Anomalous Traffic Flow and Clustering Method

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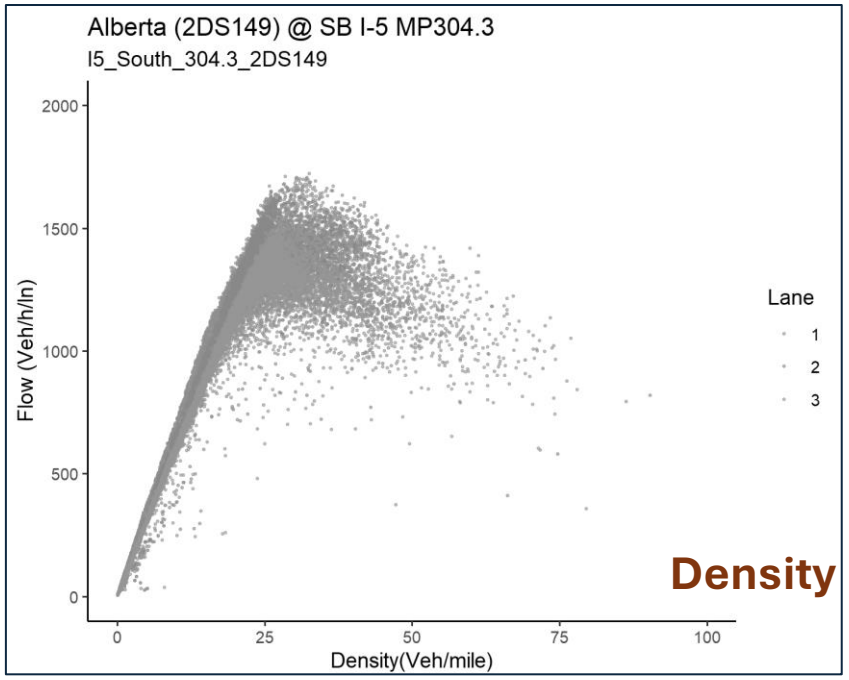
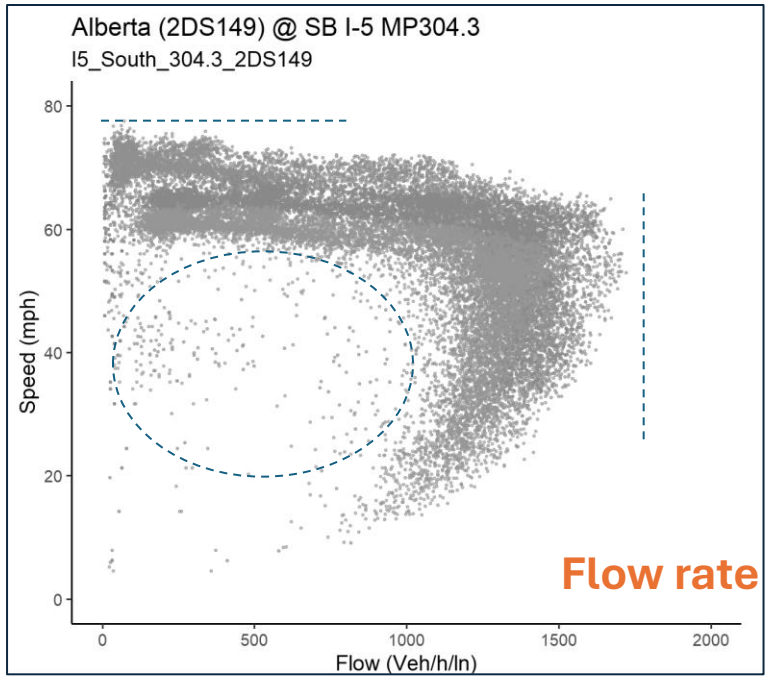
Anomalous

- Extreme, unrealistic value (magnitude)
- Rare, non-recurrent flow (frequency)
- Unknown, unreasonable status (explanation)

