APPENDIX

I. Scenario

A. Map

Fig. 1. A map of the section of US50-E El Dorado County freeway used in the study (in gray). The red dots indicate the approximate location of the PeMS detectors on that segment, from Pollock Pines to Lake Tahoe Airport.

B. PeMS detectors specifications

TABLE I
PeMS US50-E detectors used in the study, their specifications and the distance between consecutive ones. Base stations (BSs) are denoted with the same identification number as the PeMS detectors.

PeMS detectors	terrain	population	design speed limit	road width	distance | BS range
Mainline VDS 3086071–50EB JWO Sly Park EB	mountainous	rural	70 mph	24 ft	7.67 miles
Mainline VDS 3086081–50EB at Riverton Barn CCTV	mountainous	rural	60 mph	24 ft	1.62 miles
Mainline VDS 320287–50EB at Ice House	mountainous	rural	50 mph	12 ft	13.27 miles
Mainline VDS 320280–Wrights Lake Rd	mountainous	rural	50 mph	11 ft	13.41 miles
Mainline VDS 317706–Echo Summit	mountainous	rural	50 mph	12 ft	3.89 miles
Mainline VDS 3054051–50EB into Luther 50/89 R.	mountainous	rural	40 mph	12 ft	0.99 miles
Mainline VDS 3410061–50EB JEO Pioneer Trl	rolling	rural	40 mph	12 ft	3.22 miles
Mainline VDS 317715–F St	flat	urban	40 mph	32 ft	1.46 miles

C. Time span

PeMS data from March 28, 2022 to September 9, 2022, week 13 to week 36 of 2022, 24 weeks of data in total, are used in the study. The employed PeMS data comprise vehicular flow and speed from Monday to Friday. Calls are generated following the methodology described in the paper. The large time span covers seasonal changes, holiday and regular working days within the considered period. Base stations (BSs) with variety of cell ranges and observed traffic conditions are simulated.

II. Call load volumes and road traffic profiles per base station and PeMS detector

Vehicular flow per road segment and BS and total number of calls per BS are plotted on a weekly basis for the entire period, Figure 4 – Figure 11. In Section II to Section V the call duration distribution follows a mixture of two log-normally distributed variables with mean 1 minute and variance 3, and mean 10 minutes and variance 30. The correlation between flow, speed, new, handover and total number of calls is shown for the entire 24-week-long time period per BS. The linear association between the variables is not static but varies over time, see Figure 2 as an example. Furthermore, variables correlation differs between BSs too. Vehicular flow and speed, for instance, are overall inversely correlated for detector 320287, not linearly associated for detector 3086071 and reciprocal for detector 3054051. Similarly, the vehicular flow and the number of calls placed at a BS dynamically change over time—within a day, week and between weeks, see Figure 3 as an example.

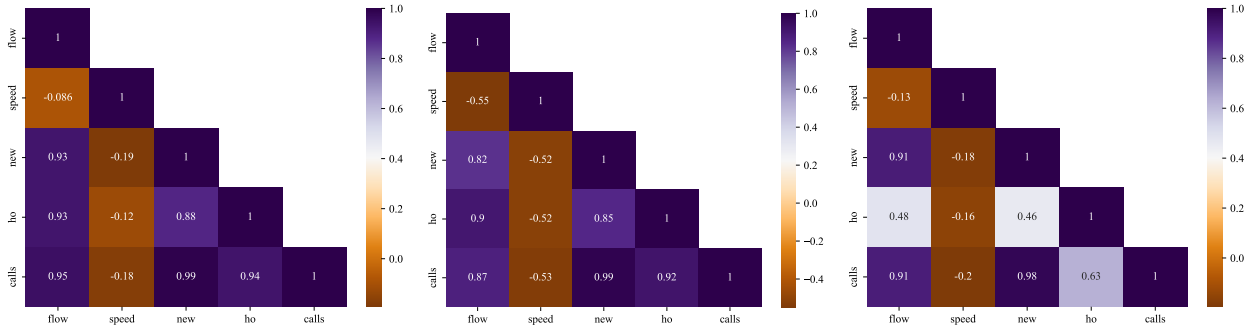

Fig. 2. BS 320280: (**left**) correlation between the variables for the first two weeks of data (weeks 13 and 14 of 2022); (**center**) correlation during week 35 of 2022; and (**right**) correlation for the whole period, weeks 13 to 36.

