

A national freight micro-simulation using open software

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Purpose and Need

FAF regions are too big for modeling

We're tired of doing state-by-state disaggregation

Existing methods won't simulate/DTA

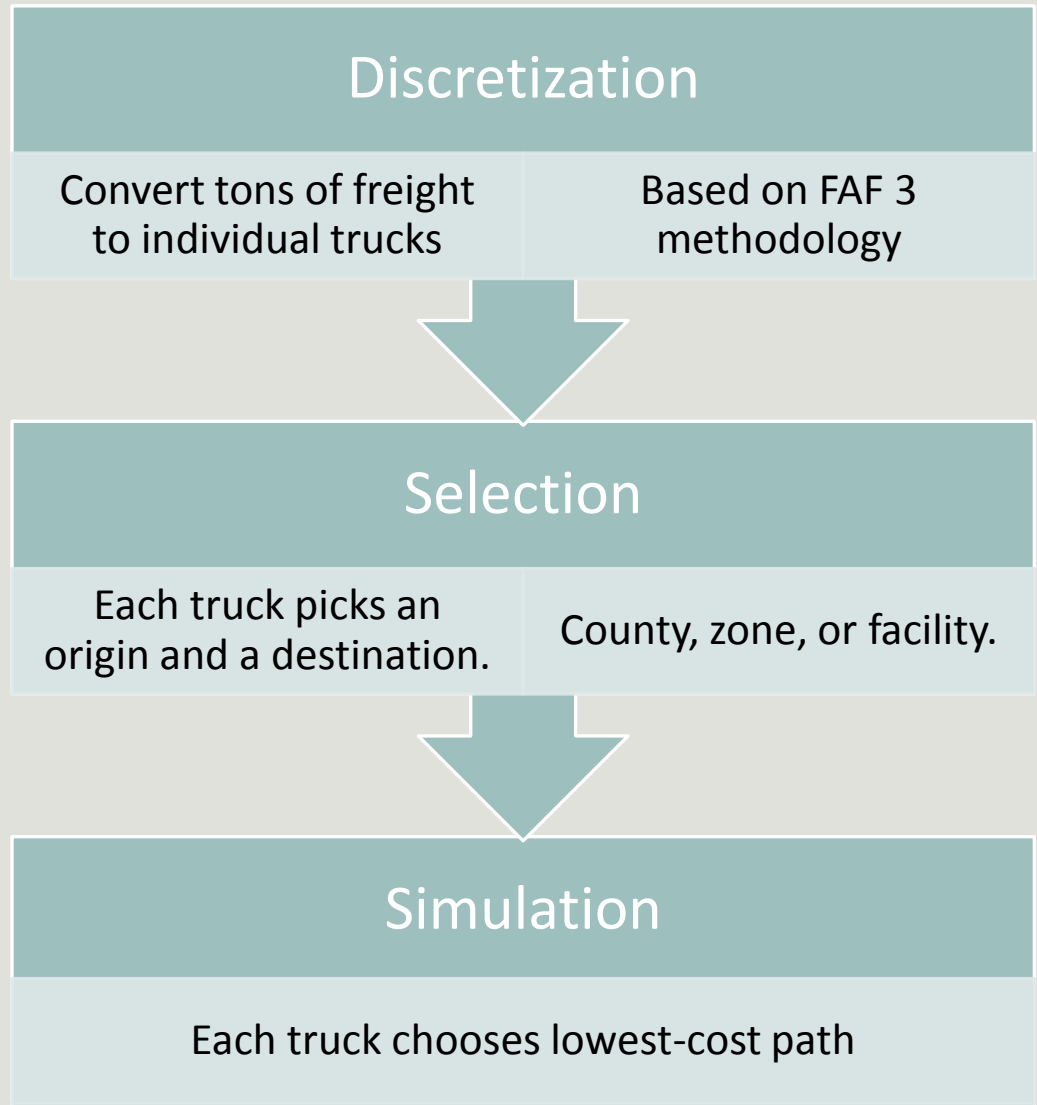
Design guidelines

Simplicity

Simulation-ready

Uniform

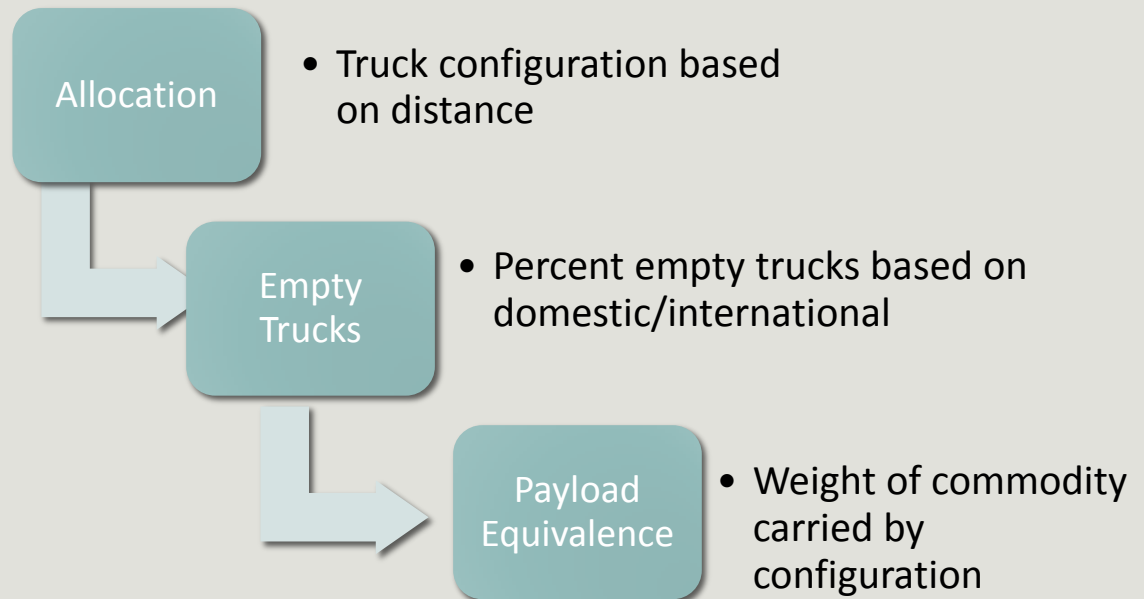
Transparent



Discretization

Convert commodity flows into a discrete number of trucks by class.

Based on ORNL traffic analysis methodology.



Discretization

dms_orig	dms_dest	tons	value	sctg	distance
11	373	5.9012	10.02	7	(200,500]
11	373	0.0003	0.0277	8	(200,500]
11	373	4.1358	0.6048	12	(200,500]
11	373	1.1085	1.8593	20	(200,500]
11	373	0.1266	0.00005	21	(200,500]

dms_orig	dms_dest	sctg	trucks	type
11	373	7	175	CS
11	373	7	17	DBL
11	373	7	55	SU
11	373	7	34	TT
11	373	7	28	CS:empty
11	373	7	3	DBL:empty
11	373	7	5	SU:empty
11	373	7	1	TT:empty

sctg	distance	config	allocation	empty	equivalence
1	[0,50]	SU	0.793201	0	0.00419
2	[0,50]	SU	0.793201	0	0.00032
3	[0,50]	SU	0.793201	0	0.00996
4	[0,50]	SU	0.793201	0	0.00334
5	[0,50]	SU	0.793201	0	0.03835
6	[0,50]	SU	0.793201	0	0.15767
7	[0,50]	SU	0.793201	0	0.02096

Selection

Each truck picks an origin and destination point based on a “size” term.

