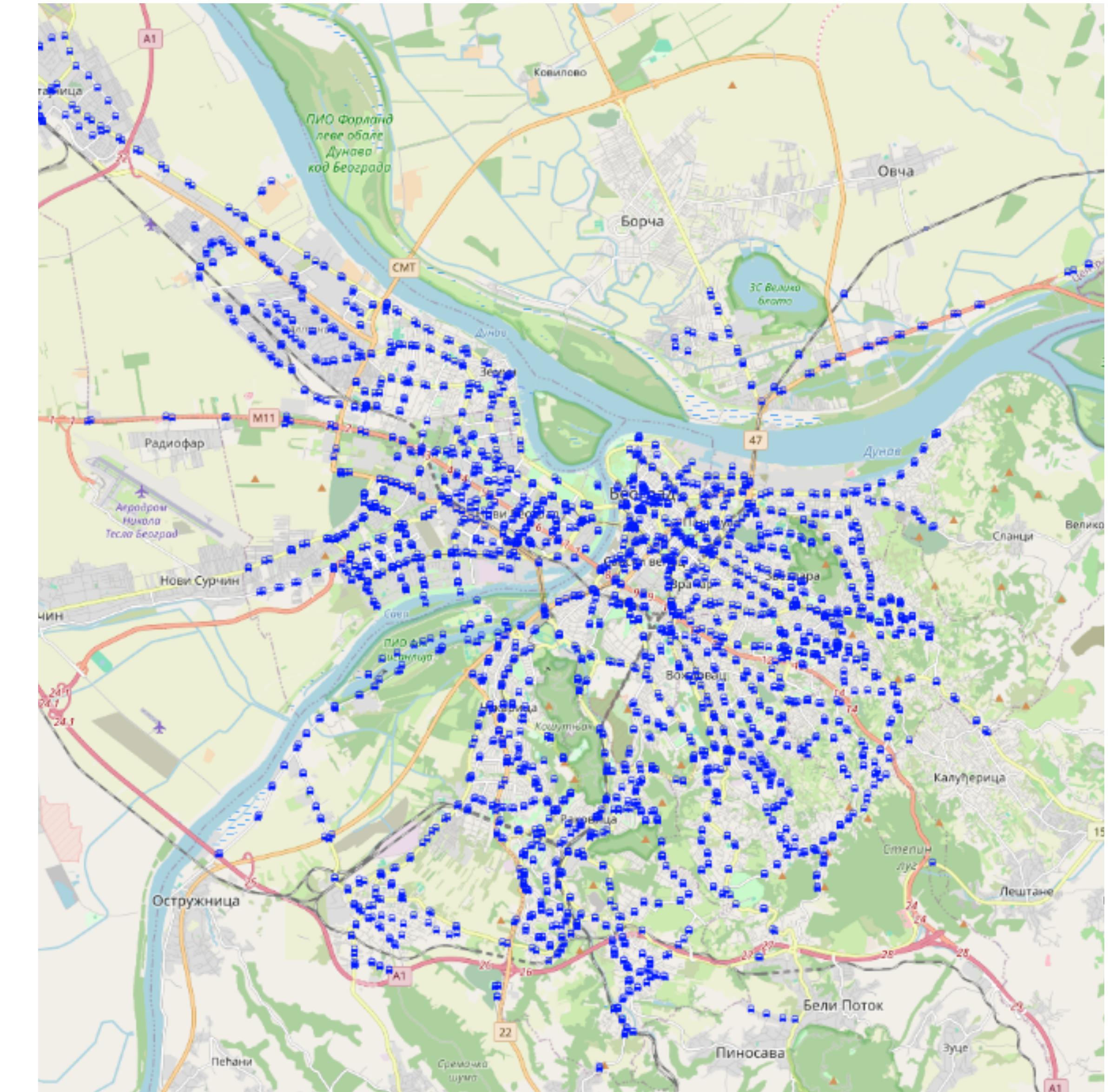
Columns

Name	Type	Nullable
osm_id	int8(64,0)	<input checked="" type="checkbox"/>
access	text	<input checked="" type="checkbox"/>
addr:housename	text	<input checked="" type="checkbox"/>
addr:housenumber	text	<input checked="" type="checkbox"/>
addr:interpolation	text	<input checked="" type="checkbox"/>
admin_level	text	<input checked="" type="checkbox"/>
aerialway	text	<input checked="" type="checkbox"/>
aeroway	text	<input checked="" type="checkbox"/>
amenity	text	<input checked="" type="checkbox"/>
area	text	<input checked="" type="checkbox"/>
barrier	text	<input checked="" type="checkbox"/>
bicycle	text	<input checked="" type="checkbox"/>