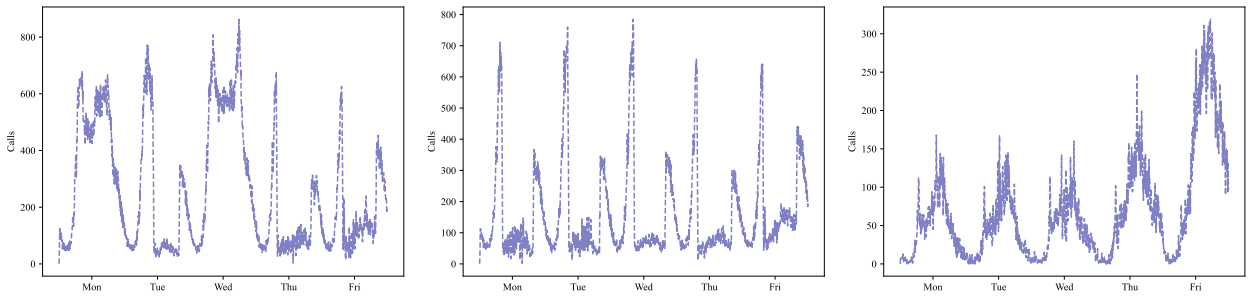

Fig. 3. BS 320280: (**left**) total number of calls for the first week of data (week 13); (**center**) total number of calls for week 2; and (**right**) total number of calls for week 23.