Production

Attraction

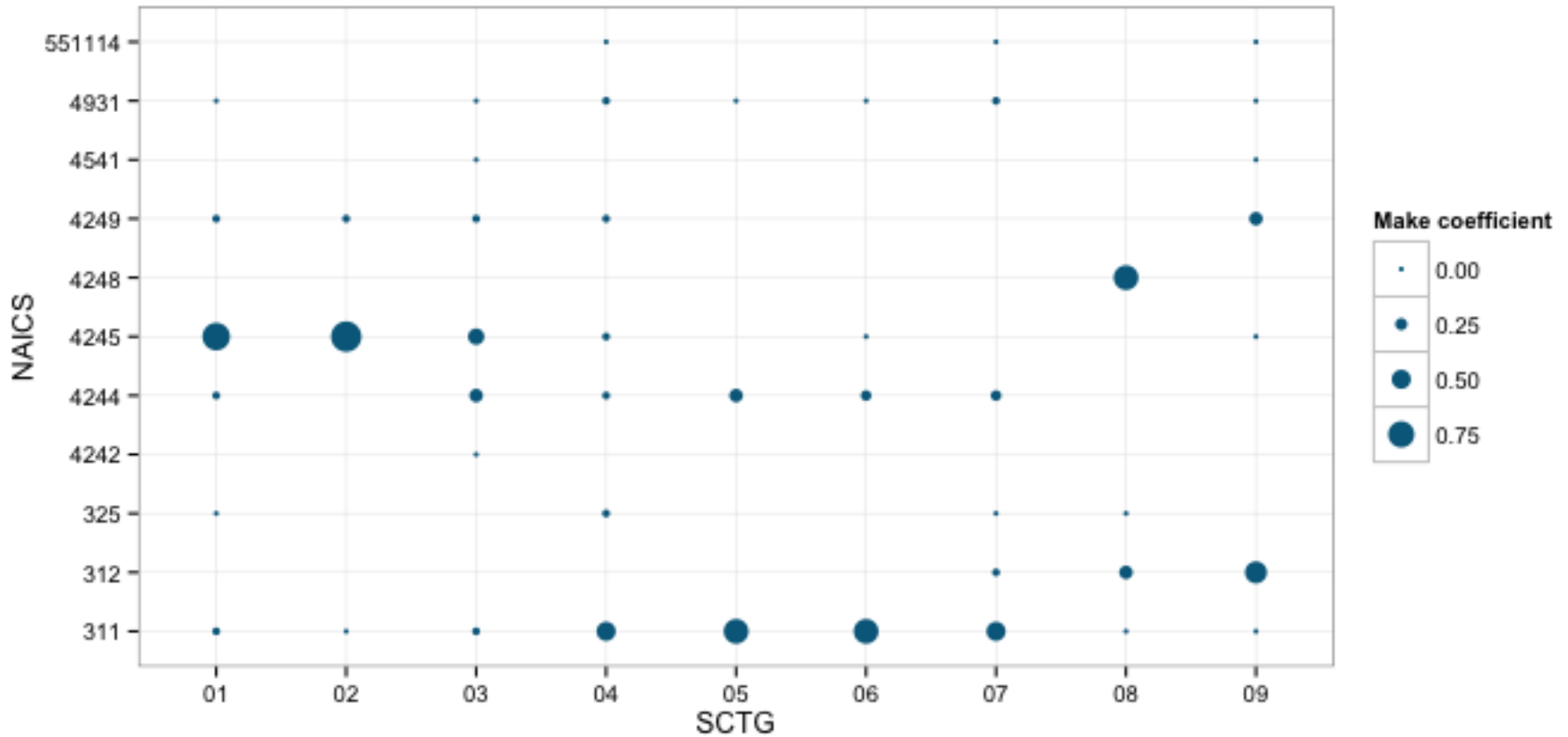
Import/Export

Extensible

```
28 def pick_county(dict_table, sctg, zone):
29     """
30     :param sctg: the commodity code for the truck's car
31     :param dict_table: the appropriate lookup table
32     :return: the O or D county FIPS code
33     """
34     # get the relevant county lookup table
35     try:
36         a = dict_table[zone][sctg]
37     except KeyError:
38         print "Key not found for zone ", zone, " and co
39         sys.exit()
40     else:
41         county = np.random.choice(
42             dict_table[zone][sctg].keys(),
43             p=dict_table[zone][sctg].values())
44         return county
45
```

