Introduction to the Trace Model

Catherine Vanderwaart
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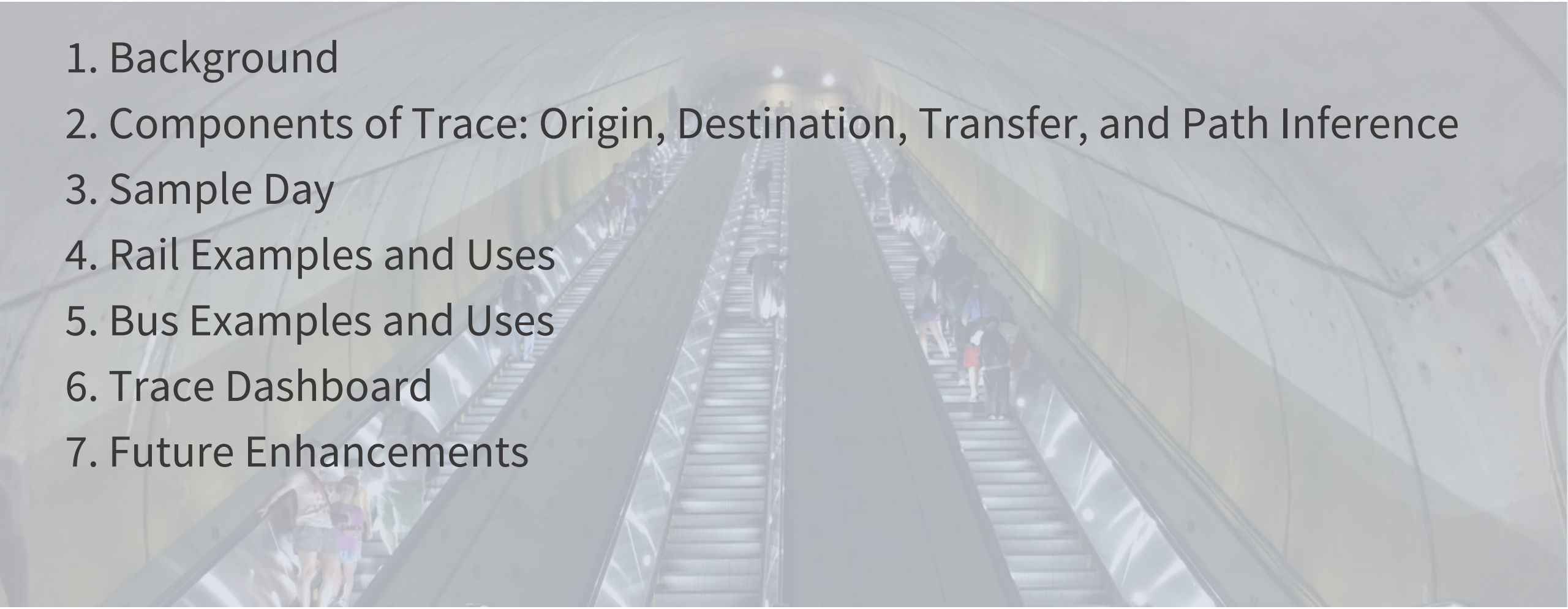
Washington Metropolitan Area Transit Authority

Tour of Trace



1. Background
2. Components of Trace: Origin, Destination, Transfer, and Path Inference
3. Sample Day
4. Rail Examples and Uses
5. Bus Examples and Uses
6. Trace Dashboard
7. Future Enhancements