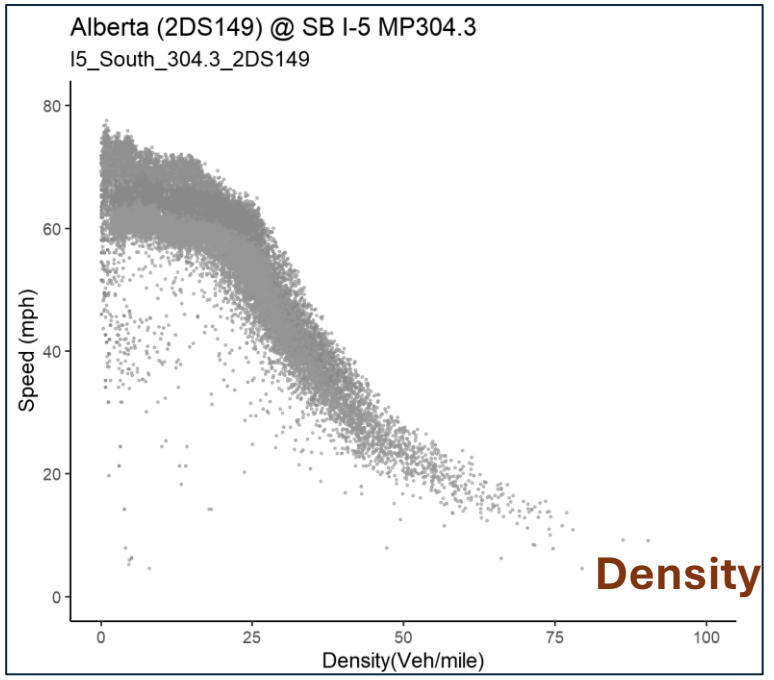
Flow rate



Speed

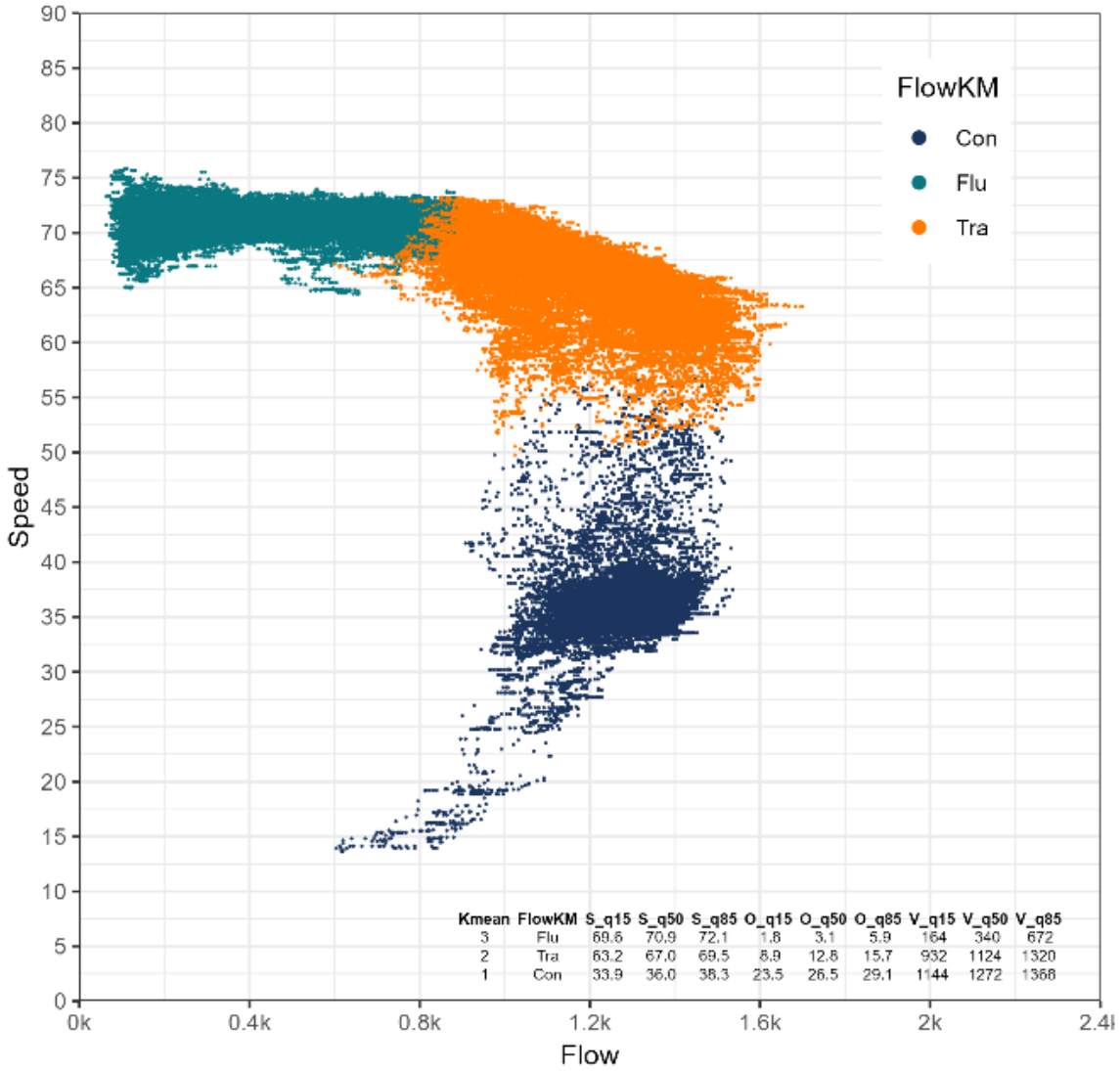


Speed



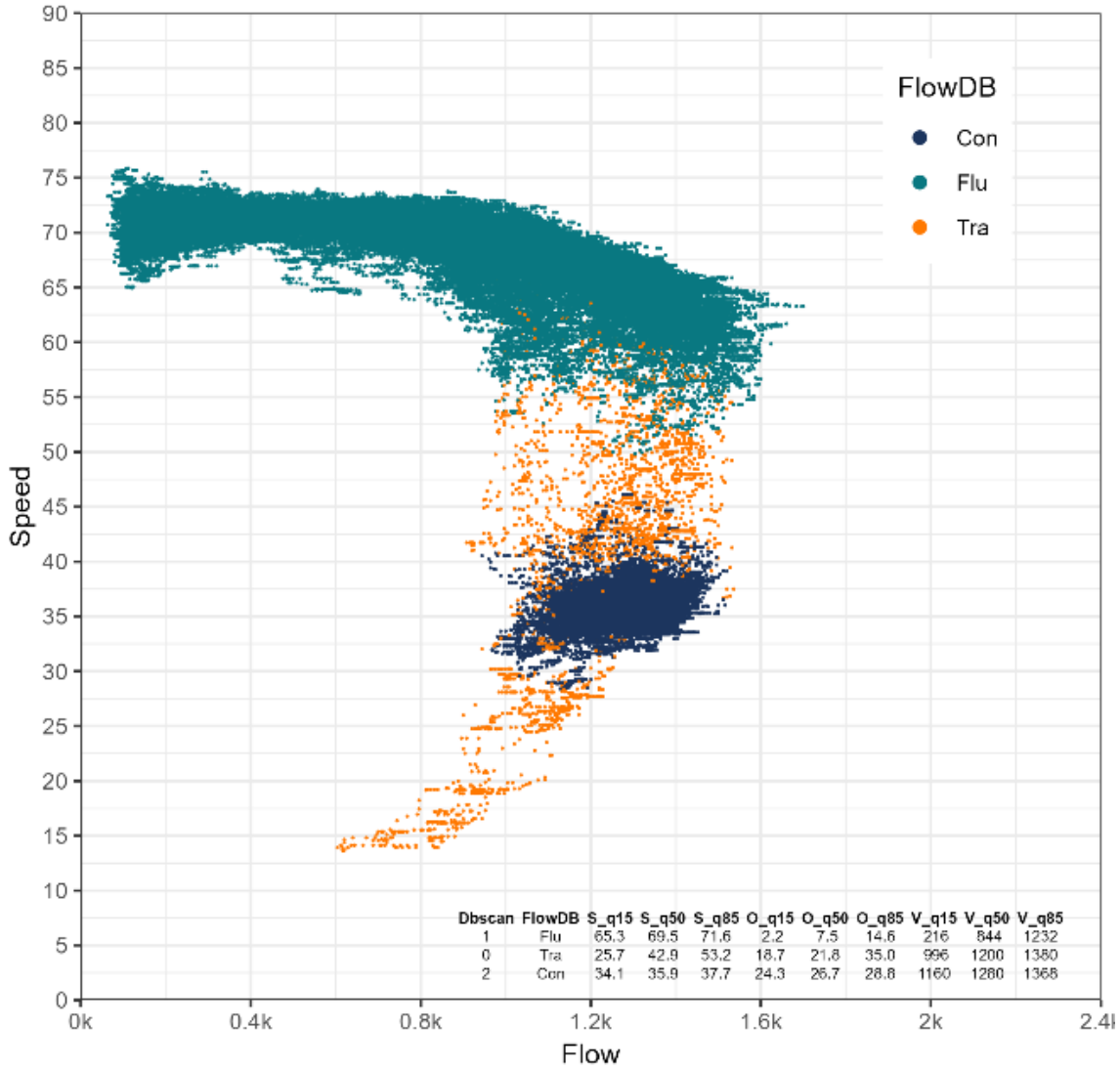
How clustering helps?