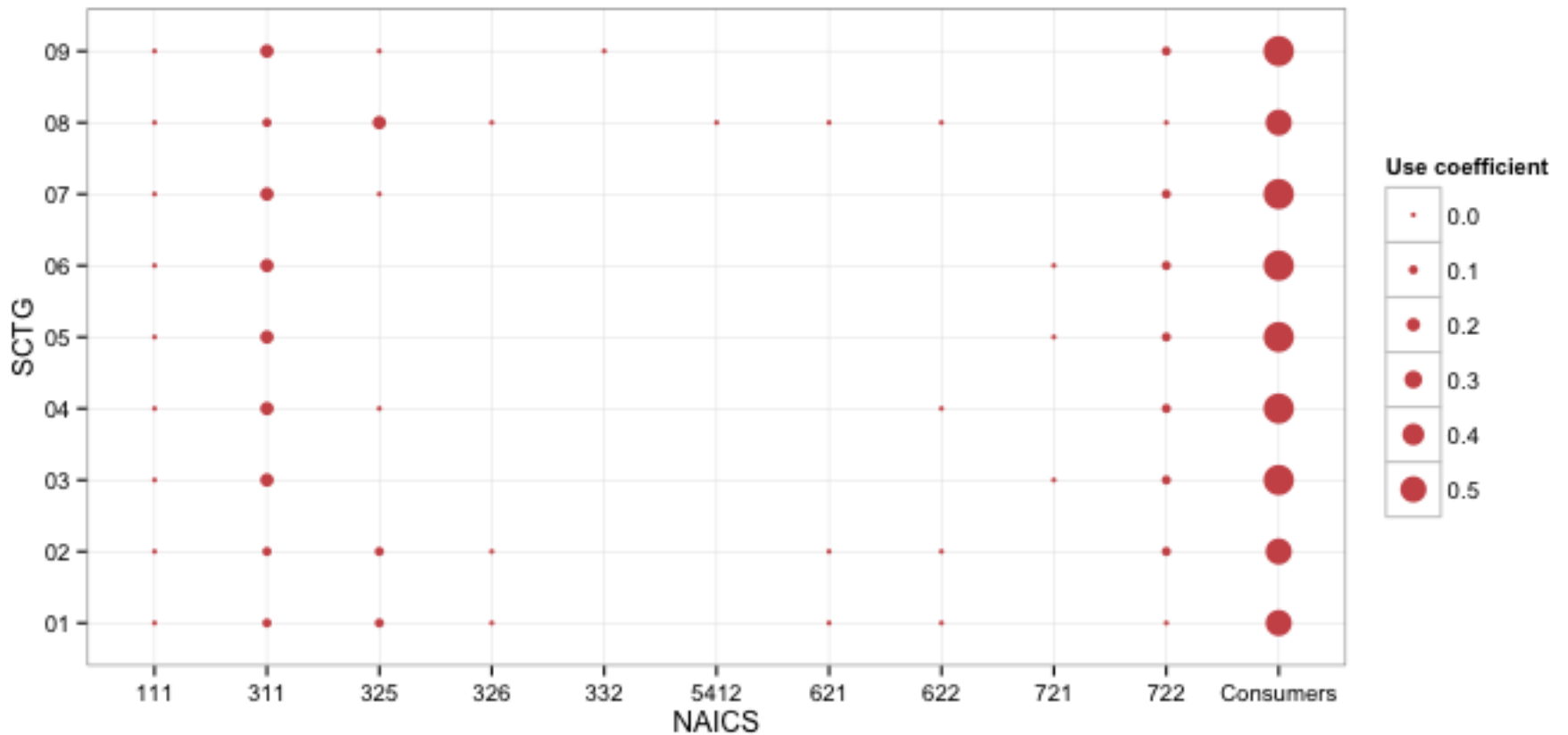
Production

F4Z	sctg	name	prob
11	7	01007	3.21E-04
11	7	01009	8.58E-02
11	7	01021	1.60E-02
11	7	01037	1.57E-06
11	7	01043	9.77E-02



Attraction

F4Z	sctg	name	prob
	373	7	37037 0.01715618
	373	7	37063 0.22334519
	373	7	37069 0.01250535
	373	7	37077 0.01707099
	373	7	37085 0.02545825



Import/Export

Ports and border crossings from US DOT National Transport Atlas Database.

Size terms from NTAD, drawn from

- Army Corps of Engineers (marine)
- Federal Aviation Administration (air)
- Customs and Border Patrol (highway)

F4Z	mode	code	prob	name
379	3	C0766	0.74732753	Port of Wilmington
379	3	C0764	0.25267247	Morehead City
379	4	NKT	0.08253038	Cherry Point MCAS
379	4	POB	0.91746962	Pope Army Airfield