Autobuske stanice Niša



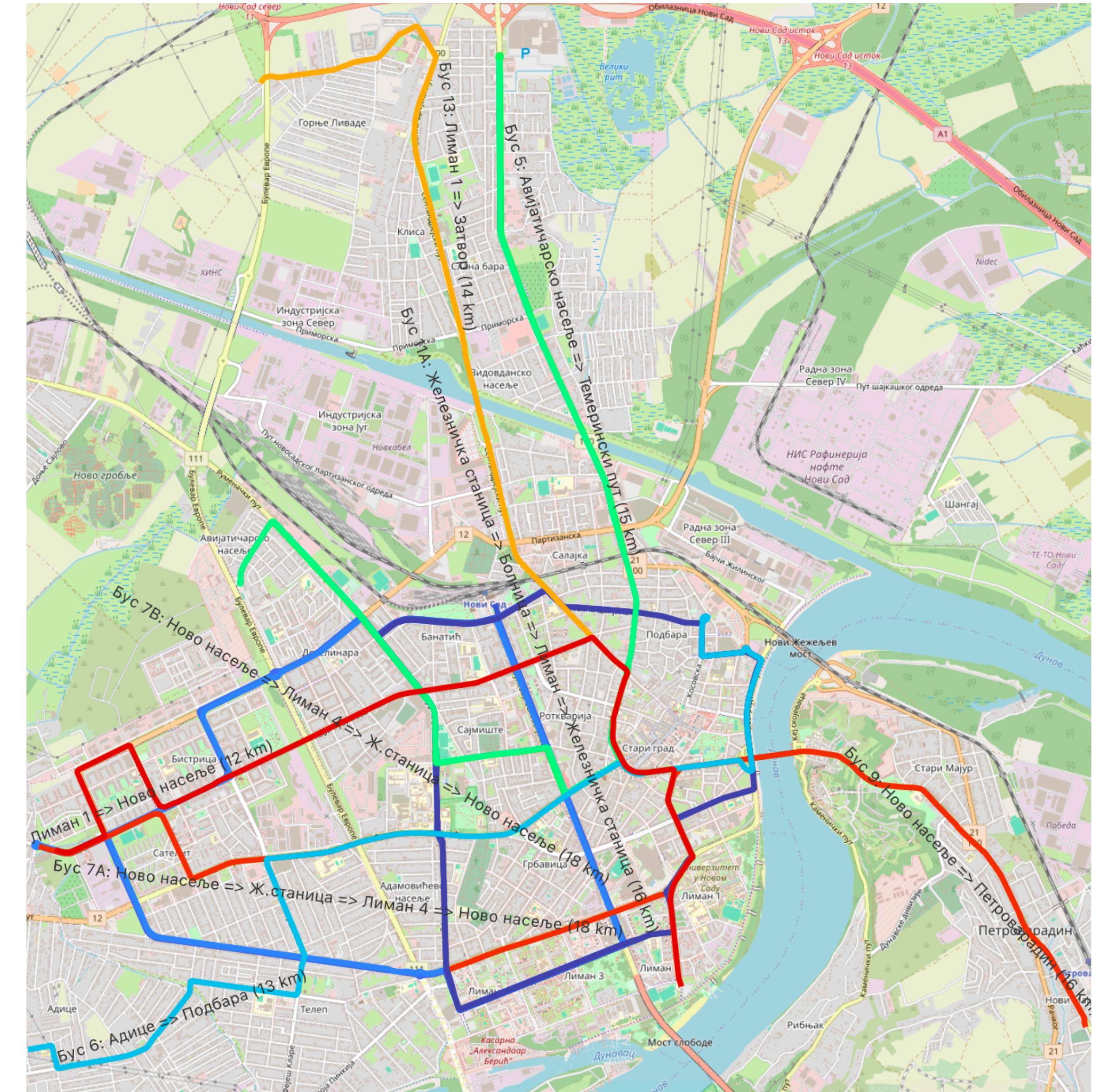
Autobuske stanice Beograda



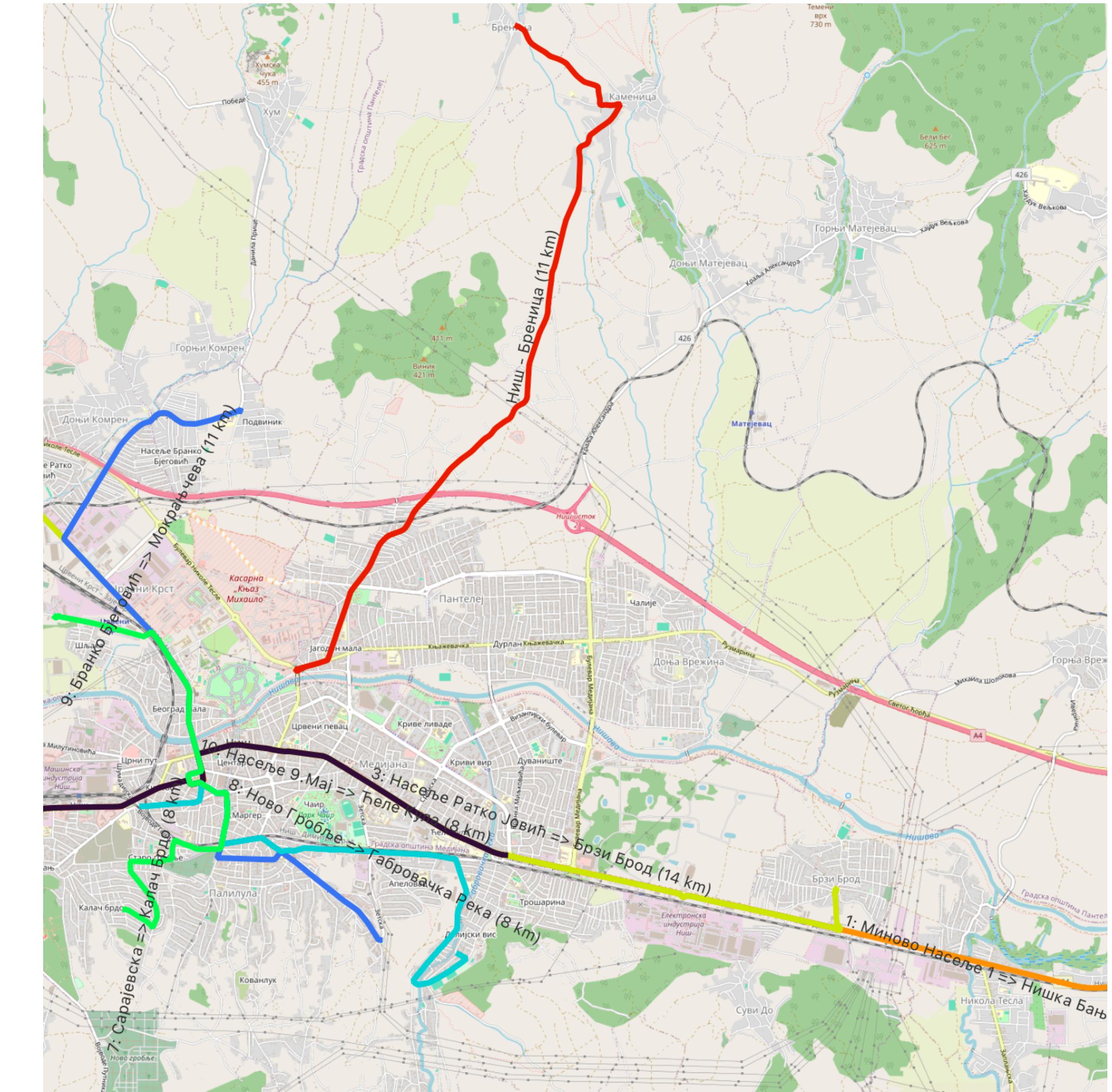
Najduže autobuske linije Beograda



Najduže autobuske linije Novog Sada

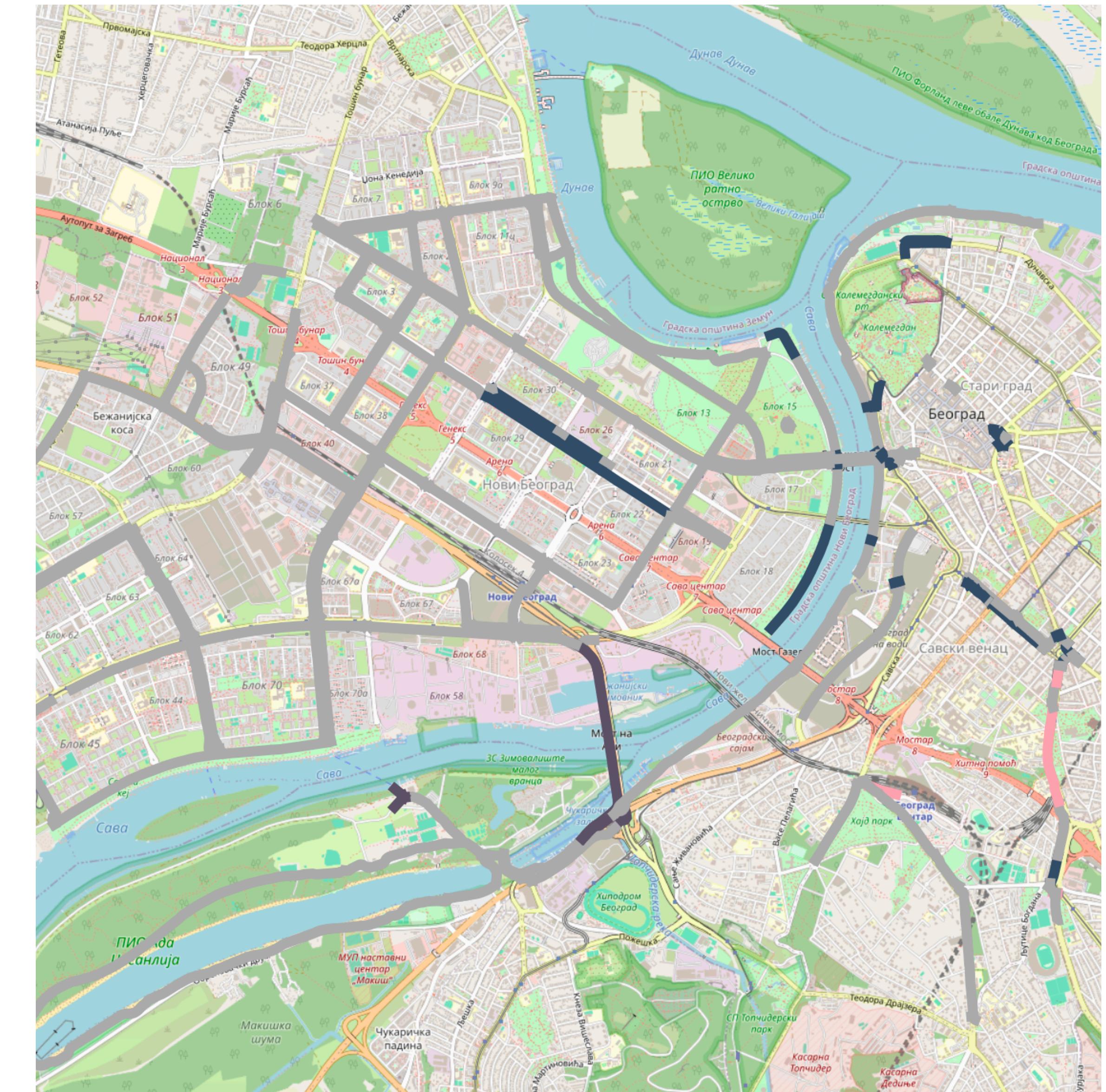


Najduže autobuske linije Niša

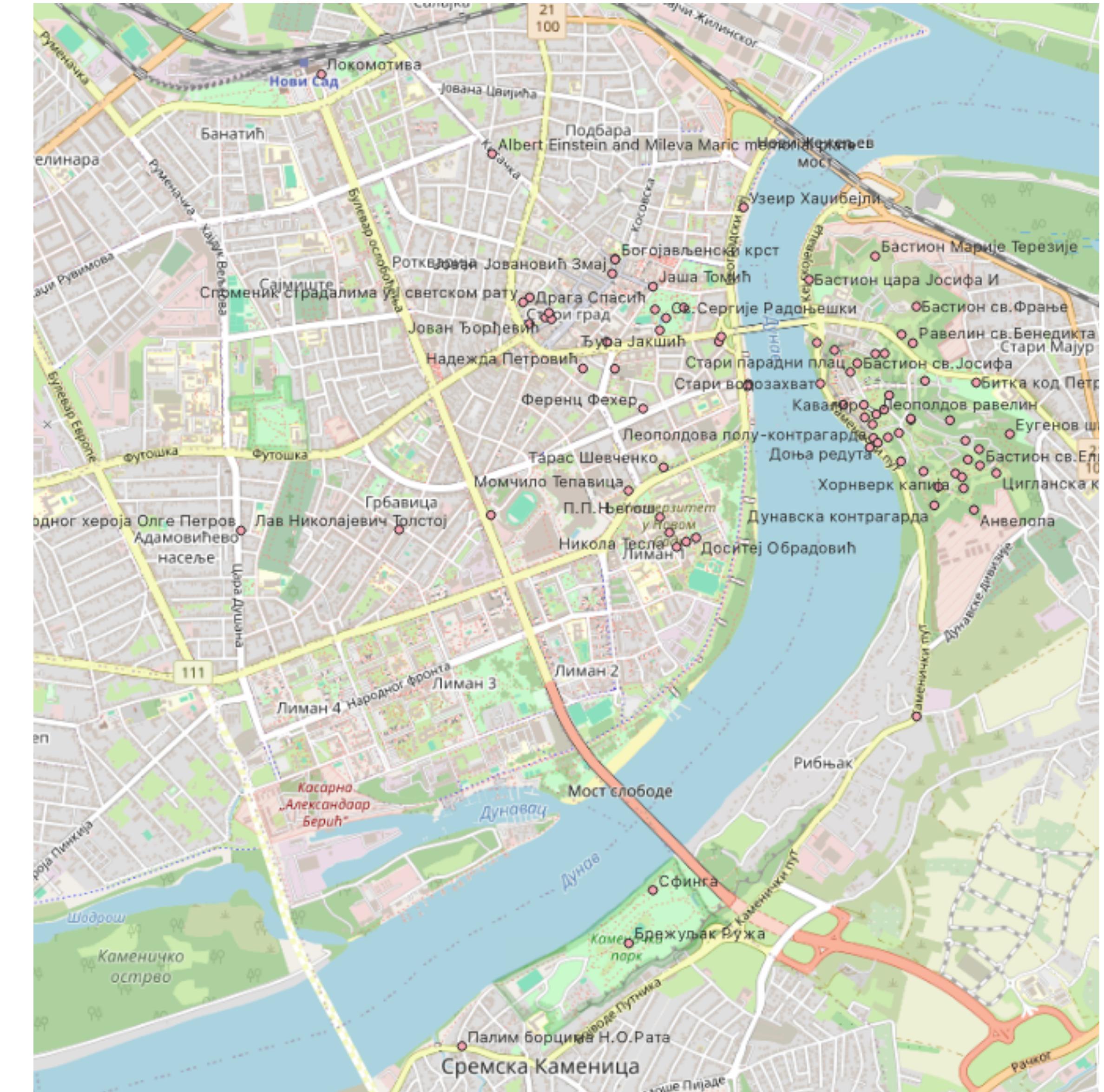


Biciklističke staze Beograda

Label	Rule
<input checked="" type="checkbox"/> asphalt	surface='asphalt'
<input checked="" type="checkbox"/> kadrma	surface='paving_stones'
<input checked="" type="checkbox"/> beton	surface='concrete'
<input checked="" type="checkbox"/> poplocano	surface='paved'
<input checked="" type="checkbox"/> zemlja	surface='dirt'



Istorijske turističke atrakcije u blizini hotela (1km)



Dužine biciklističkih staza

1	SELECT c.name AS city_name, ROUND(SUM(ST_Length(l.way)))/1000 AS total_cycleway_length	12	Београд (Земун)	14.414
2	FROM planet_osm_line l JOIN planet_osm_polygon c ON ST_Intersects(l.way, c.way)	13	Ниш (Медијана)	11.632
3	WHERE (c.name LIKE '%Ниш%' OR c.name LIKE '%Београд%' OR c.name LIKE '%Нови Сад%') AND l.highway = 'cycleway'	14	Београд (Стари град)	9.669
4	GROUP BY c.name ORDER BY total_cycleway_length DESC	15	Ниш (Пантелеј)	7.252