Traffic flow regimes and clustering methods



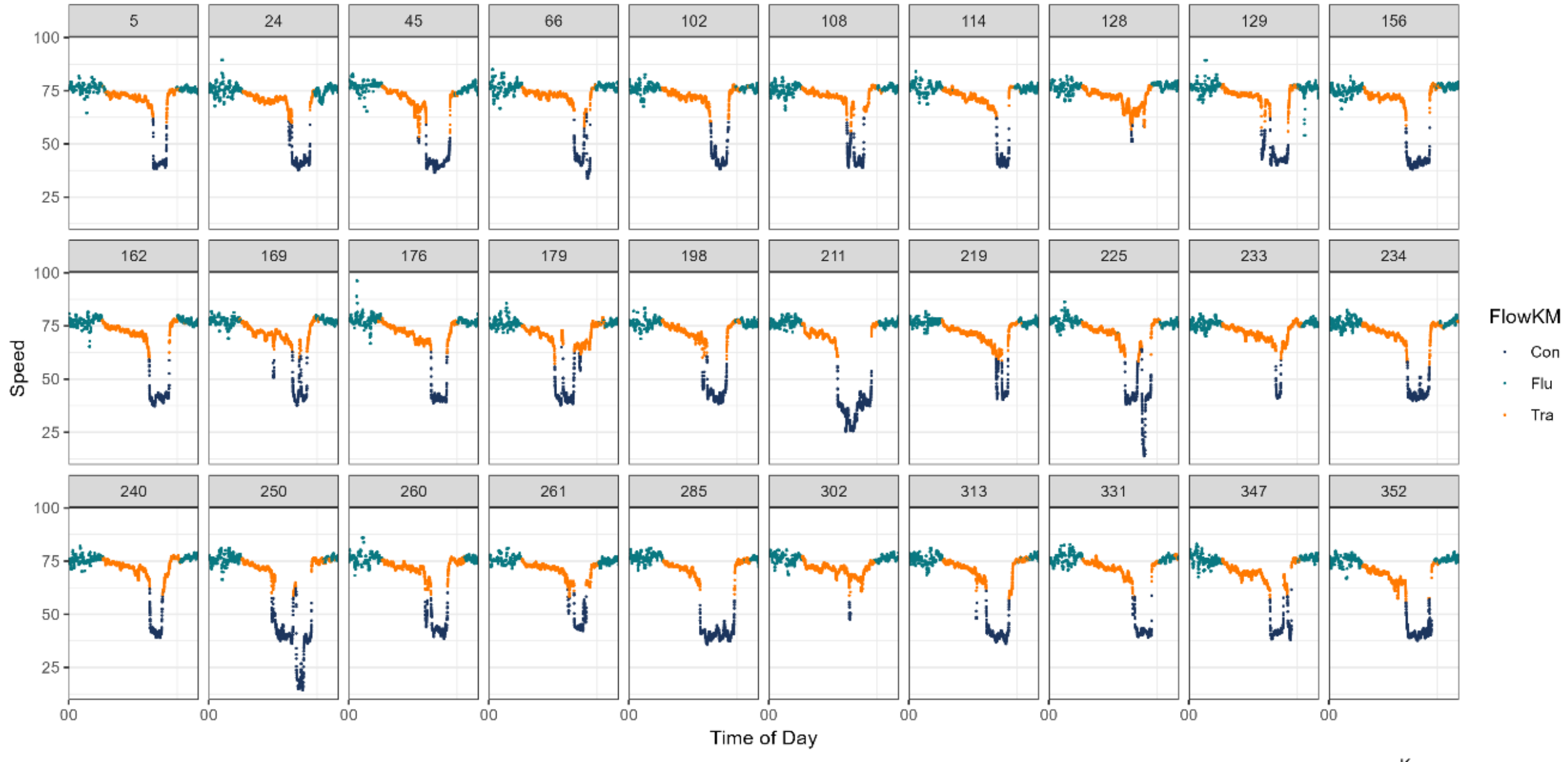
Kmean	FlowKM	S_q15	S_q50	S_q85	O_q15	O_q50	O_q85	V_q15	V_q50	V_q85
3	Flu	69.6	70.9	72.1	1.8	3.1	5.9	164	340	672
2	Tra	63.2	67.0	69.5	8.9	12.8	15.7	932	1124	1320
1	Con	33.9	36.0	38.3	23.5	26.5	29.1	1144	1272	1368

Kmeans



Dbscan	FlowDB	S_q15	S_q50	S_q85	O_q15	O_q50	O_q85	V_q15	V_q50	V_q85
1	Flu	65.3	69.5	71.6	2.2	7.5	14.6	216	844	1232
0	Tra	25.7	42.9	53.2	18.7	21.8	35.0	996	1200	1380
2	Con	34.1	35.9	37.7	24.3	26.7	28.8	1160	1280	1368

Dbscan170_2.1_12.2


5
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234
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Speed
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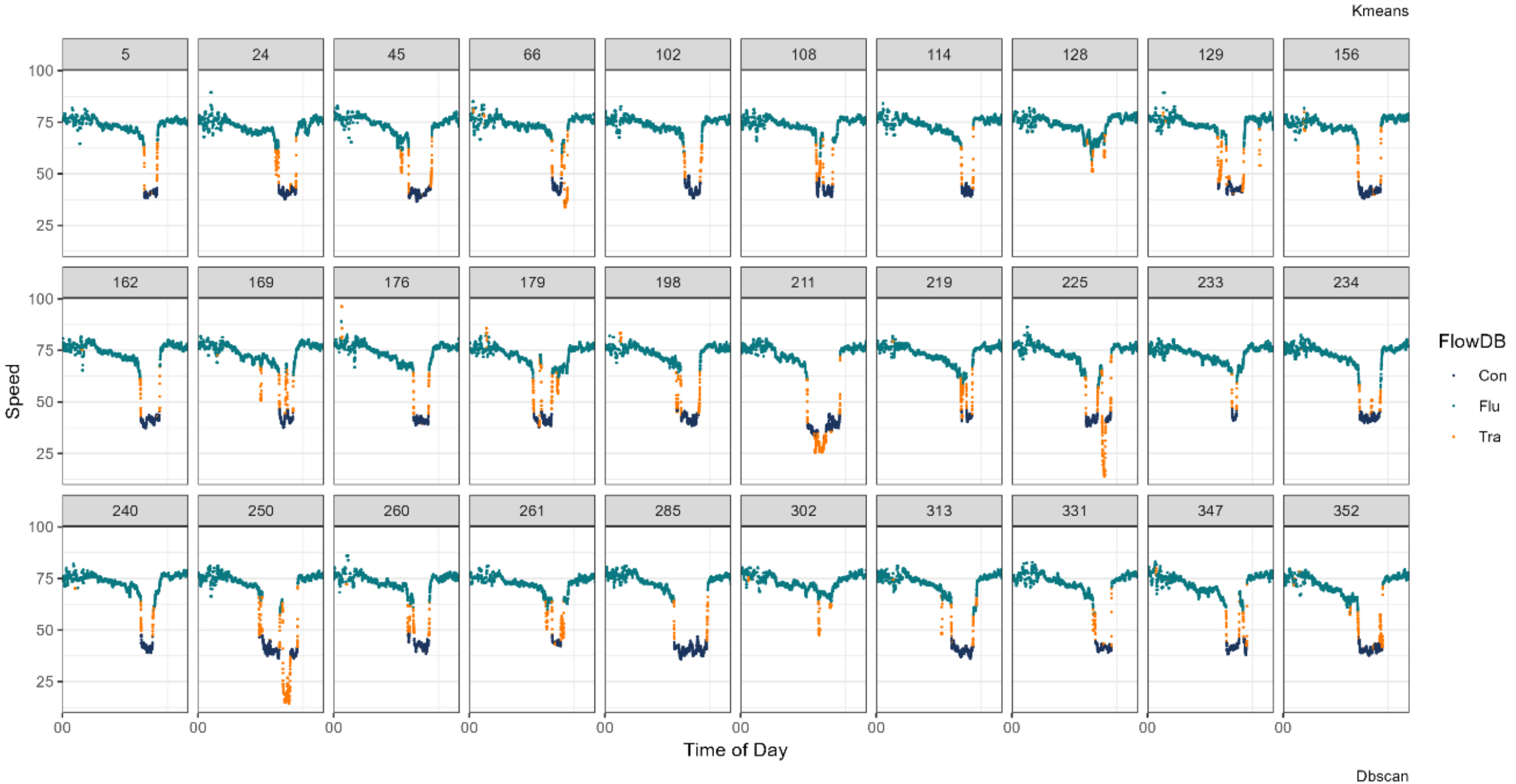
Time of Day
FlowKM
Con
Flu
Tra