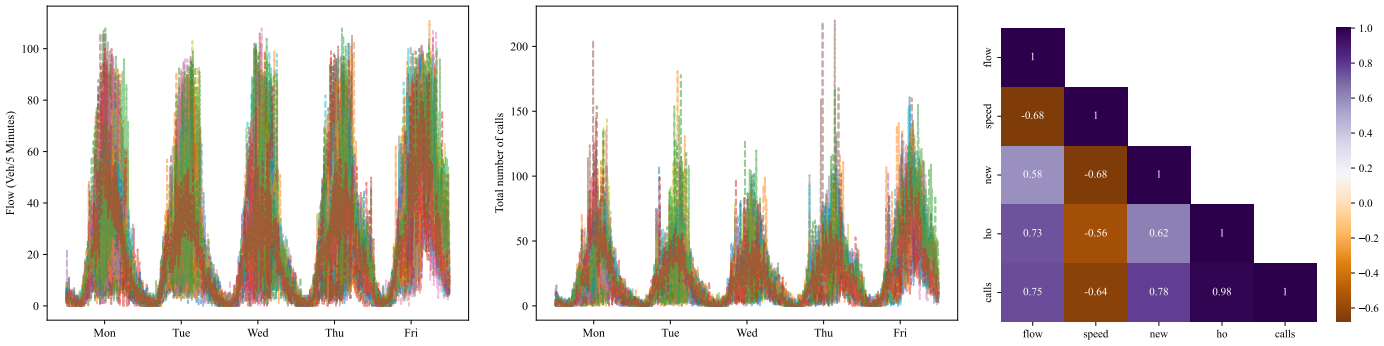

Fig. 4. BS 3054051

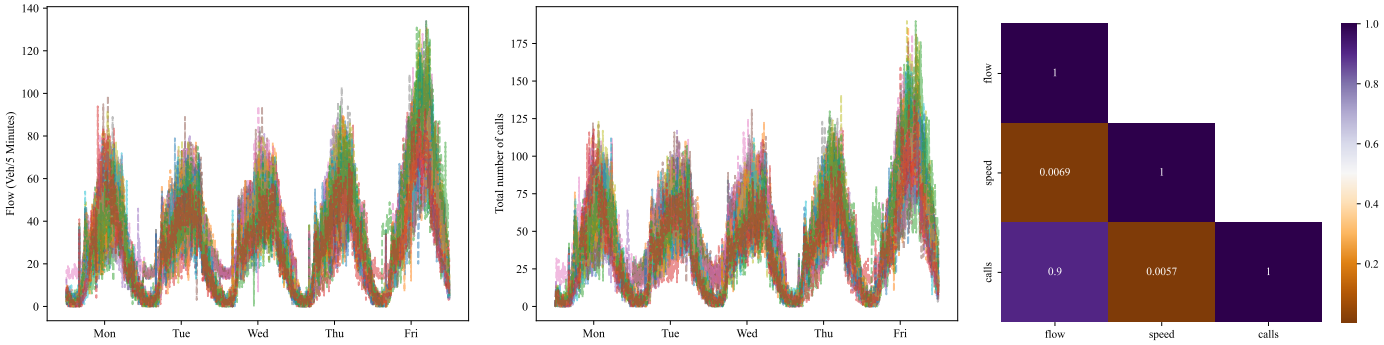

Fig. 5. BS 3086071

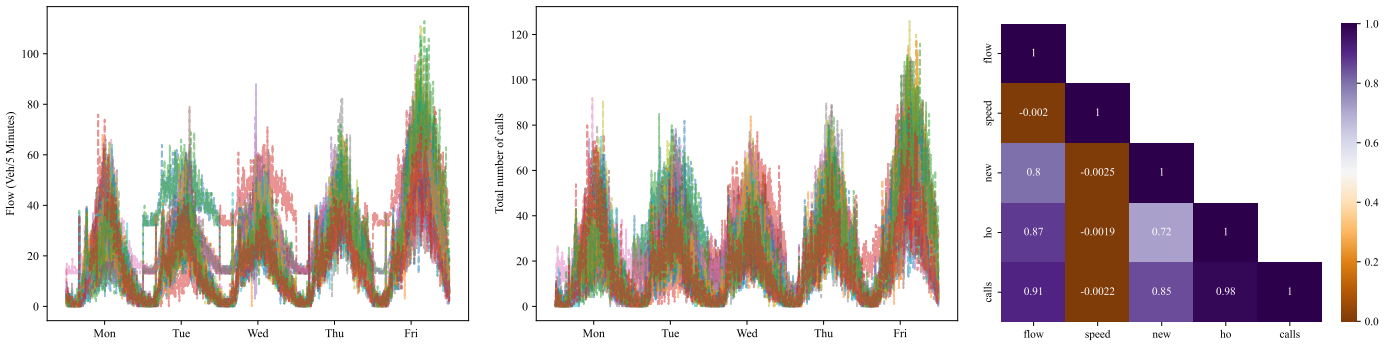

Fig. 6. BS 3086081

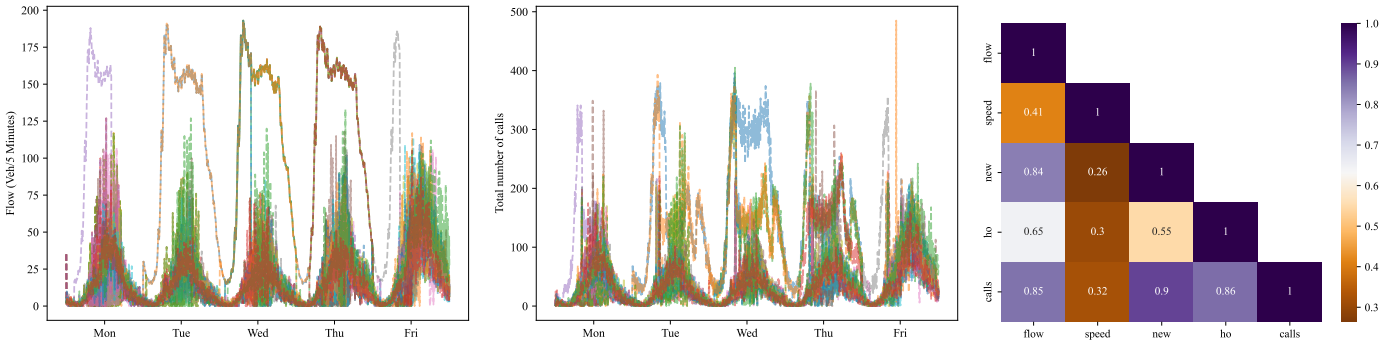

Fig. 7. BS 317706

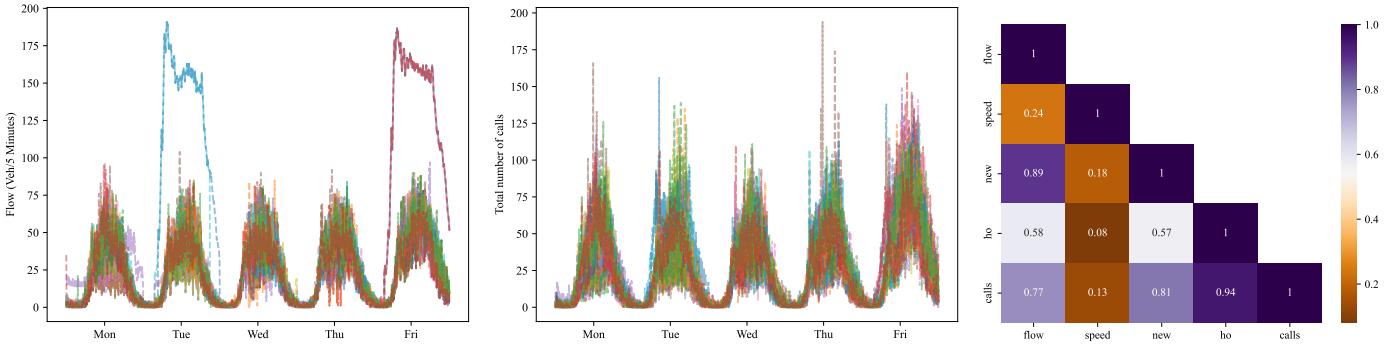

Fig. 8. BS 317715

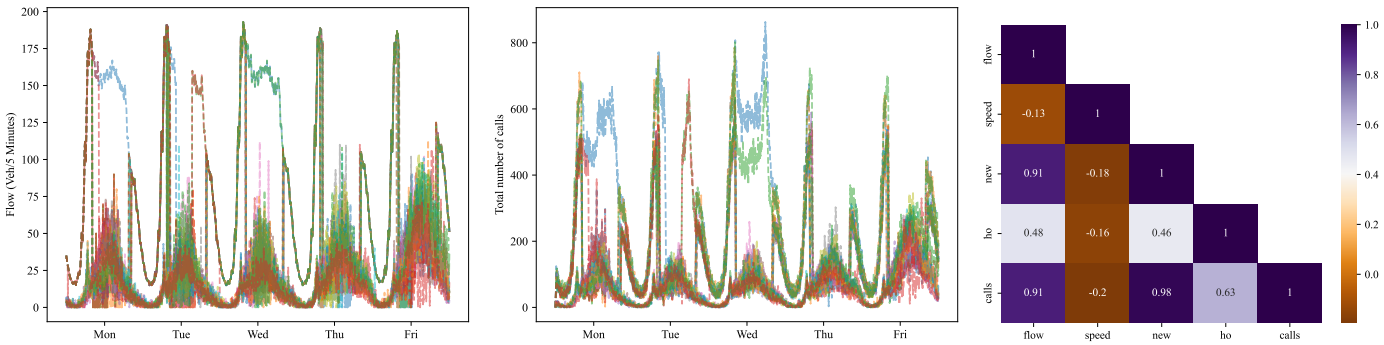

Fig. 9. BS 320280

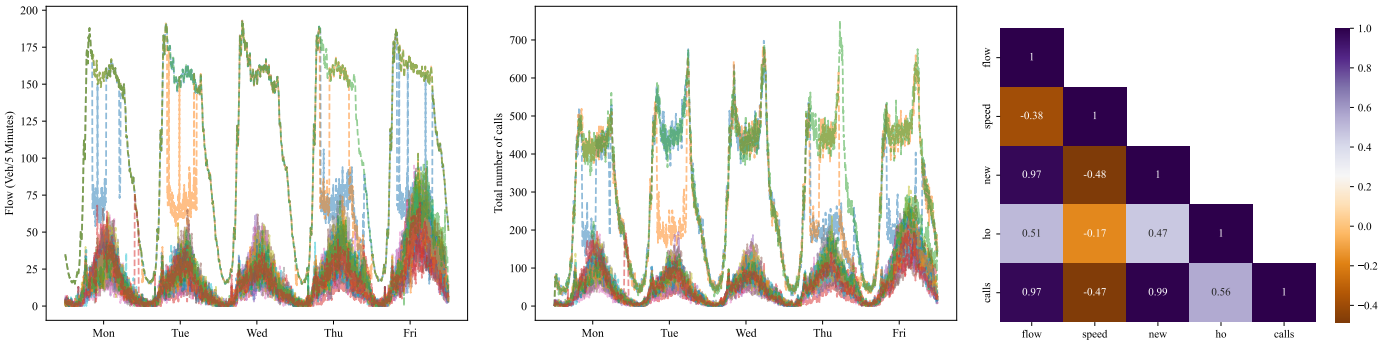