5		16	Голф клуб Београд	5.834
		17	Ниш (Палилула)	4.554
1	Град Београд 332.064	18	Нишка Бања	2.722
2	Град Нови Сад 186.111	19	Градска општина Нишка Бања	2.722
3	Београдски регион 166.032	20	Београд (Врачар)	2.31
4	Београд 142.755	21	Београд (Палилула)	2.02
5	Нови Сад 141.547			
6	Градска општина Нови Београд 92.191			
7	Београд (Нови Београд) 92.191			
8	Град Ниш 24.323			
9	Нишавски управни округ 24.323			
10	Београд (Савски венац) 20.491			
11	Београд (Чукарица) 16.742			

Procenat povrsine pokriven biciklističkim stazama

Cycling Infrastructure Coverage — Update SQL

```
SELECT row_number() over () AS _uid_ ,* FROM (SELECT c.name AS area_name,
ROUND(SUM(ST_Length(l.way)) / ST_Area(c.way) * 100) AS cycleway_coverage_percentage FROM planet_osm_line l
JOIN planet_osm_polygon c ON ST_Within(l.way, c.way) WHERE l.highway = 'cycleway' and c.name IS NOT NULL
GROUP BY c.name, c.way order by cycleway_coverage_percentage desc
) AS _subq_1_
```

Clear Fetched rows: 373/373 10866 ms Execute Stop

uid	area_name	cycleway_coverage_percentage
1	Саобраћајни полигон	12
2	Катићев Сквер	6
3	Пупинов мост	5
4	Мост на Ади	2
5	Перон VI	1
6	МЗ Центар II	1
7	Савски кеј	1
8	Дунавски парк	1