Kmeans
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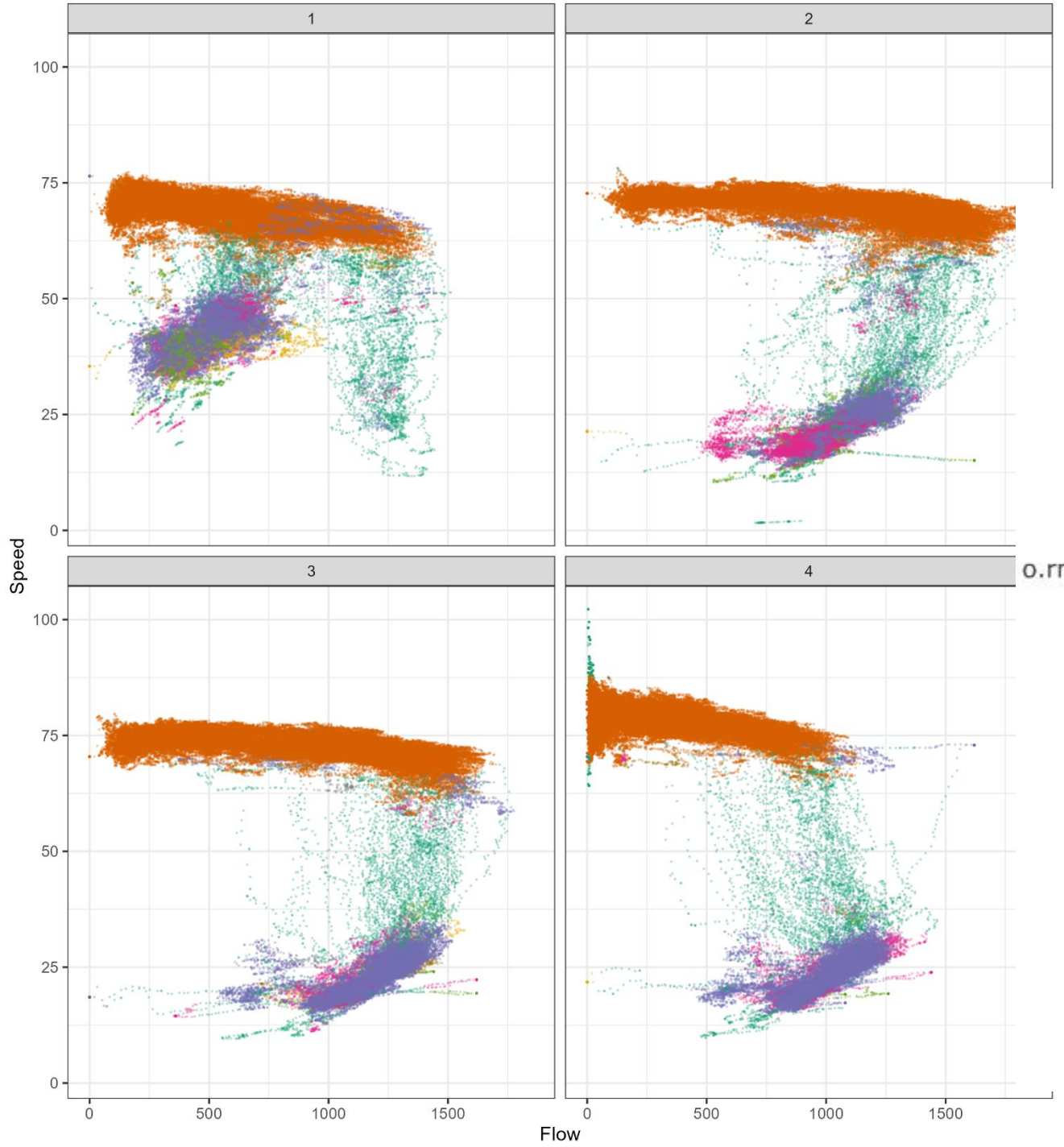
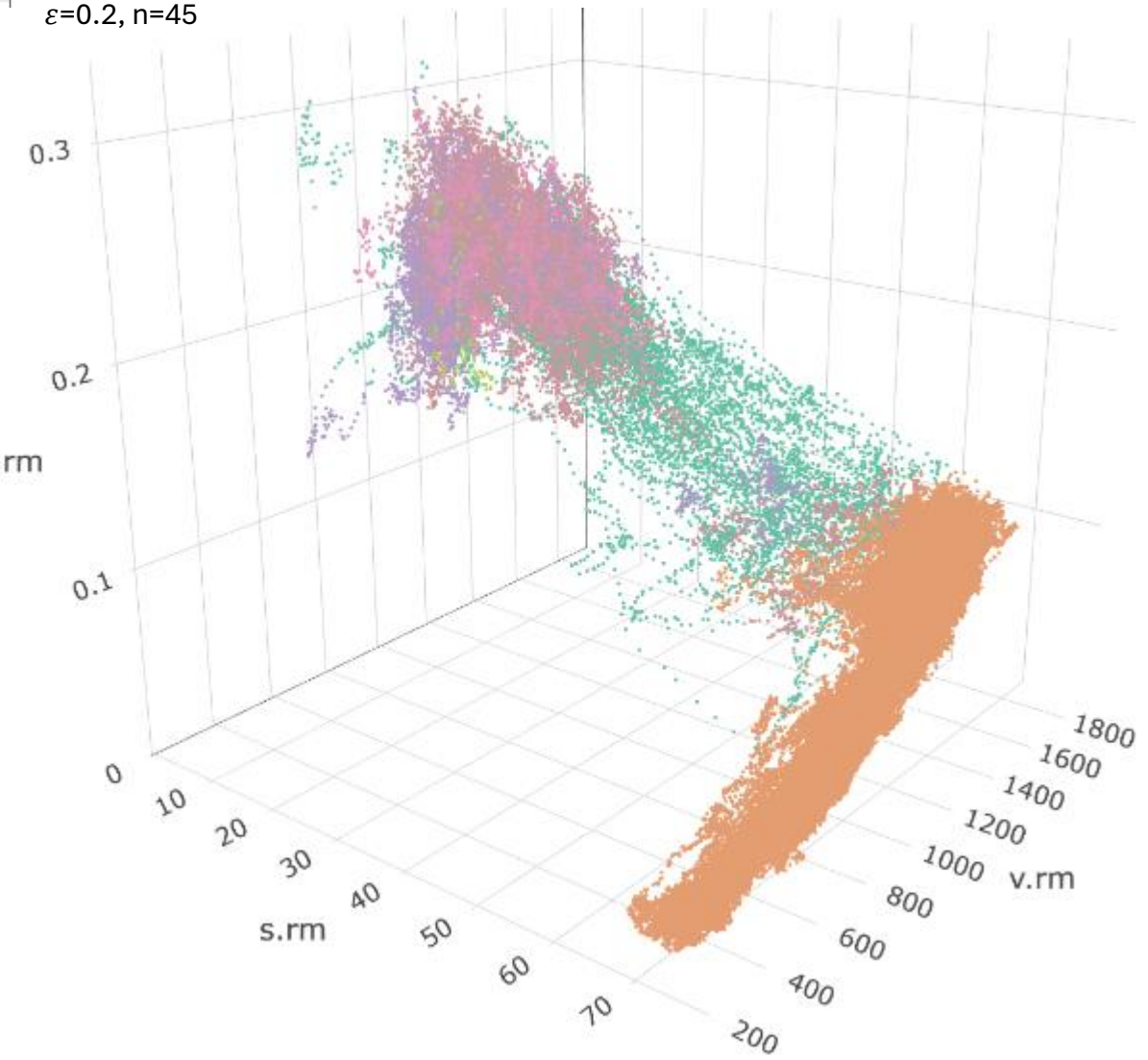
302
313
331
347
352
100
75
50
25
Speed
00
Time of Day
FlowDB
Con
Flu
Tra
Dbscan