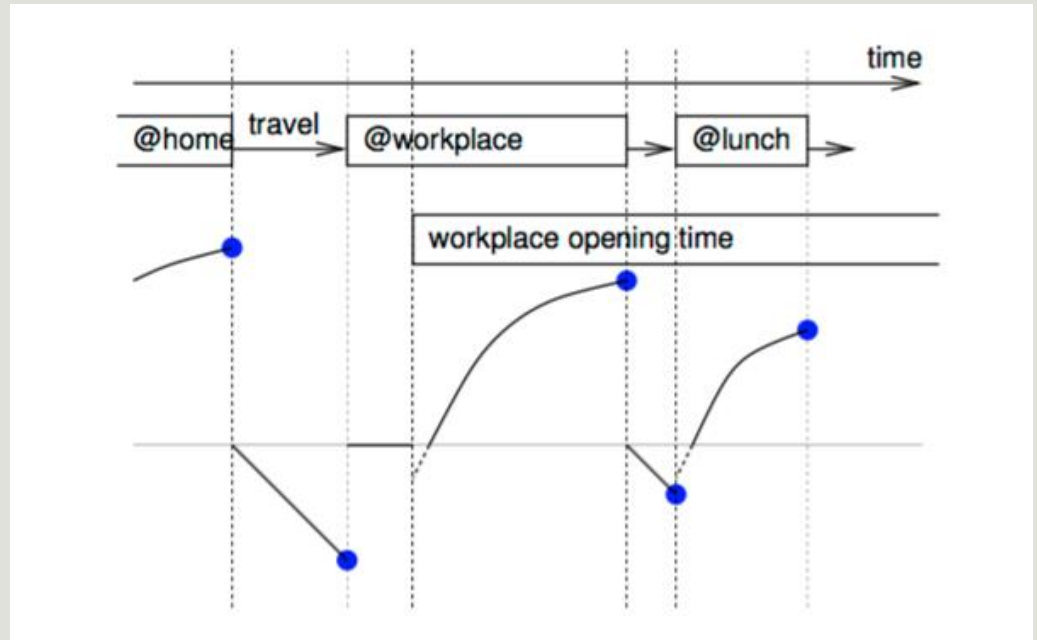
Result

```
<population>
  <person id="0">
    <plan selected="yes">
      <act end_time="314727" type="dummy" x="1328422.24819" y="-1357137.39895"/>
      <leg mode="car"/>
      <act type="dummy" x="1820667.68392" y="-1190011.42788"/>
    </plan>
  </person>
  <person id="1">
    <plan selected="yes">
      <act end_time="470690" type="dummy" x="1307337.67208" y="-1005124.14852"/>
      <leg mode="car"/>
      <act type="dummy" x="1820667.68392" y="-1190011.42788"/>
    </plan>
  </person>
```