Dodavanje indeksa

Query #1

```
1 SELECT
2   tablename,
3   indexname,
4   indexdef
5 FROM
6   pg_indexes
7 WHERE
8   schemaname = 'public'
9 ORDER BY
10  tablename,
11  indexname;
```

	tablename	indexname	indexdef
1	osm2pgsql_properties	osm2pgsql_properties_pkey	CREATE UNIQUE INDEX osm2pgsql_properties_pkey ON public.osm2pgsql_properties USING btree (property)
2	planet_osm_line	planet_osm_line_way_idx	CREATE INDEX planet_osm_line_way_idx ON public.planet_osm_line USING gist (way) WITH (fillfactor='100')
3	planet_osm_point	idx_osm_point_amenity	CREATE INDEX idx_osm_point_amenity ON public.planet_osm_point USING btree (amenity)
4	planet_osm_point	planet_osm_point_way_idx	CREATE INDEX planet_osm_point_way_idx ON public.planet_osm_point USING gist (way) WITH (fillfactor='100')
5	planet_osm_polygon	idx_osm_polygon_name	CREATE INDEX idx_osm_polygon_name ON public.planet_osm_polygon USING btree (name)
6	planet_osm_polygon	planet_osm_polygon_way_idx	CREATE INDEX planet_osm_polygon_way_idx ON public.planet_osm_polygon USING gist (way) WITH (fillfactor='100')
7	planet_osm_roads	planet_osm_roads_way_idx	CREATE INDEX planet_osm_roads_way_idx ON public.planet_osm_roads USING gist (way) WITH (fillfactor='100')
8	spatial_ref_sys	spatial_ref_sys_pkey	CREATE UNIQUE INDEX spatial_ref_sys_pkey ON public.spatial_ref_sys USING btree (srid)

Poređenje s indeksom i bez indeksa

Query #1

```
1 explain SELECT c.name AS city_name, SUM(ST_Length(l.way)) / ST_Area(c.way) * 100 AS cycleway_coverage_percentage
2 FROM planet_osm_line l
3 JOIN planet_osm_polygon c ON ST_Within(l.way, c.way)
4 WHERE l.highway = 'cycleway'
5 GROUP BY c.name, c.way
6 order by cycleway_coverage_percentage desc
```

13.783s

QUERY PLAN	
1	Sort (cost=51847245.39..51851634.30 rows=1755562 width=296)
2	Sort Key: (((sum(st_length(l.way)) / st_area(c.way)) * '100'::double precision)) DESC
3	-> Finalize GroupAggregate (cost=50173848.59..51185123.88 rows=1755562 width=296)
4	Group Key: c.name, c.way
5	-> Gather Merge (cost=50173848.59..50913011.77 rows=3511124 width=296)
6	Workers Planned: 2
7	-> Partial GroupAggregate (cost=50172848.57..50506740.91 rows=1755562 width=296)
8	Group Key: c.name, c.way
9	-> Sort (cost=50172848.57..50178706.66 rows=2343235 width=850)
10	Sort Key: c.name, c.way
11	-> Nested Loop (cost=0.29..47281925.98 rows=2343235 width=850)
12	-> Parallel Seq Scan on planet_osm_line l (cost=0.00..37828.10 rows=1073 width=562)
13	Filter: (highway = 'cycleway'::text)
14	-> Index Scan using planet_osm_polygon_way_idx on planet_osm_polygon c (cost=0.29..44028.15 rows=176 width=288)
15	Index Cond: (way ~ l.way)
16	Filter: st_within(l.way, way)

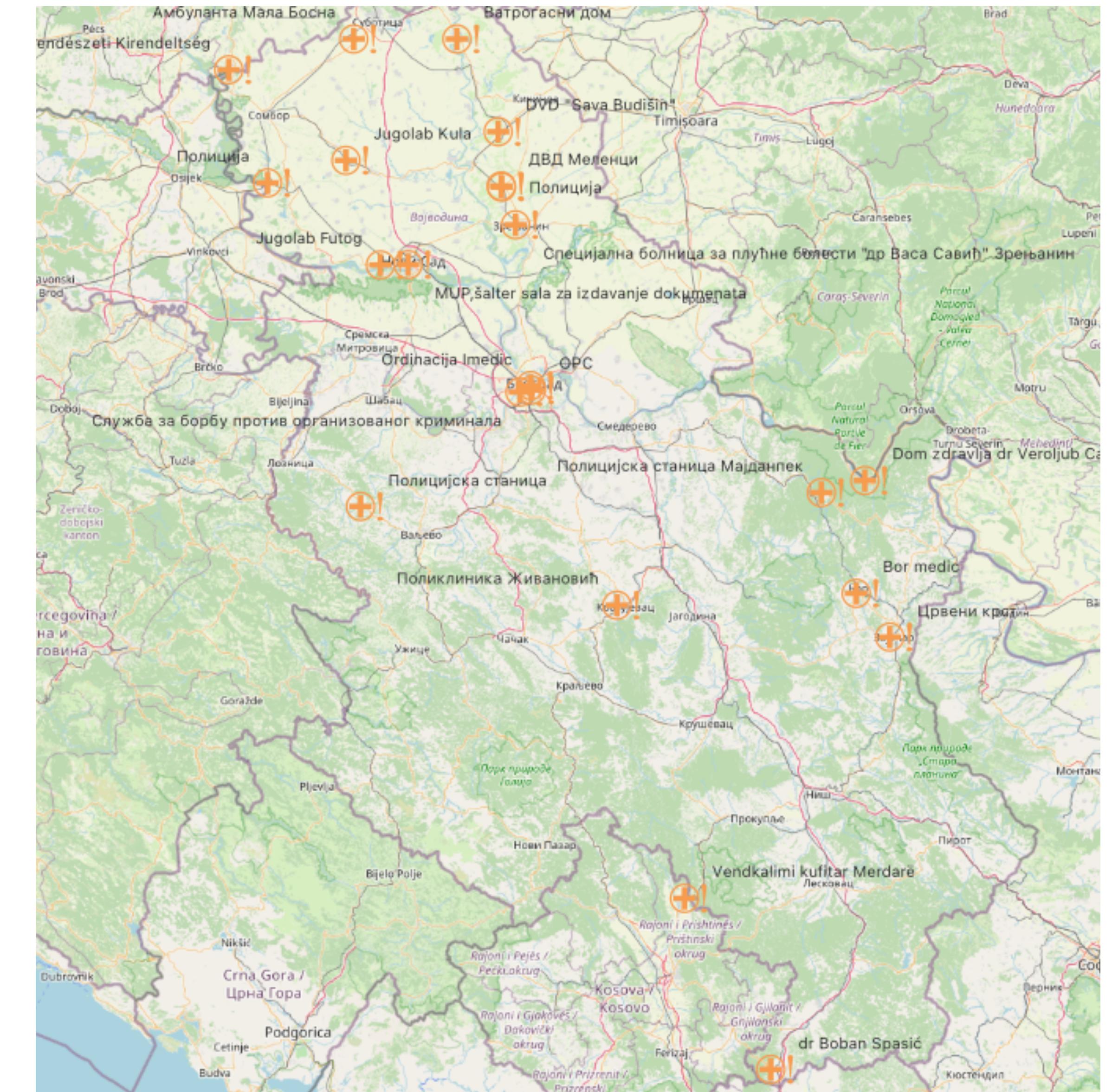
1m, 46.834s

QUERY PLAN	
1	Sort (cost=727845664.94..727845728.29 rows=25339 width=296)
2	Sort Key: (((sum(st_length(l.way)) / st_area(c.way)) * '100'::double precision)) DESC
3	-> Finalize GroupAggregate (cost=727825750.24..727840346.51 rows=25339 width=296)
4	Group Key: c.name, c.way
5	-> Gather Merge (cost=727825750.24..727836418.97 rows=50678 width=296)
6	Workers Planned: 2
7	-> Partial GroupAggregate (cost=727824750.22..727829569.44 rows=25339 width=296)
8	Group Key: c.name, c.way
9	-> Sort (cost=727824750.22..727824834.77 rows=33821 width=850)
10	Sort Key: c.name, c.way
11	-> Nested Loop (cost=288.80..727809486.93 rows=33821 width=850)
12	Join Filter: st_within(l.way, c.way)
13	-> Parallel Seq Scan on planet_osm_line l (cost=0.00..37828.10 rows=1073 width=562)
14	Filter: (highway = 'cycleway'::text)
15	-> Bitmap Heap Scan on planet_osm_polygon c (cost=288.80..44530.38 rows=25339 width=288)
16	Recheck Cond: (name IS NOT NULL)
17	-> Bitmap Index Scan on idx_osm_polygon_name (cost=0.00..282.47 rows=25339 width=0)
18	Index Cond: (name IS NOT NULL)