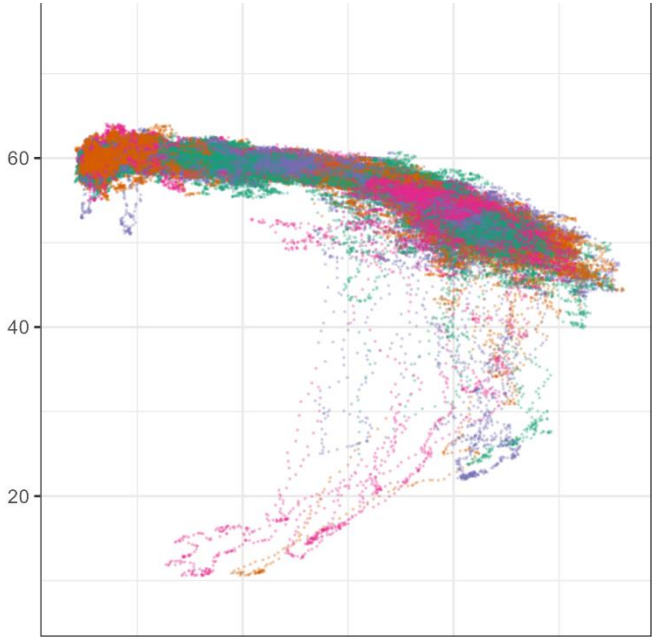
DBSCAN

(weighted harmonic) 15-mim rolling average of 20-sec,
By day,
Center (v=600, s=60, o=0.1),
ε=0.2, n=45