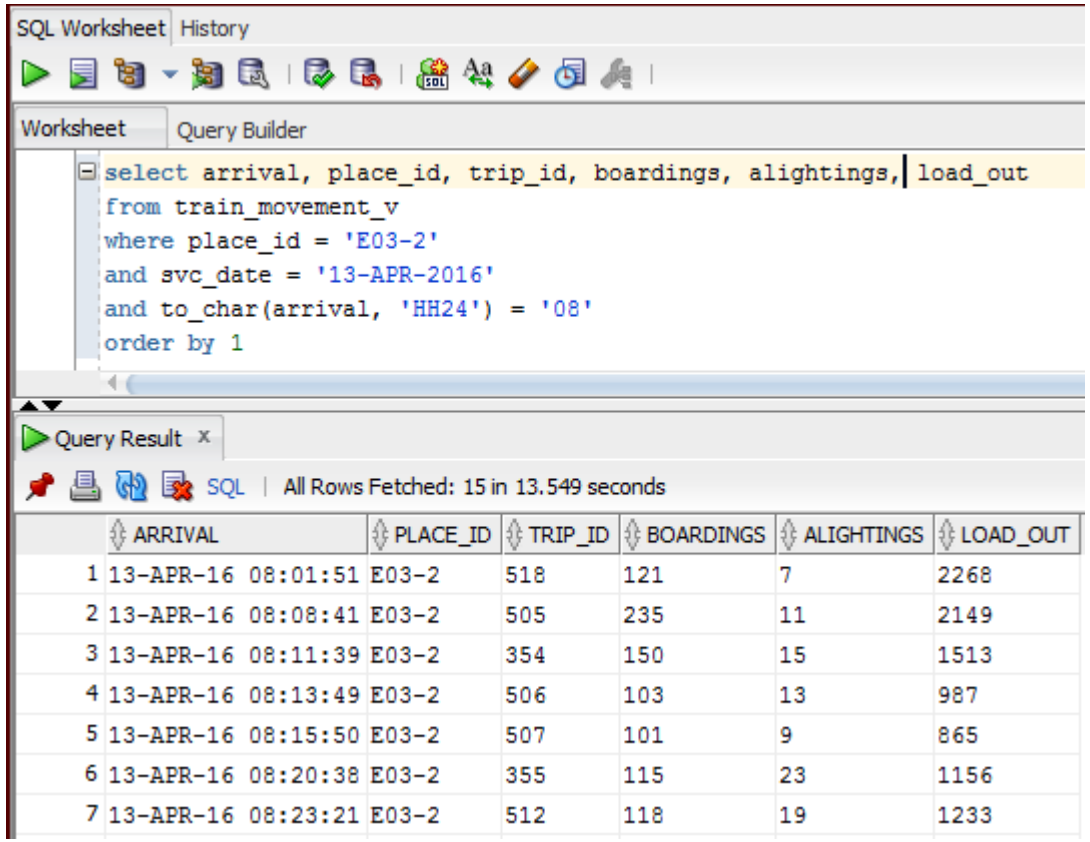
What is the Trace Model?

Why Are We Here? What We Don't Know:

Existing data sources don't give us a deep, robust understanding of how our passengers move through the system, and the conditions they experience.

Introducing the Trace Model

We now have very detailed data on passenger movements for bus and rail



	ARRIVAL	PLACE_ID	TRIP_ID	BOARDINGS	ALIGHTINGS	LOAD_OUT
1	13-APR-16 08:01:51	E03-2	518	121	7	2268
2	13-APR-16 08:08:41	E03-2	505	235	11	2149
3	13-APR-16 08:11:39	E03-2	354	150	15	1513
4	13-APR-16 08:13:49	E03-2	506	103	13	987
5	13-APR-16 08:15:50	E03-2	507	101	9	865
6	13-APR-16 08:20:38	E03-2	355	115	23	1156
7	13-APR-16 08:23:21	E03-2	512	118	19	1233

- Data service with nightly updates
  - Vendor is Korbato
- We can query via SQL statements

The Trace Model

- Origin Inference
  - Generally, the origin is known for rail trips
  - For bus trips, match the fare transaction to the vehicle location data to find the stop
- Destination Inference
  - Generally known for rail trips
  - For bus, use the next tap on the SmarTrip card to identify the likely alighting location, subject to constraints
- Transfer Inference
  - Use spatial, temporal, and logical conditions to identify when two trips are linked
- Path Inference
  - For rail trips, identify all possible trains and paths the person could have taken given the tap in and tap out time and location
  - Determine probability of each train/path based on the walk and transfer times each would have required
  - Enables probabilistic calculation of train loads and platform occupancy