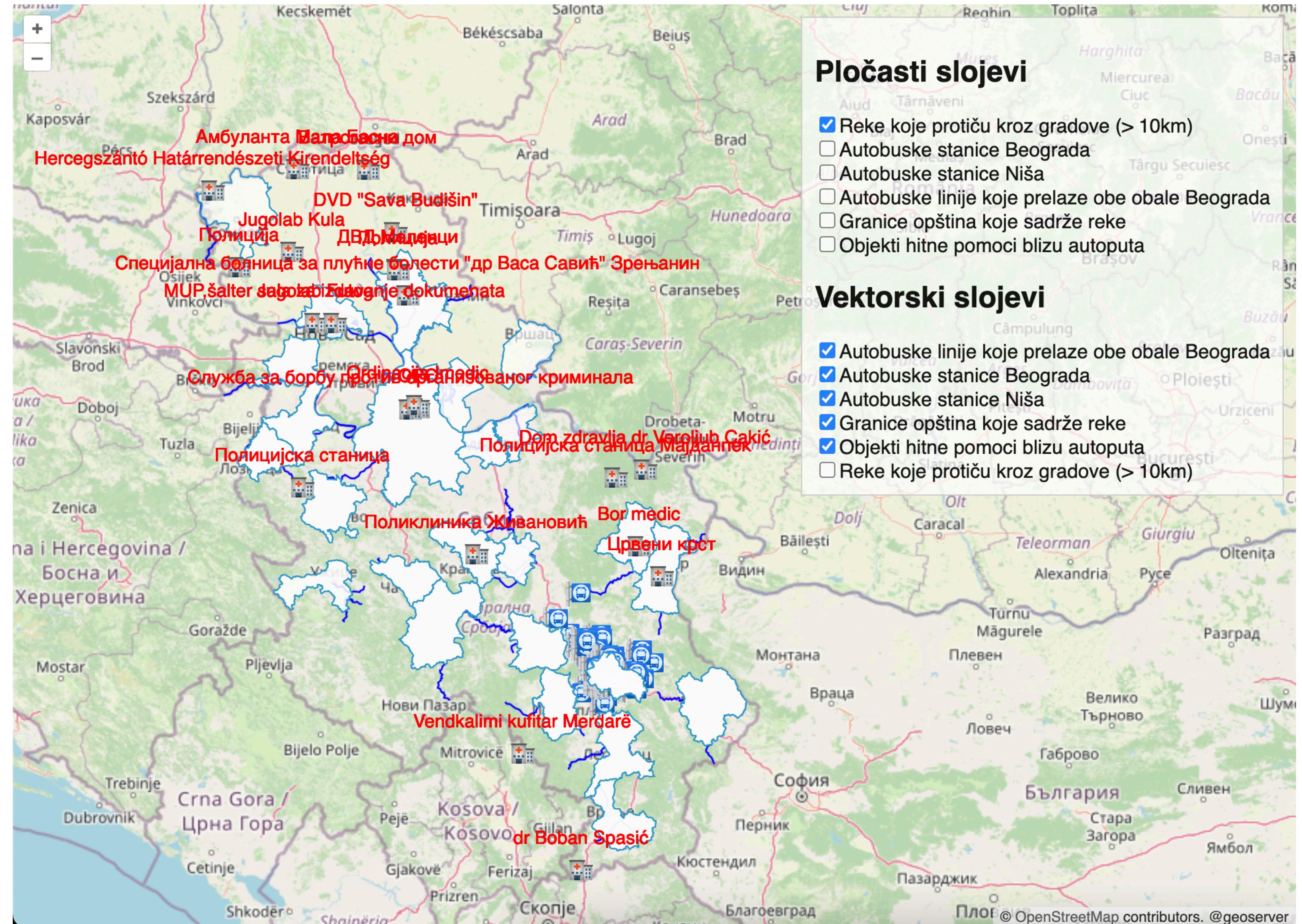
Objekti za hitne slučajeve u blizini autoputa (200m)

```
SELECT DISTINCT e.* FROM planet_osm_point e
JOIN planet_osm_line l ON ST_DWithin(e.way, l.way, 200)
WHERE e.amenity IN ('hospital', 'fire_station', 'police')
AND e.name IS NOT NULL
AND l.highway IN ('motorway', 'trunk', 'primary')
```

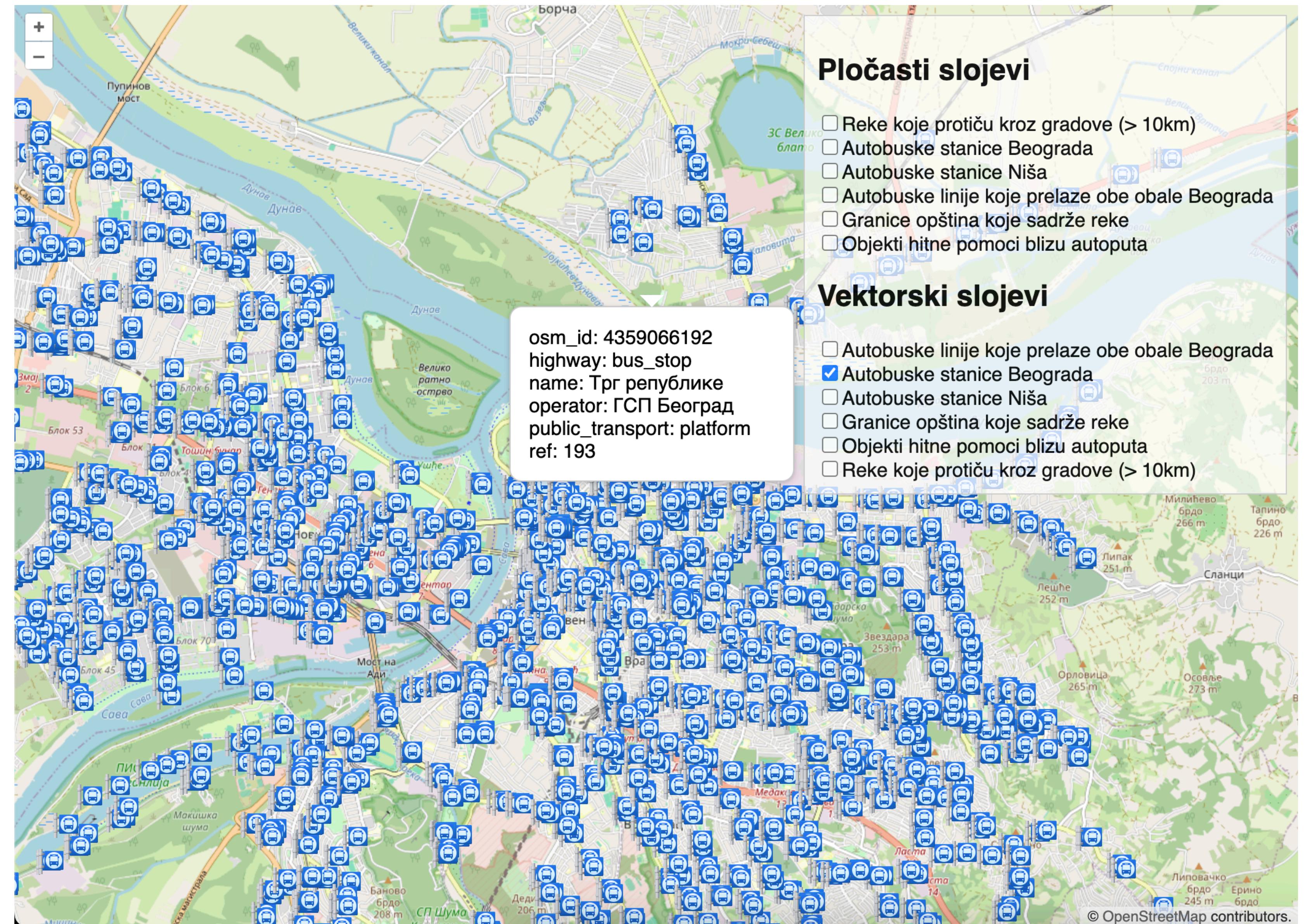
	Sa indeksom	Bez indeksa
Vreme izvršenja [ms]	97	806