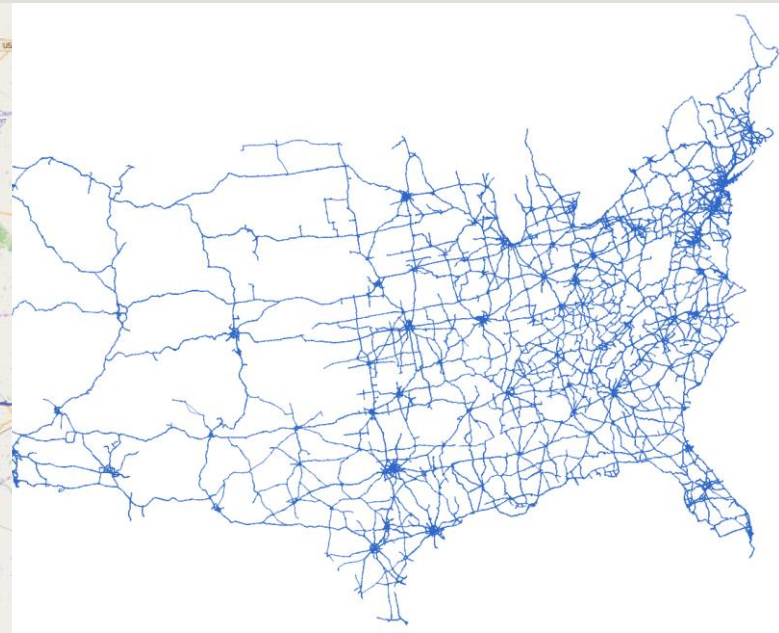
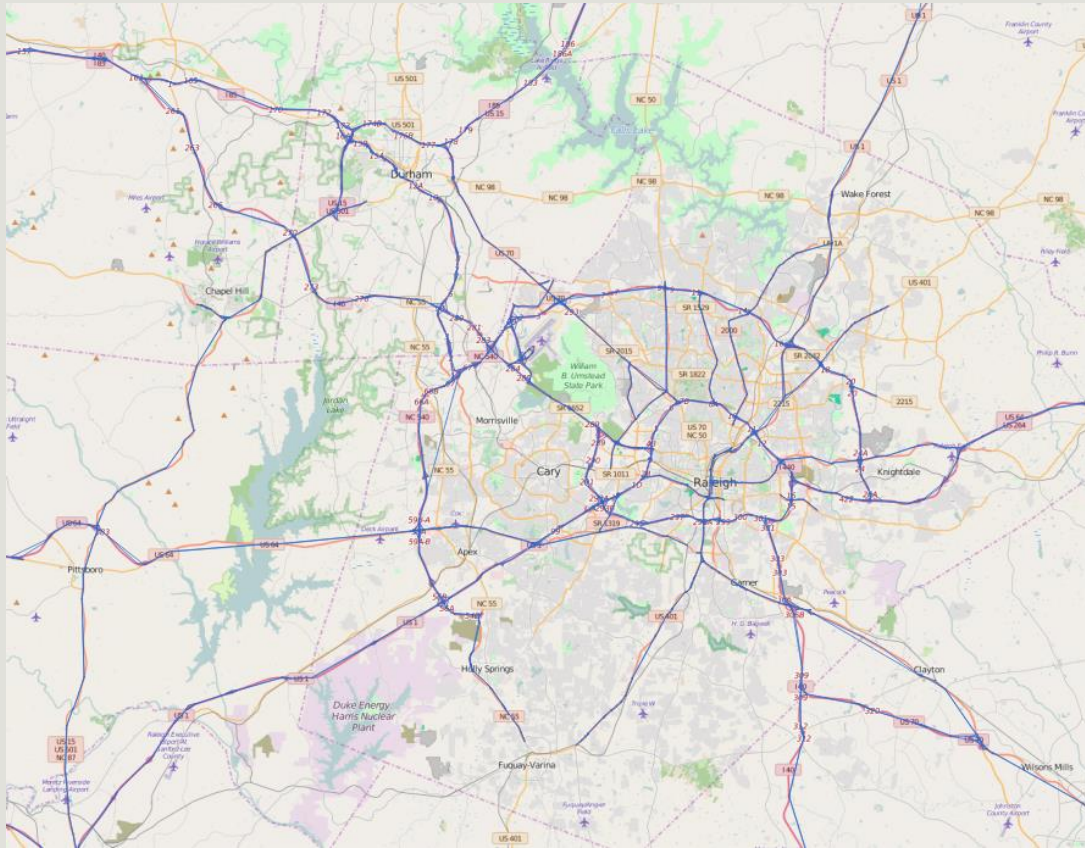
Simulation

Use MATSim, a discrete event simulation engine for transport networks.