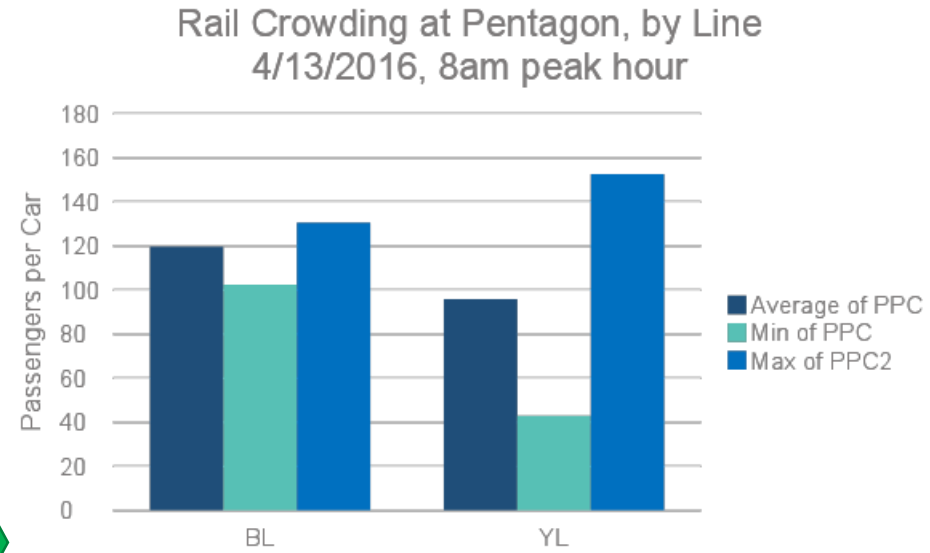
Uses for Trace Data

Rail Use Example: Link Loads

Trace Model Data:

	place_id	arrival	TTI	train_id	boarding	alightings	load_out	Length	PPC	Color
2	C07-1	4/13/2016 8:01	193	305	214	70	520	6	87	YL
3	C07-1	4/13/2016 8:03	232	359	68	95	258	6	43	YL
4	C07-1	4/13/2016 8:08	159	309	143	219	599	6	100	YL
5	C07-1	4/13/2016 8:10	309	403	381	203	782	6	130	BL
6	C07-1	4/13/2016 8:13	58	306	238	52	660	6	110	YL
7	C07-1	4/13/2016 8:16	286	360	112	86	468	6	78	YL
8	C07-1	4/13/2016 8:20	172	310	247	197	754	6	126	YL
9	C07-1	4/13/2016 8:22	313	404	380	185	671	6	112	BL
10	C07-1	4/13/2016 8:25	161	313	180	64	679	6	113	YL
11	C07-1	4/13/2016 8:27	288	361	90	97	485	6	81	YL
12	C07-1	4/13/2016 8:31	45	302	138	216	560	6	93	YL
13	C07-1	4/13/2016 8:33	370	405	406	178	740	6	123	BL
14	C07-1	4/13/2016 8:38	37	311	293	83	916	6	153	YL
15	C07-1	4/13/2016 8:41	326	351	182	118	531	6	89	YL
16	C07-1	4/13/2016 8:44	270	303	143	175	564	6	94	YL
17	C07-1	4/13/2016 8:47	349	406	492	191	783	6	131	BL
18	C07-1	4/13/2016 8:52	317	312	253	67	691	6	115	YL
19	C07-1	4/13/2016 8:55	283	352	143	90	446	6	74	YL
20	C07-1	4/13/2016 8:57	271	304	86	170	499	6	83	YL
21	C07-1	4/13/2016 8:59	32	407	362	133	614	6	102	BL

PPC Statistics:



Link Volumes:

Row Labels	Trains per Hour	Link Volume: (Sum of load_out)
C07-1	20	12,220
E02-2	16	6,959
F04-1	10	5,118
K01-1	19	11,395

Other Uses for Rail

- **DATA on the Customer Experience**
  - How crowded is a platform at peak times?
  - Vertical circulation - how utilized is an escalator? Are we violating our standards?
  - How many passengers experienced crowding conditions over X?

- **Behind-the-Gates Transfer Volumes:** what is causing platform crowding at a transfer station - entries and exits at that station, or within-station transfers?

- **Route Choice:** Are Yellow Line riders switching back to Blue since July?

- **Train-Level Ridership**

- **Cleaned Train Movement Data:** train runs

- **Platform for Future Research:** trains too full to board, dwell time analysis, linking delays to incidents, predicting crowding in real-time, effects of offloads, denied boardings, etc....