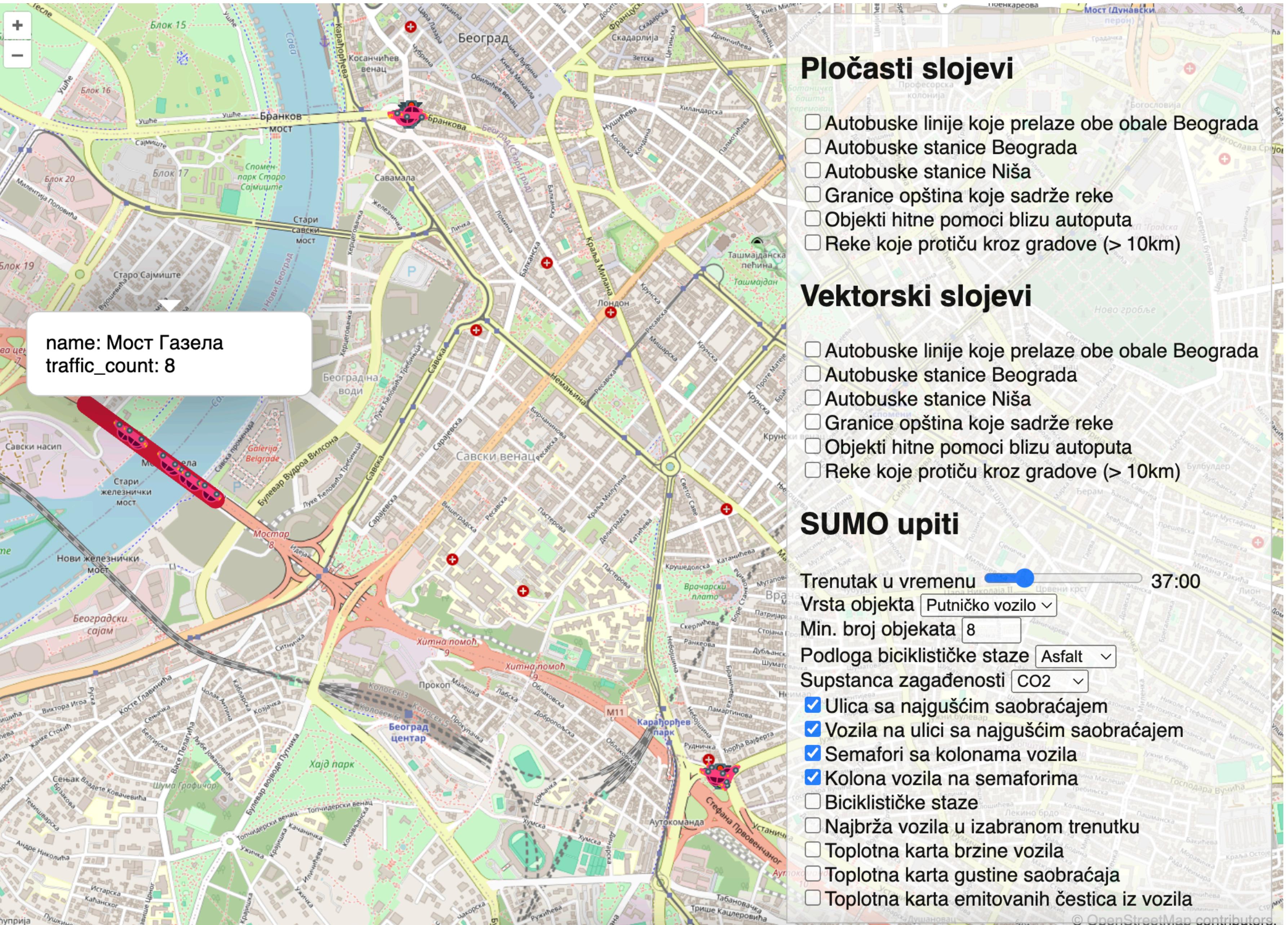
OpenLayers