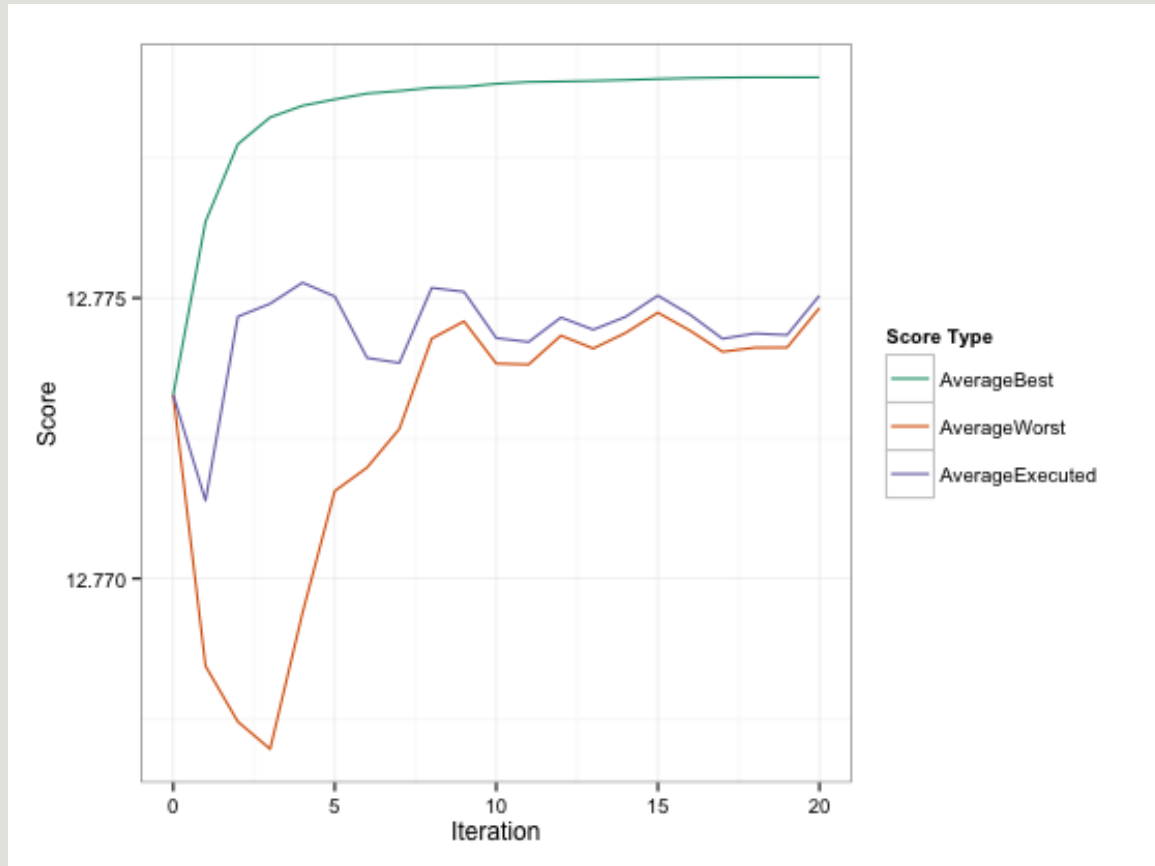
Evolutionary algorithm helps each agent find its lowest-cost solution iteratively.