Fig. 10. BS 320287

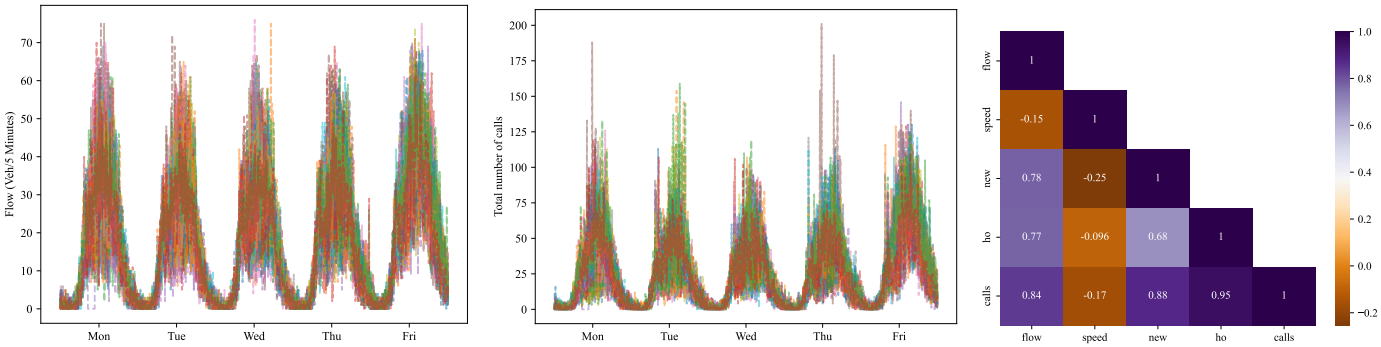

Fig. 11. BS 3410061

III. Prediction performance results: a mixture of two log-normally distributed call durations and 12:6:6 data split

The forecasting performance is measured with the mean absolute error (MAE), mean absolute percentage error (MAPE), mean squared error (MSE) and root mean squared error (RMSE). The lower the error, the better the prediction.