Bus Use Example: O-D Matrix

Route 16A East, 8 - 9 a.m. on April 13, 2016

From	To	Annandale	Rte 236 & Medford	John Marr & Columbia Pk	Columbia Pk & Lincoln	Columbia Pk & Carlin	Columbia Pk & Fmr	Columbia Pk & Geo Mason	Columbia Pk & Walt Reed	Columbia Pk & S Orme	
		Rte 236 & Medford	John Marr & Columbia Pk	Columbia Pk & Lincoln	Columbia Pk & Carlin	Columbia Pk & Fmr	Columbia Pk & Geo Mason	Columbia Pk & Walt Reed	Columbia Pk & S Orme	Pentagon	Total
Annandale	Rte 236 & Medford	1.5	0.0	1.2	5.7	1.1	0.0	8.7	0.0	0.7	**19.0**
Rte 236 & Medford	John Marr & Columbia Pk		0.0	0.0	1.2	0.0	1.1	2.4	0.0	3.0	**7.8**
John Marr & Columbia Pk	Columbia Pk & Lincoln			0.0	3.4	2.2	0.0	0.0	0.0	1.1	**6.7**
Columbia Pk & Lincoln	Columbia Pk & Carlin				3.7	0.0	0.0	2.2	0.0	11.6	**17.5**
Columbia Pk & Carlin	Columbia Pk & Fmr					1.4	0.0	4.0	0.1	6.7	**12.2**
Columbia Pk & Fmr	Columbia Pk & Geo Mason						0.0	0.0	0.0	2.2	**2.2**
Columbia Pk & Geo Mason	Columbia Pk & Walt Reed							0.2	1.2	0.8	**2.2**
Columbia Pk & Walt Reed	Columbia Pk & S Orme								0.0	12.3	**12.3**
Columbia Pk & S Orme	Pentagon									7.8	**7.8**
Total		**1.5**	**0.0**	**1.2**	**14.0**	**4.8**	**1.2**	**17.6**	**1.3**	**46.2**	**87.7**

Bus Use Example: O-D Matrix

Route 70 South, 8 - 9 a.m. on April 13, 2016

	To	Silver Spring	Georgia & Eastern	Georgia & Kennedy	Georgia & Petworth	Georgia & Irving	7th & Florida	7th & H	7th & Penn	
From		Georgia & Eastern	Georgia & Kennedy	Georgia & Petworth	Georgia & Irving	7th & Florida	7th & H	7th & Penn	Archives	Total
Silver Spring	Georgia & Eastern	13.1	8.5	17.6	0.0	1.7	4.9	1.1	0.0	**46.9**
Georgia & Eastern	Georgia & Kennedy		28.2	83.7	6.4	16.4	17.9	3.7	0.0	**156.3**
Georgia & Kennedy	Georgia & Petworth			37.0	3.2	23.0	32.0	12.0	0.0	**107.2**
Georgia & Petworth	Georgia & Irving				2.2	9.1	16.4	3.5	0.0	**31.2**
Georgia & Irving	7th & Florida					8.5	21.3	6.0	0.0	**35.8**
7th & Florida	7th & H						15.0	10.3	3.7	**29.0**
7th & H	7th & Pennsylvania							0.6	0.6	**1.1**
7th & Pennsylvania	Archives								0.0	**0.0**
Total		**13.1**	**36.7**	**138.4**	**11.8**	**58.7**	**107.5**	**37.2**	**4.3**	**407.6**

Other Uses for Metrobus

- **Directional transfer data**: when people transfer between the S2 and the H2, which way are they traveling on each route?

- **Boardings by stop and fare instrument**: where are people using UPass? Which stops do people with disabilities use most? Where do people pay in cash?