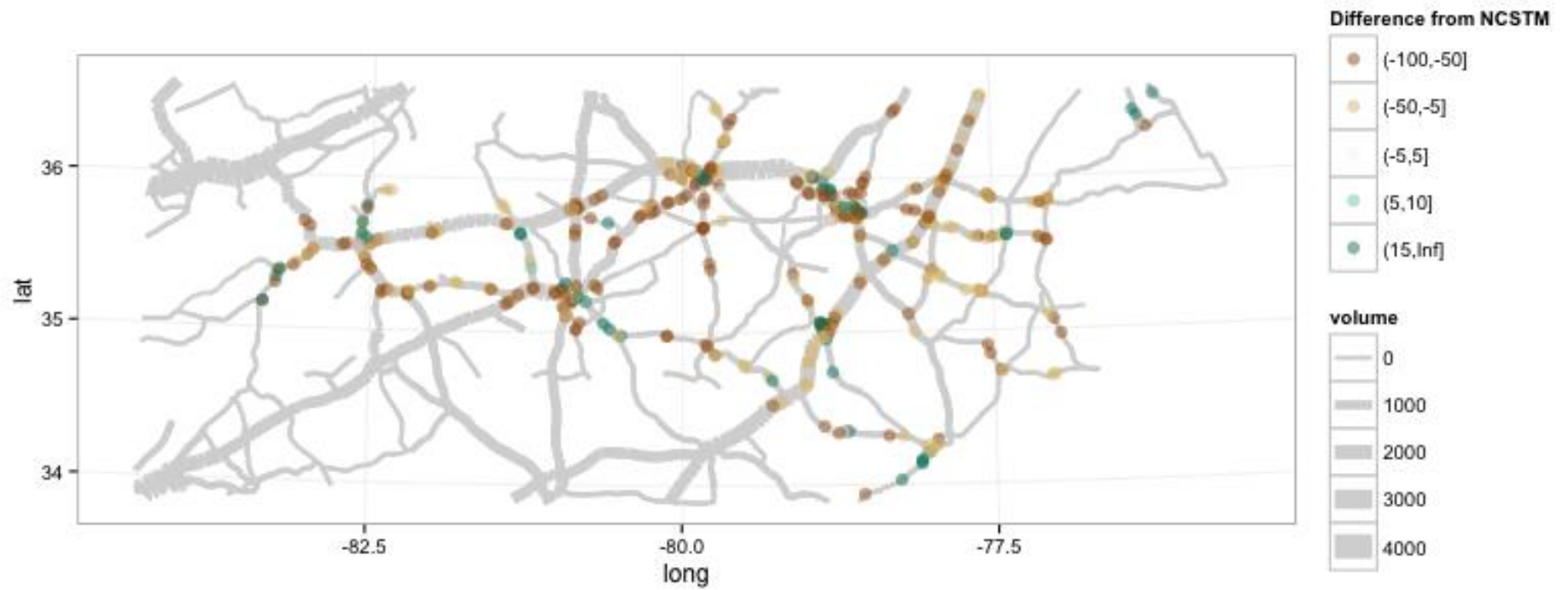
Network (OpenStreetMap)