TABLE II
PREDICTION PERFORMANCE ON CALLS DATASET AND FLOW, SPEED AND CALLS DATASET
A MIXTURE OF TWO LOG-NORMALLY DISTRIBUTED CALL DURATION TIMES
24 WEEKS, 12:6:6 DATA SPLIT

BS	Calls												Flow Speed Calls											
	MAE			MSE			MAPE			RMSE			MAE			MSE			MAPE			RMSE		
	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max
3054051	0.434	0.434	0.439	0.485	0.492	0.503	116.0	118.0	128.3	0.697	0.702	0.709	0.364	0.369	0.377	0.341	0.347	0.354	84.3	90.1	93.1	0.584	0.589	0.595
3086071	0.282	0.283	0.287	0.154	0.155	0.157	820.8	837.2	880.6	0.392	0.393	0.396	0.187	0.187	0.187	0.067	0.067	0.068	506.8	515.6	523.9	0.259	0.259	0.261
3086081	0.394	0.396	0.399	0.317	0.318	0.319	335.2	347.4	365.4	0.563	0.564	0.565	0.339	0.34	0.342	0.237	0.238	0.238	293.2	298.3	305.9	0.487	0.487	0.488
317706	0.155	0.156	0.158	0.058	0.059	0.060	127.5	128.4	137.8	0.241	0.242	0.244	0.129	0.13	0.135	0.038	0.039	0.040	107.4	110.8	112.0	0.196	0.198	0.199
317715	0.321	0.324	0.325	0.242	0.243	0.246	103.5	109.3	117.3	0.492	0.493	0.496	0.295	0.297	0.3	0.208	0.21	0.218	87.4	92.4	92.8	0.456	0.459	0.467
320280	0.080	0.081	0.097	0.013	0.013	0.015	54.0	54.6	57.3	0.112	0.114	0.121	0.065	0.066	0.070	0.008	0.008	0.009	47.3	47.7	49.1	0.090	0.091	0.094
320287	0.066	0.067	0.067	0.009	0.009	0.009	86.7	87.0	88.3	0.094	0.094	0.094	0.051	0.052	0.054	0.005	0.006	0.006	64.6	66.6	67.7	0.073	0.075	0.076
3410061	0.404	0.404	0.407	0.389	0.391	0.397	696.4	725.7	757.9	0.624	0.626	0.63	0.354	0.356	0.358	0.309	0.31	0.316	484.8	494.5	503.2	0.556	0.557	0.562

[a]The three values listed per error type are the minimum, median, and maximum. The MAPE is in percentage.

TABLE III
PREDICTION PERFORMANCE ON NEW, HANDOVER, AND TOTAL CALLS DATASET AND FLOW, SPEED, NEW, HANDOVER, AND TOTAL CALLS DATASET
A MIXTURE OF TWO LOG-NORMALLY DISTRIBUTED CALL DURATION TIMES
24 WEEKS, 12:6:6 DATA SPLIT

BS	New HO Calls												Flow Speed New HO Calls											
	MAE			MSE			MAPE			RMSE			MAE			MSE			MAPE			RMSE		
	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max
3054051	0.426	0.428	0.431	0.479	0.498	0.504	101.3	103.1	114.5	0.692	0.706	0.71	0.366	0.369	0.37	0.343	0.35	0.355	83.7	88.2	91.9	0.585	0.591	0.596
3086071	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3086081	0.39	0.39	0.392	0.307	0.307	0.309	326.7	337.1	349.7	0.554	0.554	0.556	0.336	0.339	0.346	0.235	0.235	0.238	294.6	300.3	321.9	0.484	0.485	0.488
317706	0.154	0.155	0.158	0.056	0.057	0.06	128.1	131.7	134.0	0.237	0.24	0.245	0.131	0.131	0.133	0.039	0.04	0.041	106.6	112.0	114.1	0.199	0.2	0.202
317715	0.323	0.326	0.329	0.242	0.245	0.25	106.3	111.3	113.4	0.492	0.495	0.5	0.299	0.304	0.306	0.215	0.218	0.233	82.2	85.5	91.9	0.463	0.467	0.482
320280	0.076	0.081	0.100	0.012	0.012	0.015	54.0	55.5	56.4	0.108	0.111	0.123	0.062	0.063	0.069	0.008	0.008	0.008	44.9	46.8	48.6	0.087	0.089	0.092
320287	0.066	0.066	0.067	0.009	0.009	0.009	87.8	88.7	90.6	0.093	0.094	0.094	0.052	0.053	0.055	0.005	0.006	0.006	65.5	66.0	70.4	0.073	0.075	0.078
3410061	0.405	0.408	0.415	0.394	0.403	0.423	590.1	639.2	655.4	0.628	0.635	0.65	0.355	0.357	0.363	0.312	0.316	0.322	458.7	474.7	483.2	0.558	0.562	0.568

[a]BS 3086071 is the first one in our scenario. Therefore, there is no handover traffic from a preceding BS.

TABLE IV
PREDICTION PERFORMANCE WITH GAUSSIAN NOISE ADDED TO THE FLOW
A MIXTURE OF TWO LOG-NORMALLY DISTRIBUTED CALL DURATION TIMES
24 WEEKS, 12:6:6 DATA SPLIT