- **Transfers on passes**: pass transfers are not included in our current transfer counts

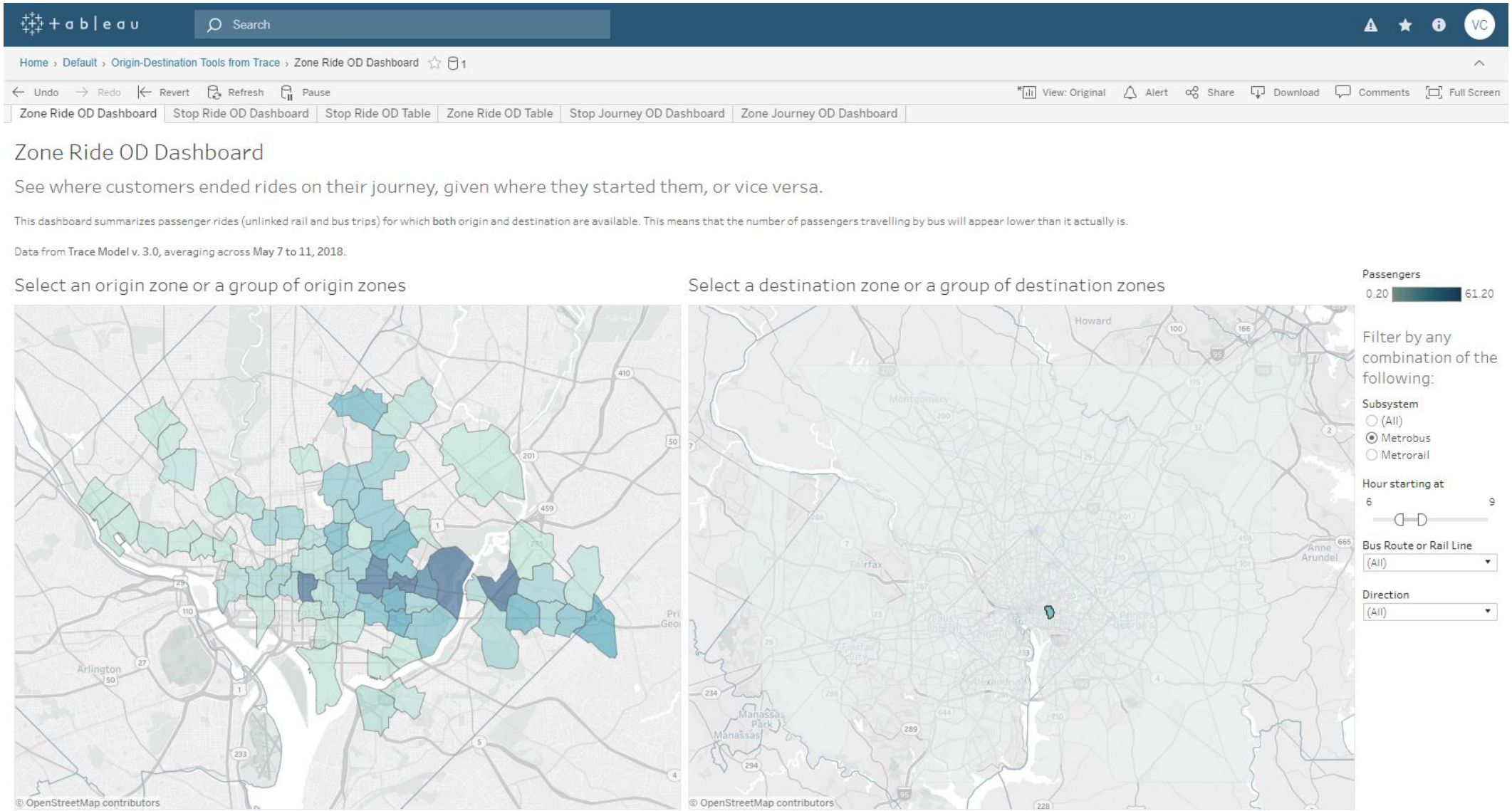
- **Follow people over time**: how do the same passengers use a local and a MetroExtra route over time, and at which stops? Do they ride more or less after a corridor is restructured?