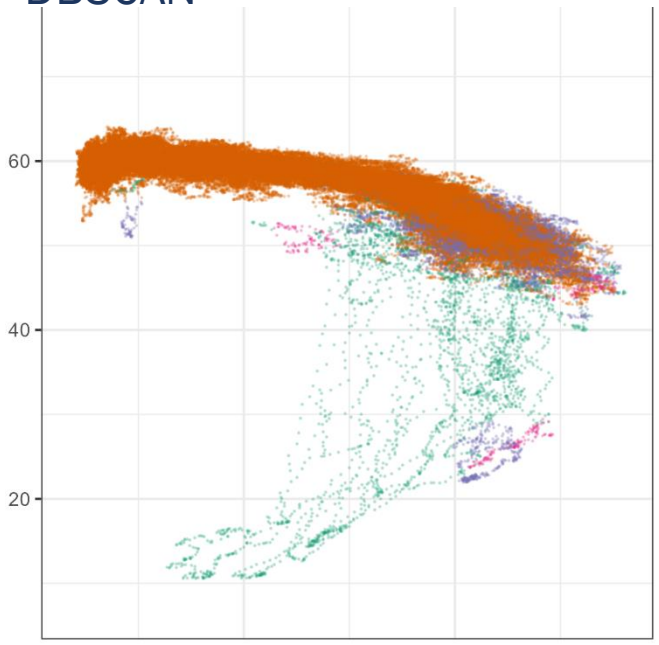


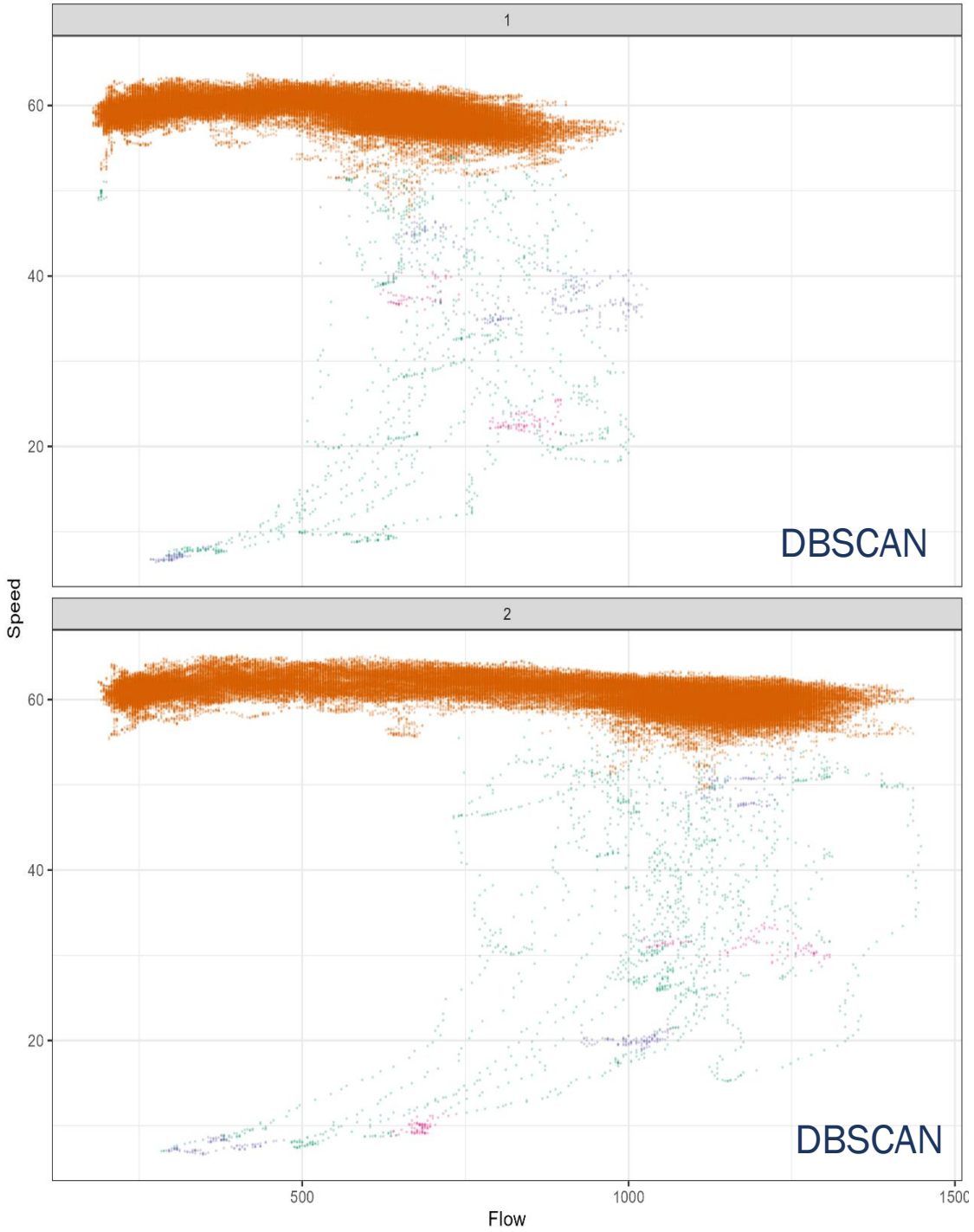


K-mean

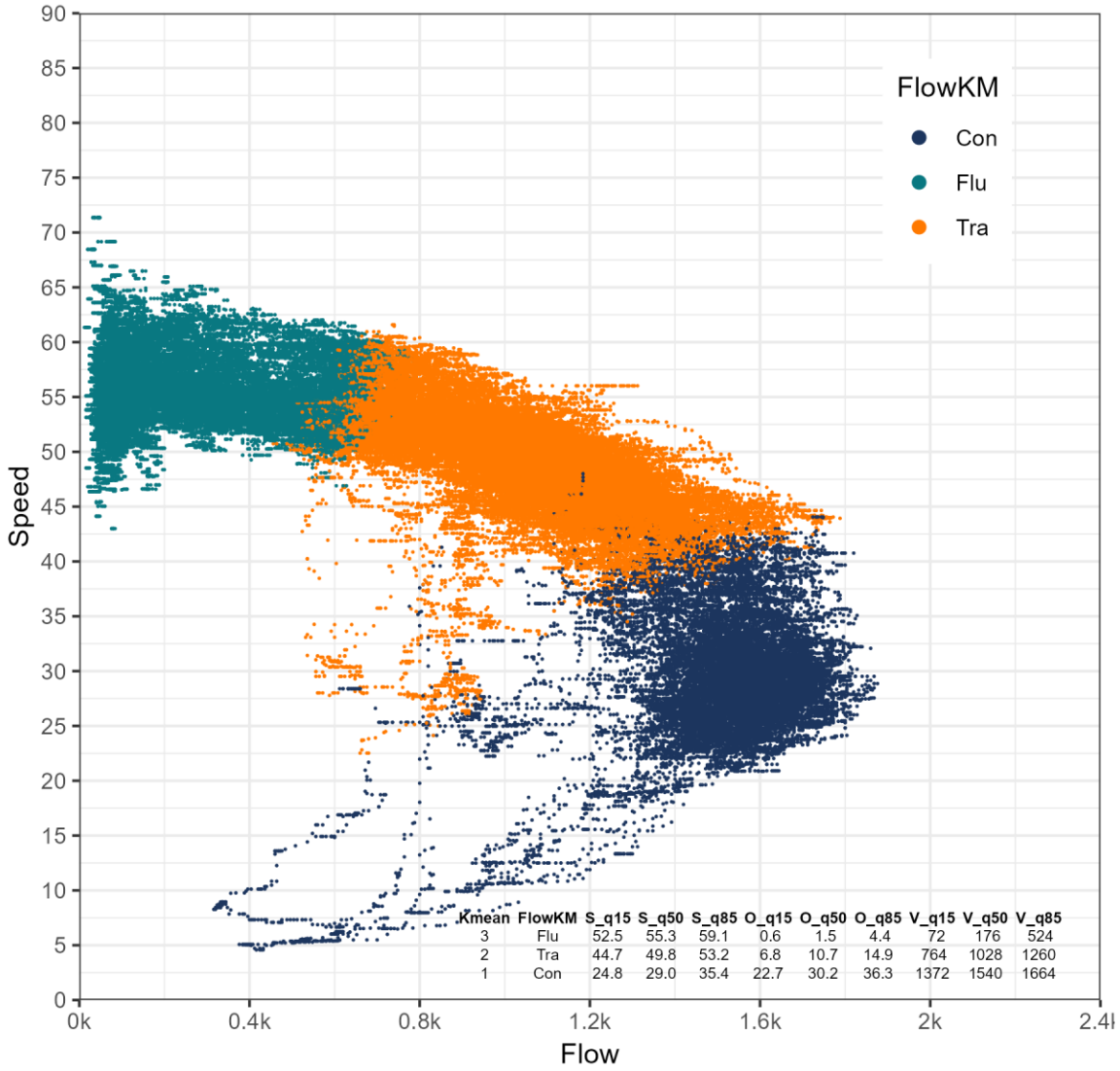


DBSCAN



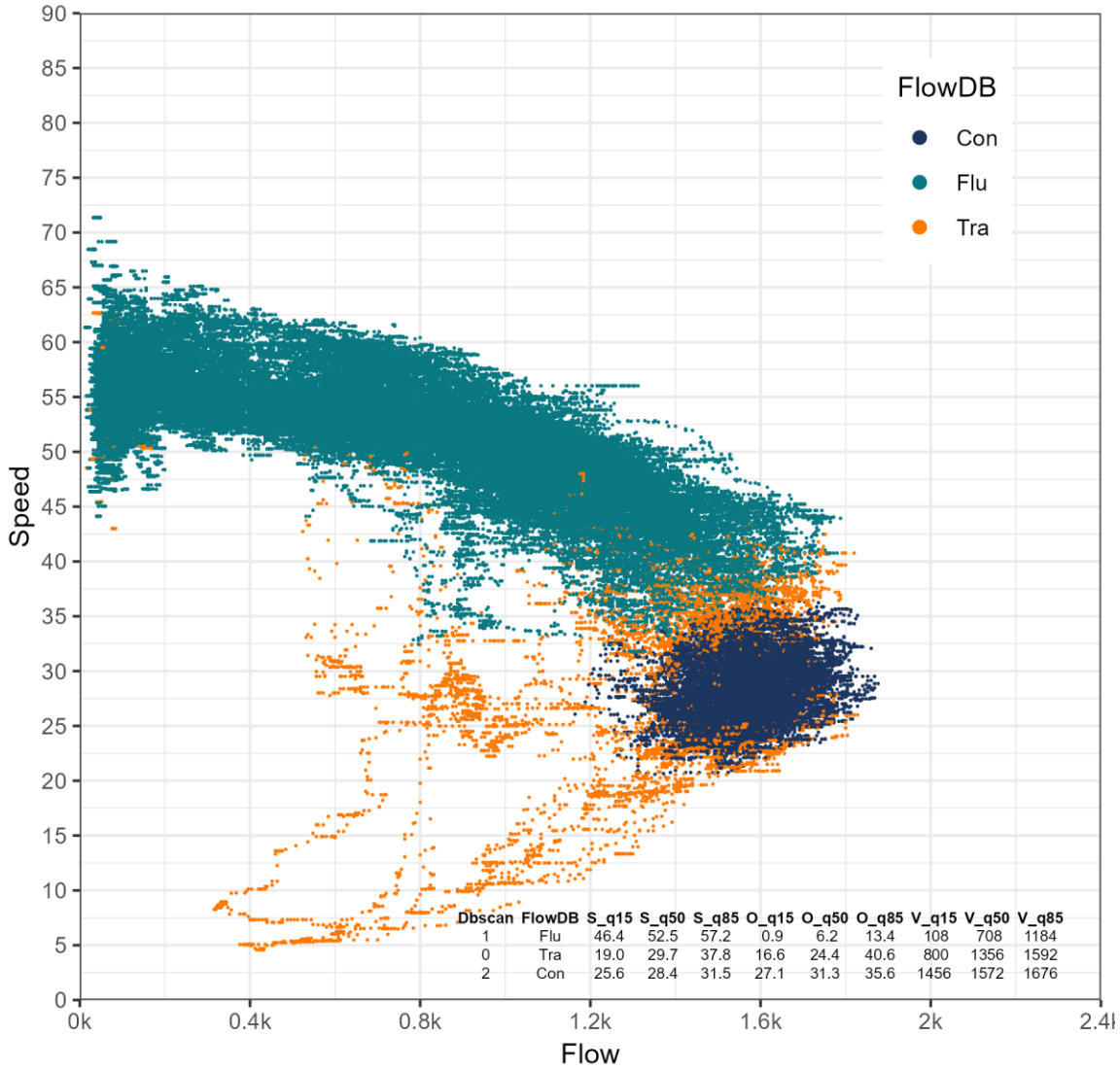


$$P_{50}(V_{con}) > P_{95}(V_{flu}) \qquad P_{50}(S_{con}) < P_{05}(S_{flu})$$



Kmean	FlowKM	S_q15	S_q50	S_q85	O_q15	O_q50	O_q85	V_q15	V_q50	V_q85
3	Flu	52.5	55.3	59.1	0.6	1.5	4.4	72	176	524
2	Tra	44.7	49.8	53.2	6.8	10.7	14.9	764	1028	1260
1	Con	24.8	29.0	35.4	22.7	30.2	36.3	1372	1540	1664