BS	Flow Speed Calls												Flow Speed New HO Calls											
	MAE			MSE			MAPE			RMSE			MAE			MSE			MAPE			RMSE		
	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max
3054051	0.369	0.371	0.375	0.348	0.354	0.358	84.0	85.9	87.8	0.59	0.595	0.598	0.367	0.368	0.372	0.343	0.348	0.354	86.3	89.4	92.7	0.586	0.589	0.595
3086071	0.205	0.205	0.206	0.077	0.077	0.078	594.5	599.4	602.1	0.278	0.278	0.279	-	-	-	-	-	-	-	-	-	-	-	-
3086081	0.346	0.349	0.35	0.244	0.245	0.247	293.1	315.5	320.6	0.494	0.495	0.497	0.344	0.347	0.348	0.241	0.242	0.243	311.9	314.9	315.8	0.491	0.492	0.493
317706	0.134	0.136	0.138	0.04	0.042	0.043	110.0	111.3	119.5	0.2	0.205	0.207	0.135	0.135	0.138	0.041	0.042	0.043	107.5	110.8	117.1	0.202	0.204	0.207
317715	0.301	0.303	0.306	0.214	0.214	0.224	88.5	91.0	96.4	0.462	0.463	0.473	0.303	0.304	0.309	0.216	0.22	0.228	89.7	94.0	95.6	0.465	0.469	0.477
320280	0.070	0.072	0.074	0.009	0.009	0.010	50.5	50.9	51.1	0.096	0.097	0.098	0.071	0.076	0.084	0.009	0.010	0.011	49.8	50.0	52.1	0.095	0.099	0.104
320287	0.057	0.057	0.058	0.006	0.006	0.006	71.7	72.9	74.8	0.079	0.080	0.080	0.056	0.057	0.058	0.006	0.006	0.007	72.9	75.0	76.4	0.078	0.079	0.083
3410061	0.36	0.361	0.365	0.313	0.318	0.327	481.2	495.0	514.7	0.56	0.564	0.572	0.361	0.362	0.369	0.32	0.322	0.334	475.7	496.3	510.8	0.566	0.567	0.578

[a]BS 3086071 is the first one in our scenario. Therefore, there is no handover traffic from a preceding BS.

The improvement in prediction resulting from using population dynamics statistics in addition to network KPIs is measured as the percentage difference in error by $(ErrM_{net} - ErrM_{net\&road})/ErrM_{net}$, where $ErrM$ is the error measure. *Net* refers to using network KPIs only and *net&road* to combined network and road data. In all other cases, the first mentioned dataset is the baseline. All percentage difference plots are for the medians. Datasets: total number of calls (C); new, handover, and total calls number (NHC); flow, speed, total calls number (FSC); and flow, speed, new, handover and total calls number (FSNHC).

A. Prediction error reduction when using population dynamics statistics

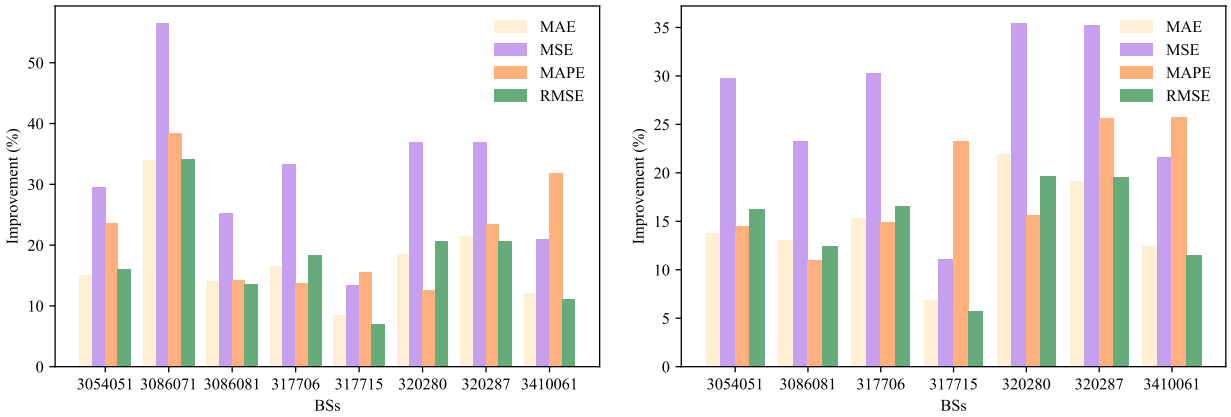

Fig. 12. Improvement in prediction when employing (**left**) calls vs the same data (C) combined with flow and speed statistics (FSC); (**right**) NHC vs FSNHC.