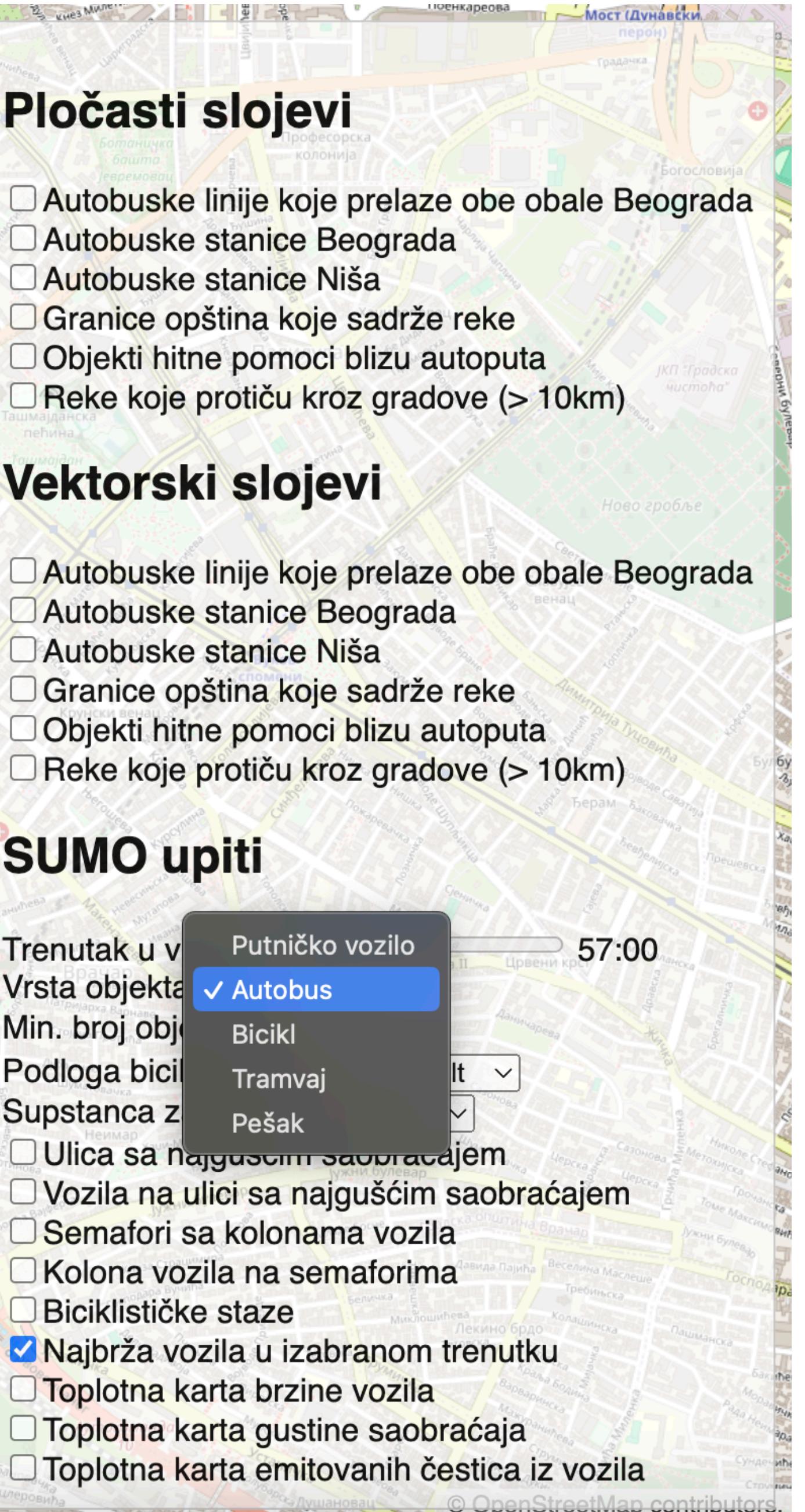
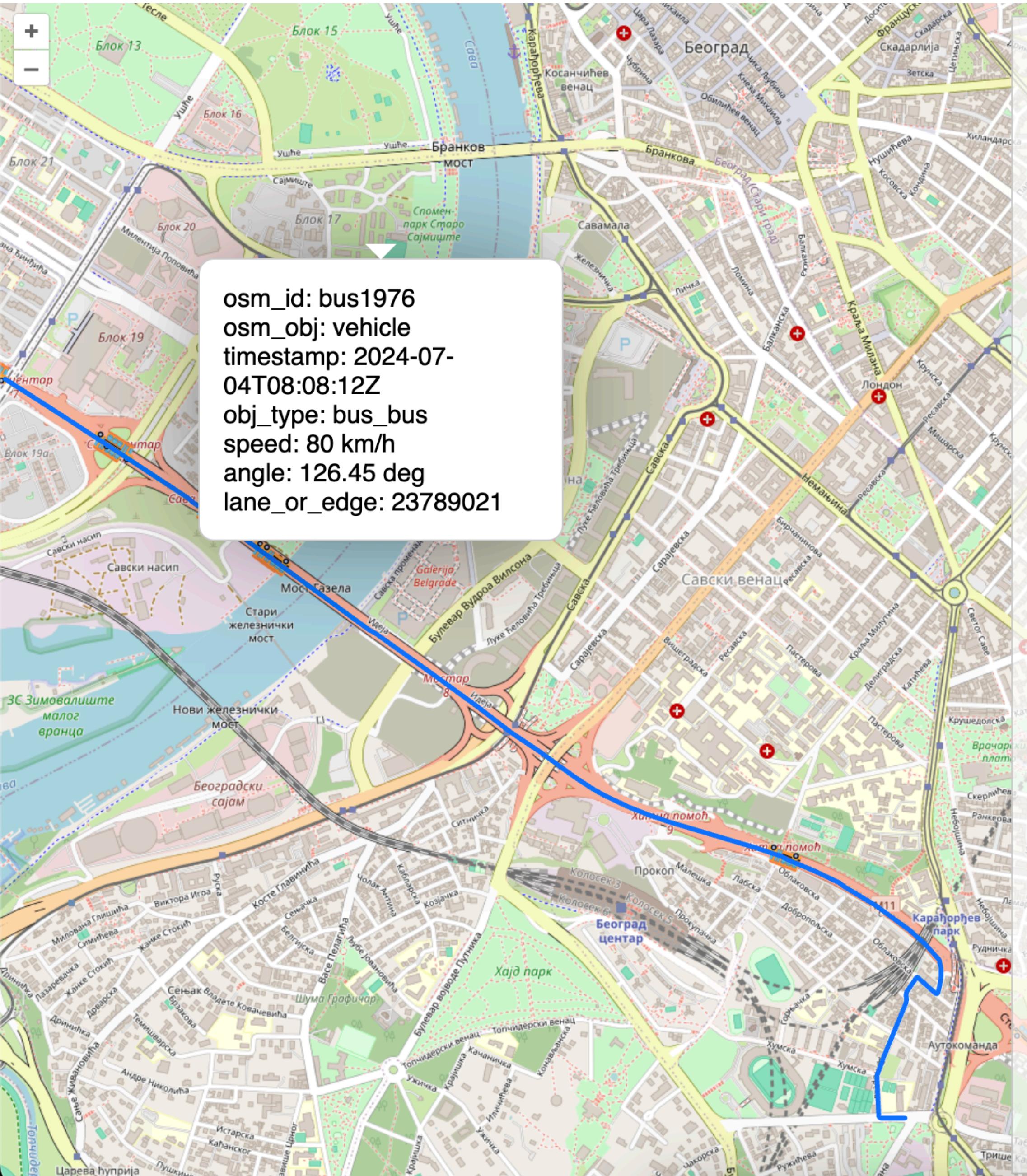
Overlay