Kmeans

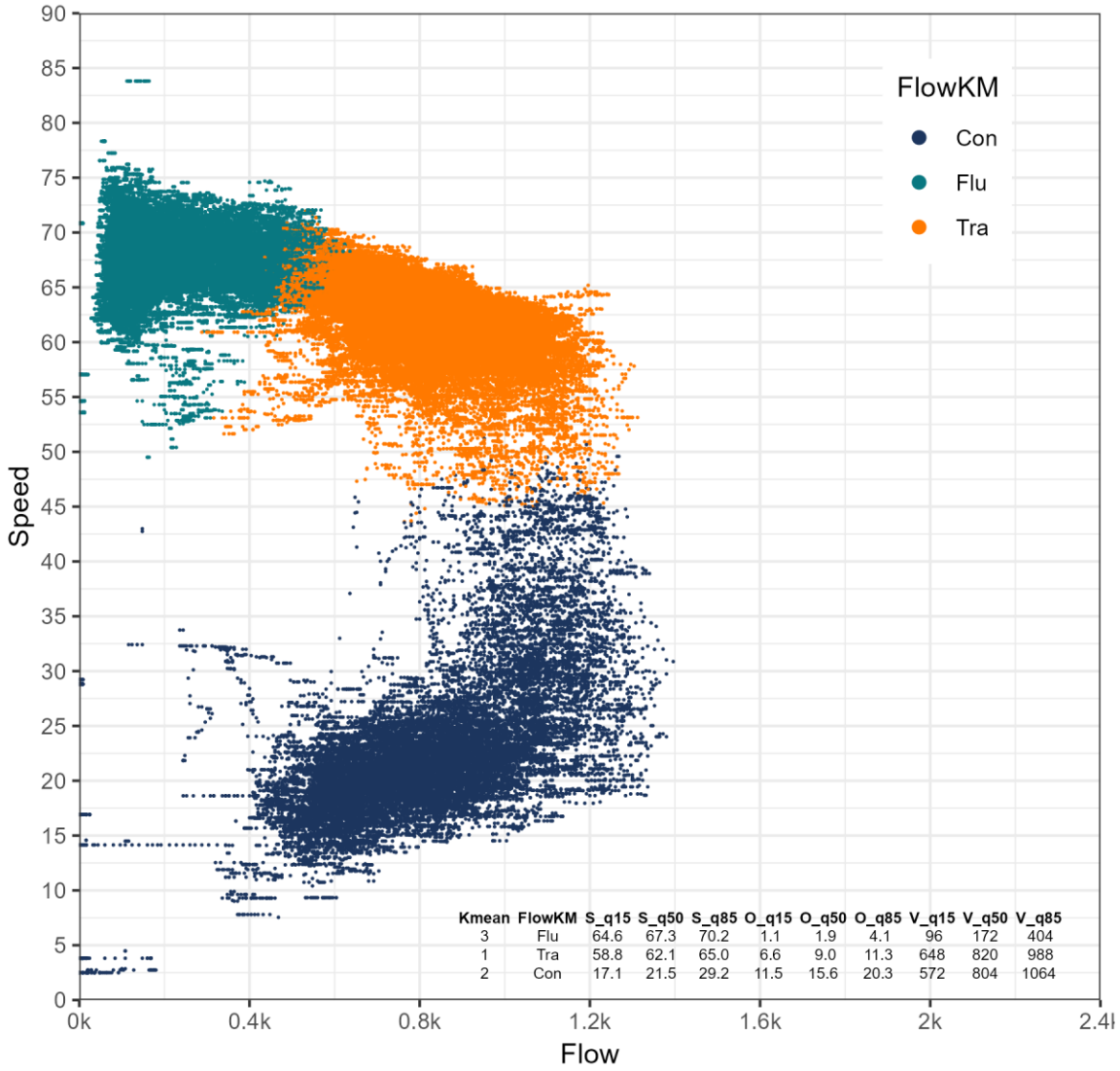


Dbscan	FlowDB	S_q15	S_q50	S_q85	O_q15	O_q50	O_q85	V_q15	V_q50	V_q85
1	Flu	46.4	52.5	57.2	0.9	6.2	13.4	108	708	1184
0	Tra	19.0	29.7	37.8	16.6	24.4	40.6	800	1356	1592
2	Con	25.6	28.4	31.5	27.1	31.3	35.6	1456	1572	1676

Dbscan140_4.8_12

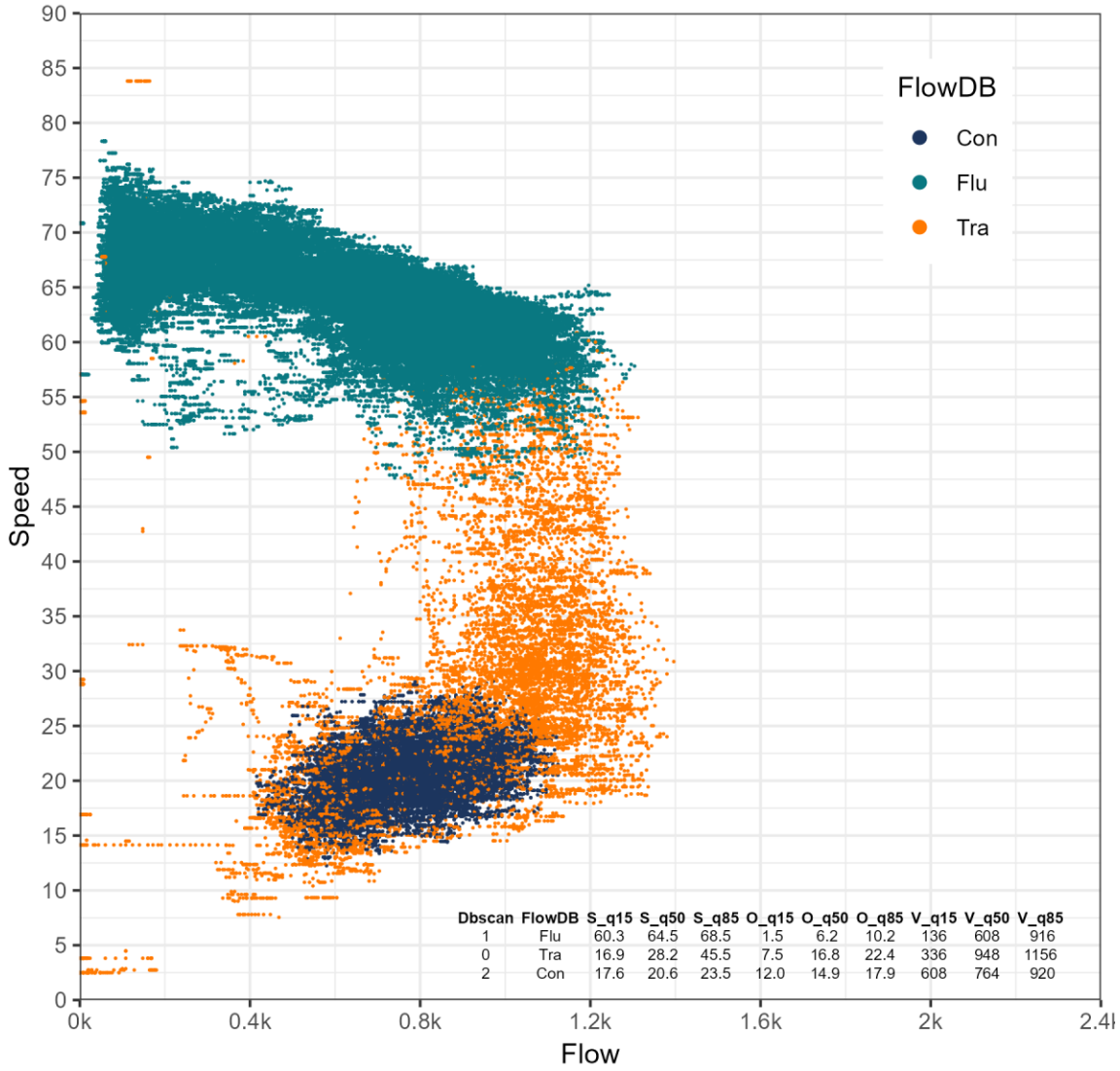
US26_73.71_W_2

$$\underset{50}{P}(V_{con}) < \underset{95}{P}(V_{flu}) \qquad \underset{50}{P}(S_{con}) \ll \underset{05}{P}(S_{flu})$$



Kmean	FlowKM	S_q15	S_q50	S_q85	O_q15	O_q50	O_q85	V_q15	V_q50	V_q85
3	Flu	64.6	67.3	70.2	1.1	1.9	4.1	96	172	404
1	Tra	58.8	62.1	65.0	6.6	9.0	11.3	648	820	988
2	Con	17.1	21.5	29.2	11.5	15.6	20.3	572	804	1064

Kmeans



Dbscan	FlowDB	S_q15	S_q50	S_q85	O_q15	O_q50	O_q85	V_q15	V_q50	V_q85
1	Flu	60.3	64.5	68.5	1.5	6.2	10.2	136	608	916
0	Tra	16.9	28.2	45.5	7.5	16.8	22.4	336	948	1156
2	Con	17.6	20.6	23.5	12.0	14.9	17.9	608	764	920

Dbscan155_9.6_10.9

I-405_4.2_N_1

Summary

- Anomalous

Magnitude - vary by cases — **20s, 1m, 5m, 15m, 1hour**

Frequency - vary by research questions — **0 mph or 0 veh/h**

Explanation - vary by users' preferences — **Noise vs. outlier**

- Data authenticity
- Transparent & traceable
- Tagging potential status/events