B. How much can handover statistics help?

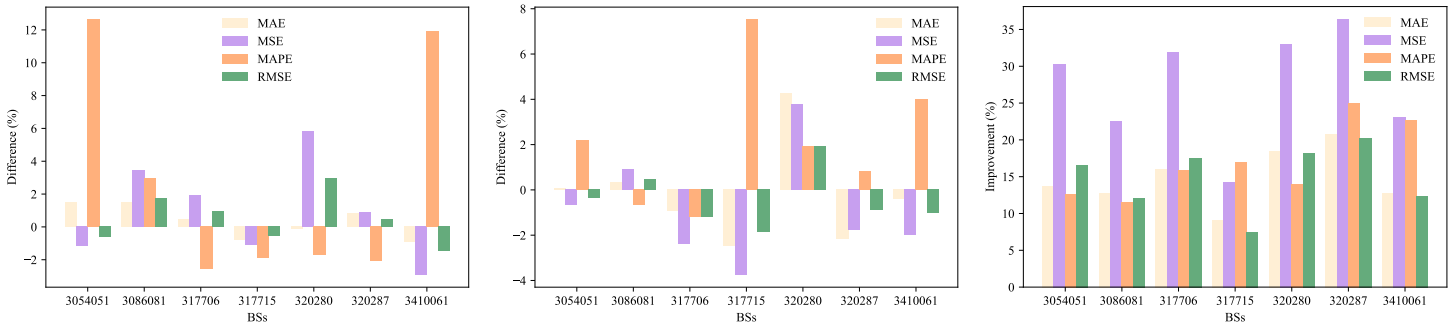

Fig. 13. (**left**) Calls (baseline) vs the same data (C) augmented with new and handover calls (NHC). (**center**) FSC vs FSNHC. (**right**) NHC dataset vs FSC.

C. Prediction error reduction when the vehicular flow is estimated with errors

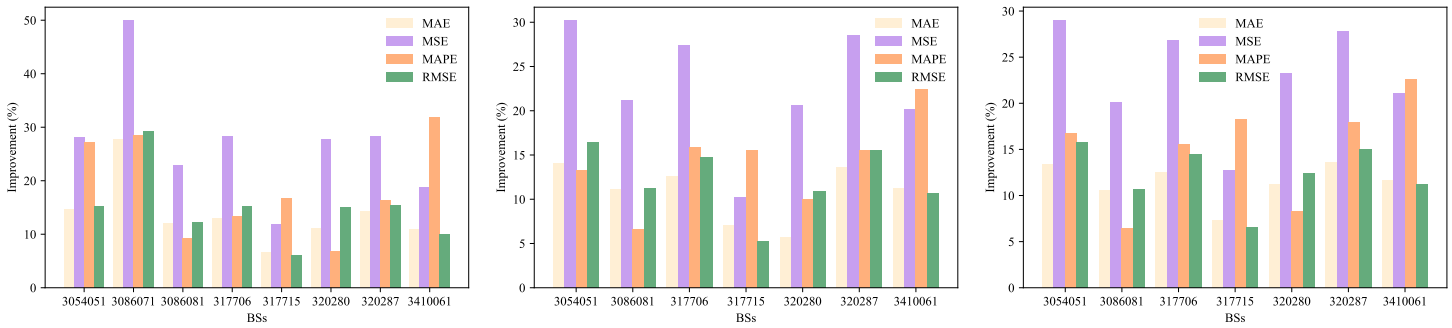

Fig. 14. (**left**) Calls vs the same data (C) augmented with vehicular flow estimated with errors and speed $\hat{F}$SC. (**center**) NHC vs $\hat{F}$SNHC. (**right**) NHC vs $\hat{F}$SC.

IV. Prediction performance results: a mixture of two log-normally distributed call durations and 3:2:2 data split

TABLE V
PREDICTION PERFORMANCE ON CALLS DATASET AND FLOW, SPEED, AND CALLS DATASET
A MIXTURE OF TWO LOG-NORMALLY DISTRIBUTED CALL DURATION TIMES
15-21 (7) WEEKS, 3:2:2 DATA SPLIT

BS	Calls												Flow Speed Calls											
	MAE			MSE			MAPE			RMSE			MAE			MSE			MAPE			RMSE		
	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max
3054051	0.281	0.281	0.284	0.191	0.192	0.197	288.9	302.5	308.3	0.437	0.439	0.444	0.234	0.235	0.237	0.125	0.128	0.129	222.3	234.4	236.4	0.353	0.358	0.36
3086071	0.223	0.223	0.225	0.093	0.094	0.095	92.4	95.4	98.4	0.306	0.306	0.308	0.15	0.151	0.153	0.043	0.043	0.044	63.7	64.3	64.9	0.207	0.208	0.209
3086081	0.319	0.321	0.323	0.197	0.198	0.198	116.2	123.4	124.6	0.444	0.445	0.445	0.27	0.271	0.272	0.145	0.146	0.146	103.2	105.3	107.3	0.381	0.382	0.382
317706	0.238	0.239	0.246	0.128	0.13	0.131	155.6	160.7	163.3	0.357	0.36	0.362	0.207	0.21	0.21	0.096	0.097	0.099	137.0	138.5	145.1	0.309	0.312	0.315
317715	0.248	0.249	0.25	0.137	0.137	0.139	117.5	125.0	127.8	0.371	0.371	0.372	0.233	0.234	0.236	0.124	0.125	0.125	115.5	116.3	118.1	0.353	0.353	0.354
320280	0.176	0.177	0.178	0.064	0.064	0.065	112.6	114.1	117.3	0.253	0.254	0.255	0.144	0.146	0.148	0.042	0.044	0.044	92.8	98.1	99.3	0.206	0.209	0.21
320287	0.171	0.172	0.172	0.056	0.057	0.057	80.5	81.9	82.7	0.237	0.238	0.238	0.148	0.165	0.167	0.068	0.123	0.125	66.5	68.1	69.3	0.26	0.351	0.354
3410061	0.269	0.269	0.27	0.162	0.162	0.164	125.5	129.2	134.3	0.402	0.403	0.405	0.234	0.234	0.235	0.127	0.128	0.129	102.4	106.1	109.2	0.356	0.358	0.359