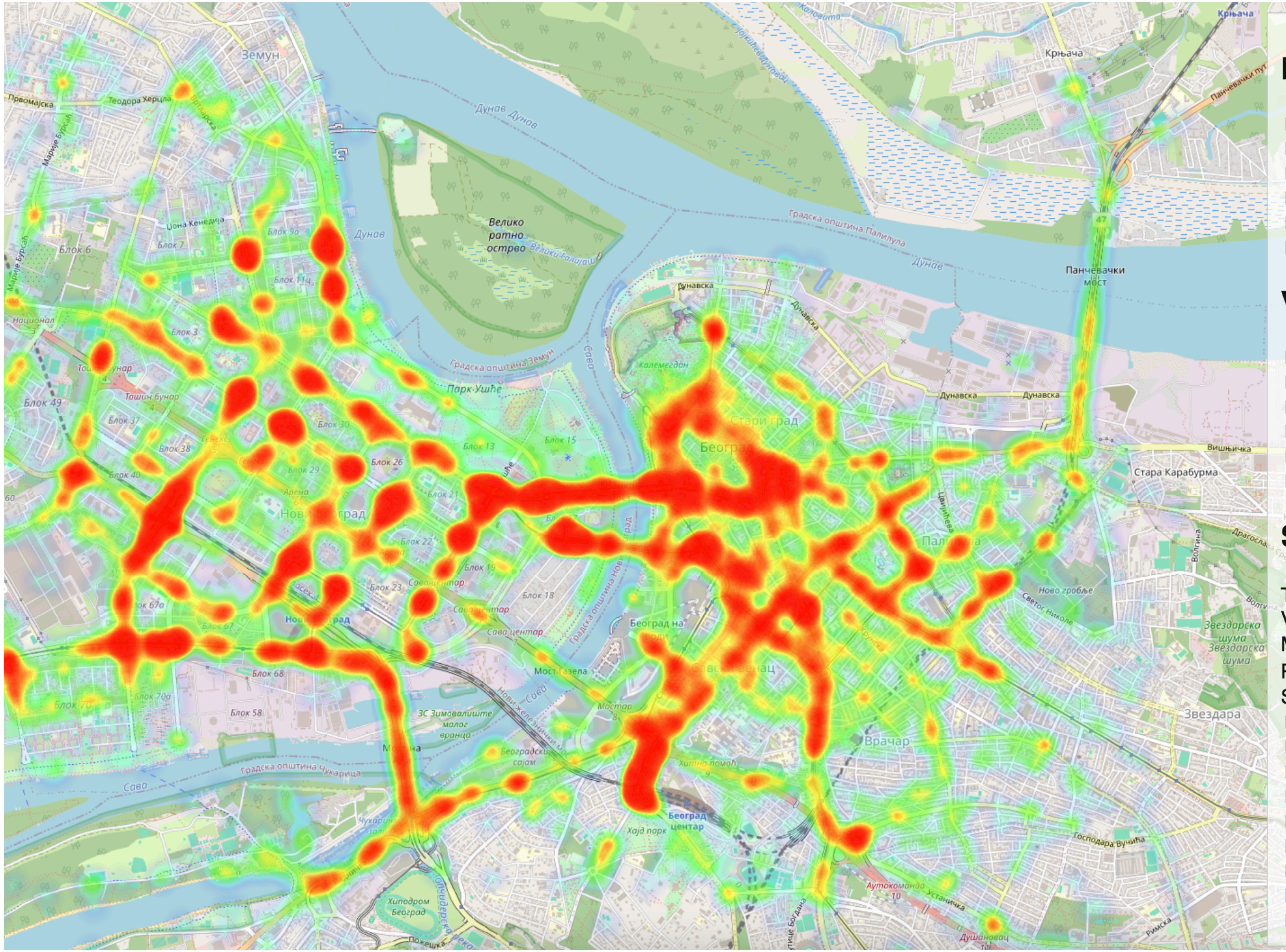


SUMO



SUMO





Pločasti slojevi

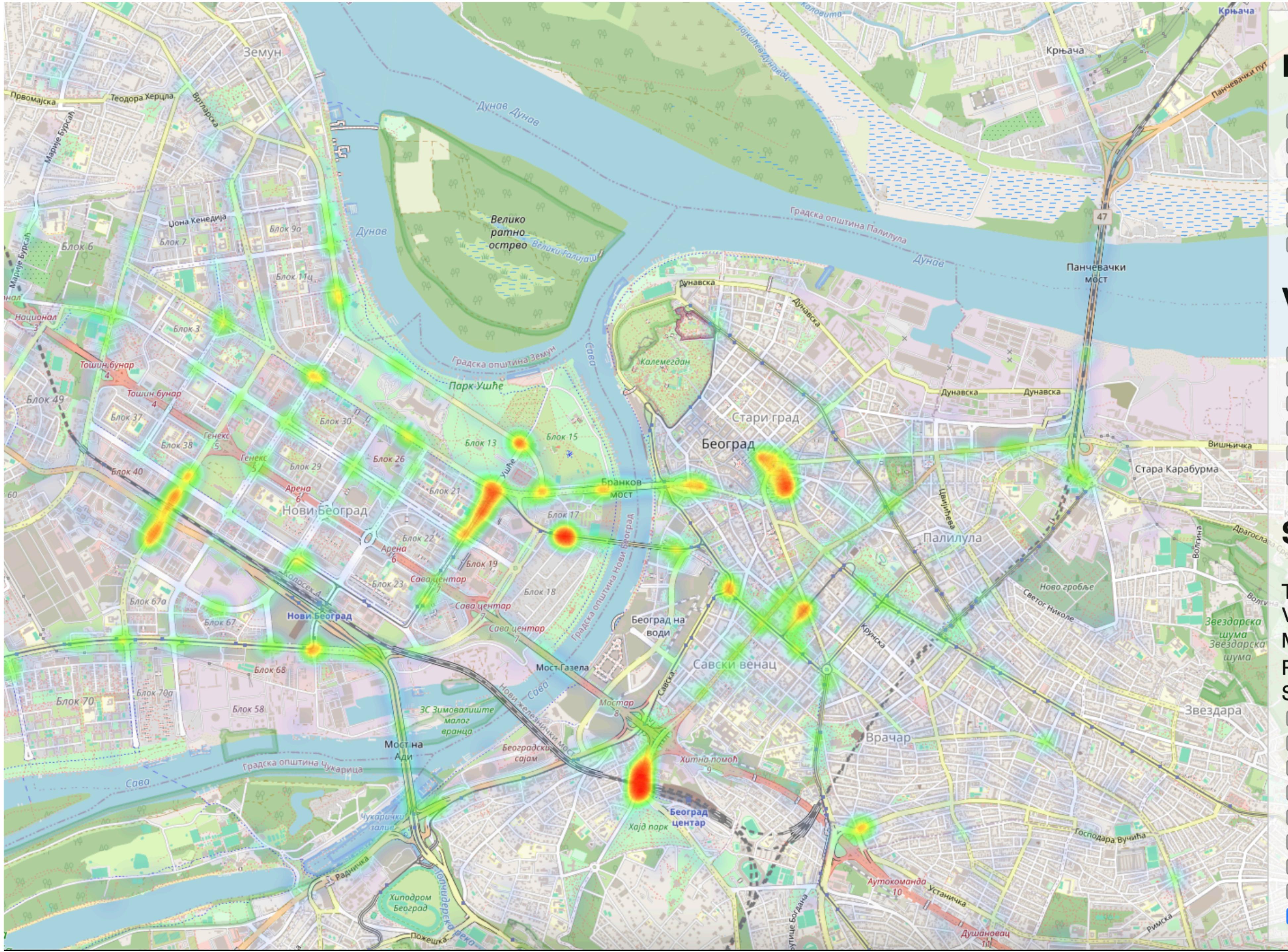
- Autobuske linije koje prelaze obe obale Beograda
- Autobuske stanice Beograda
- Autobuske stanice Niša
- Granice opština koje sadrže reke
- Objekti hitne pomoći blizu autoputa
- Reke koje protiču kroz gradove (> 10km)

Vektorski slojevi

- Autobuske linije koje prelaze obe obale Beograda
- Autobuske stanice Beograda
- Autobuske stanice Niša
- Granice opština koje sadrže reke
- Objekti hitne pomoći blizu autoputa
- Reke koje protiču kroz gradove (> 10km)

SUMO upiti

- Trenutak u vremenu
- Vrsta objekta Autobus
- Min. broj objekata 8
- Podloga biciklističke staze Asfalt
- Supstanca zagađenosti CO₂
- Ulica sa najgušćim saobraćajem
 - Vozila na ulici sa najgušćim saobraćajem
 - Semafori sa kolonama vozila
 - Kolona vozila na semaforima
 - Biciklističke staze
 - Najbrža vozila u izabranom trenutku
 - Toplotna karta brzine vozila
 - Toplotna karta gustine saobraćaja
 - Toplotna karta emitovanih čestica iz vozila



Pločasti slojevi

- Autobuske linije koje prelaze obe obale Beograda
- Autobuske stanice Beograda
- Autobuske stanice Niša
- Granice opština koje sadrže reke
- Objekti hitne pomoći blizu autoputa
- Reke koje protiču kroz gradove (> 10km)

Vektorski slojevi

- Autobuske linije koje prelaze obe obale Beograda
- Autobuske stanice Beograda
- Autobuske stanice Niša
- Granice opština koje sadrže reke
- Objekti hitne pomoći blizu autoputa
- Reke koje protiču kroz gradove (> 10km)

SUMO upiti

- Trenutak u vremenu 34:00
- Vrsta objekta Autobus
- Min. broj objekata 8
- Podloga biciklističke staze
- Supstanca zagađenosti
- Benzin
- Buka
- Ulica sa najgušćim saobraćajem
 - Vozila na ulici sa najgušćim saobraćajem
 - Semafori sa kolonama vozila
 - Kolona vozila na semaforima
 - Biciklističke staze
 - Najbrža vozila u izabranom trenutku
 - Toplotna karta brzine vozila
 - Toplotna karta gustine saobraćaja
 - Toplotna karta emitovanih čestica iz vozila