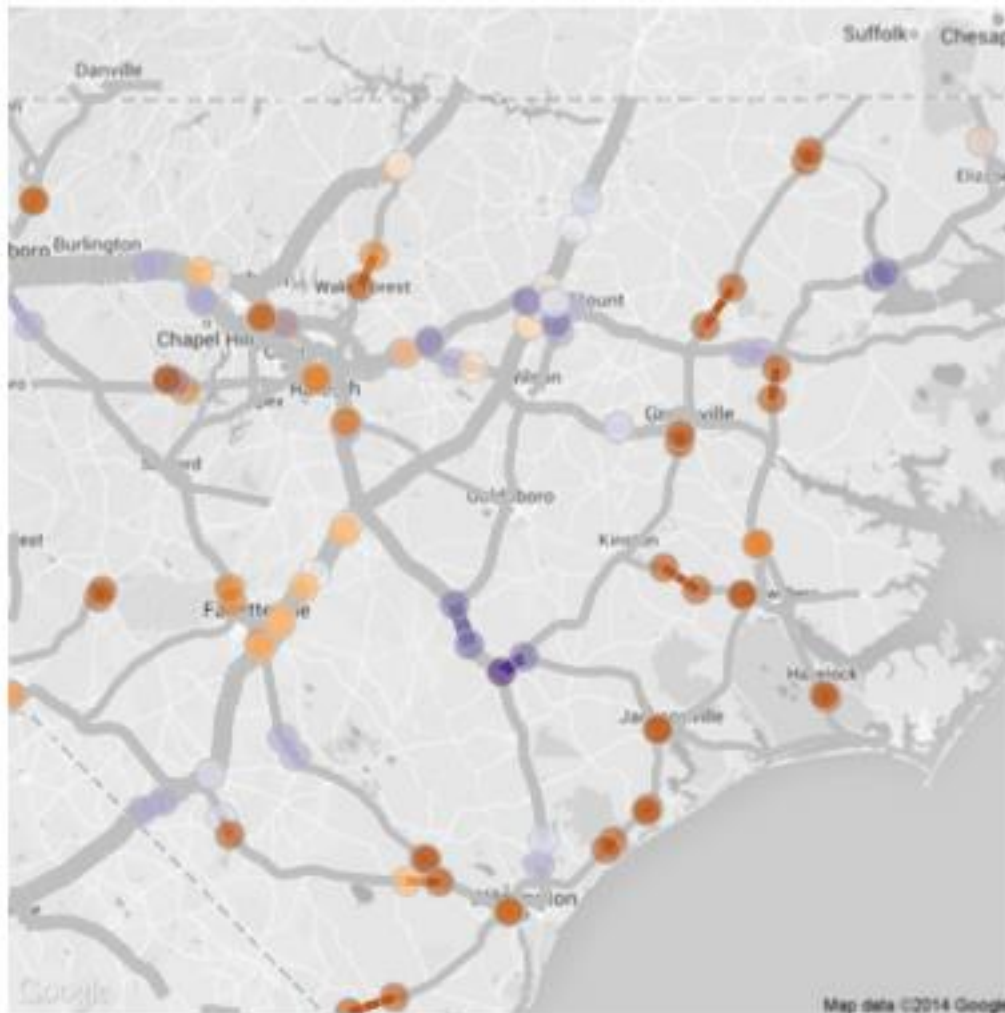
Simulation Results



Senozon Via



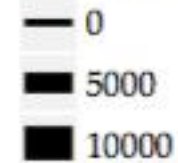
Comparison with NCSTM long distance flows



Percent Error



Simulated Truck Volume



FAF 3 simulation vs counts

Open

Macfarlane, G. and
Donnelly, R. (2015). A
national simulation of
freight truck flows.

<https://github.com/gregmacfarlane/trucksim-disagg>

<https://github.com/gregmacfarlane/trucksim-network>

<https://github.com/gregmacfarlane/trucksim>