- **Bus OD**: more accurate and granular than existing estimation and survey methods, including data by trip or hour, not just time period

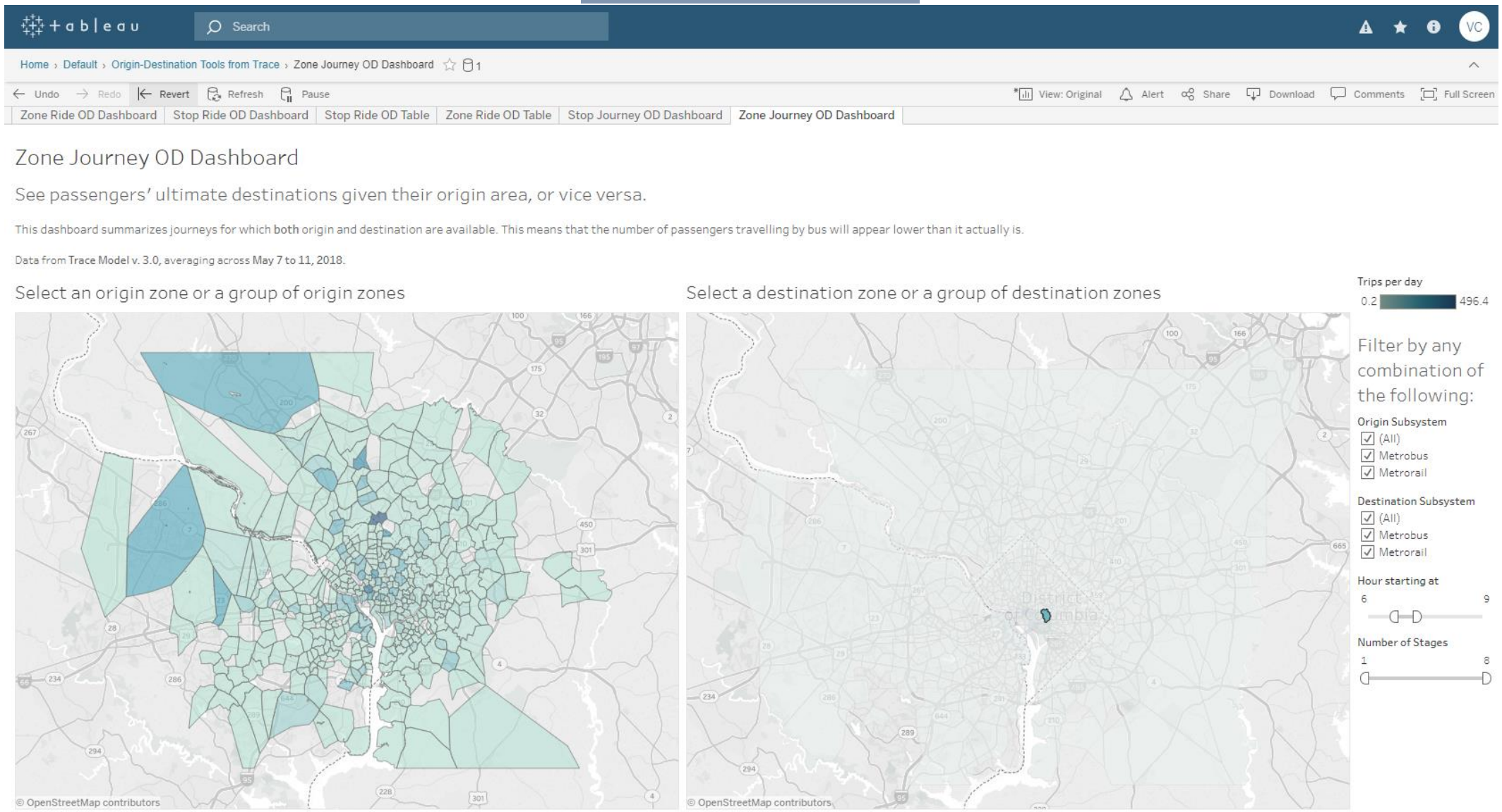
- **Full system OD**: what are the ultimate destinations of people boarding at a specific stop? When people transfer from bus to rail at Fort Totten, are they transferring to Red or Green?

Visualizing Trace Data

Trace Dashboard: Bus Trips to Union Station



Trace Dashboard: All Journeys to Union Station



What’s Next?

What's Next?

- Develop additional tools and visualizations to make the data more accessible
- Start using Trace data
  - Bus service planning
    - Example: If we moved the terminal of a route from one station to another, how would passengers' trips be affected?
  - Rail service planning and monitoring
    - Example: monitor platform crowding during disruptions due to track work
- Eventually, expand to include data from regional partners