TABLE VI
PREDICTION PERFORMANCE ON NEW, HANDOVER, AND TOTAL CALLS DATASET AND FLOW, SPEED, NEW, HANDOVER, AND TOTAL CALLS DATASET
A MIXTURE OF TWO LOG-NORMALLY DISTRIBUTED CALL DURATION TIMES
15-21 (7) WEEKS, 3:2:2 DATA SPLIT

BS	New HO Calls												Flow Speed New HO Calls											
	MAE			MSE			MAPE			RMSE			MAE			MSE			MAPE			RMSE		
	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max
3054051	0.28	0.28	0.283	0.189	0.191	0.192	304.9	310.7	316.1	0.435	0.437	0.439	0.235	0.236	0.239	0.128	0.131	0.131	223.2	228.3	230.8	0.358	0.361	0.362
3086071	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3086081	0.314	0.317	0.319	0.19	0.191	0.192	120.4	122.0	125.4	0.436	0.436	0.438	0.269	0.269	0.273	0.143	0.143	0.144	104.9	106.5	108.1	0.378	0.379	0.379
317706	0.234	0.237	0.241	0.124	0.126	0.131	155.3	158.8	161.2	0.353	0.356	0.361	0.207	0.207	0.21	0.095	0.096	0.100	130.2	139.3	144.5	0.309	0.31	0.316
317715	0.248	0.249	0.251	0.139	0.14	0.14	123.4	124.7	128.9	0.372	0.374	0.374	0.233	0.233	0.237	0.124	0.124	0.125	116.0	116.3	123.6	0.352	0.352	0.354
320280	0.172	0.174	0.176	0.059	0.059	0.061	100.2	105.4	111.4	0.243	0.244	0.247	0.143	0.145	0.15	0.042	0.043	0.045	94.4	96.7	101.3	0.205	0.206	0.211
320287	0.17	0.17	0.171	0.055	0.056	0.056	80.5	81.8	82.9	0.236	0.236	0.237	0.144	0.155	0.171	0.054	0.083	0.12	67.8	68.4	70.5	0.233	0.289	0.346
3410061	0.269	0.274	0.278	0.162	0.164	0.168	117.6	135.6	141.4	0.403	0.405	0.41	0.236	0.236	0.237	0.128	0.13	0.131	104.3	106.6	111.1	0.358	0.36	0.362

TABLE VII
PREDICTION PERFORMANCE WITH GAUSSIAN NOISE ADDED TO THE FLOW
A MIXTURE OF TWO LOG-NORMALLY DISTRIBUTED CALL DURATION TIMES
15-21 (7) WEEKS, 3:2:2 DATA SPLIT

BS	Flow Speed Calls												Flow Speed New HO Calls											
	MAE			MSE			MAPE			RMSE			MAE			MSE			MAPE			RMSE		
	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max
3054051	0.236	0.239	0.246	0.128	0.132	0.133	221.4	234.4	240.2	0.358	0.363	0.364	0.237	0.24	0.243	0.13	0.132	0.134	220.5	232.3	234.6	0.361	0.363	0.365
3086071	0.165	0.166	0.167	0.049	0.050	0.050	70.1	71.5	72.5	0.222	0.223	0.225	-	-	-	-	-	-	-	-	-	-	-	-
3086081	0.278	0.279	0.281	0.15	0.151	0.152	109.4	109.5	112.5	0.388	0.388	0.39	0.276	0.277	0.278	0.148	0.149	0.149	107.8	109.0	111.9	0.385	0.386	0.386
317706	0.211	0.212	0.217	0.099	0.099	0.105	131.0	136.6	142.7	0.314	0.315	0.324	0.212	0.214	0.221	0.1	0.102	0.105	133.4	140.7	145.5	0.317	0.319	0.325
317715	0.235	0.236	0.238	0.125	0.126	0.129	114.1	116.6	119.8	0.354	0.355	0.359	0.234	0.235	0.236	0.124	0.125	0.126	115.6	116.8	119.7	0.353	0.354	0.355
320280	0.154	0.159	0.16	0.047	0.050	0.052	89.3	89.3	99.9	0.216	0.224	0.228	0.155	0.156	0.16	0.047	0.048	0.051	88.3	91.5	94.2	0.217	0.219	0.227
320287	0.168	0.169	0.182	0.084	0.098	0.142	72.7	74.6	75.5	0.289	0.314	0.376	0.151	0.162	0.175	0.047	0.066	0.114	70.7	71.5	74.2	0.217	0.258	0.337
3410061	0.237	0.239	0.239	0.129	0.129	0.13	101.2	105.9	109.0	0.359	0.36	0.361	0.237	0.241	0.243	0.13	0.131	0.137	108.0	110.1	111.2	0.361	0.363	0.37

A. *Difference in prediction error when using population dynamics statistics*

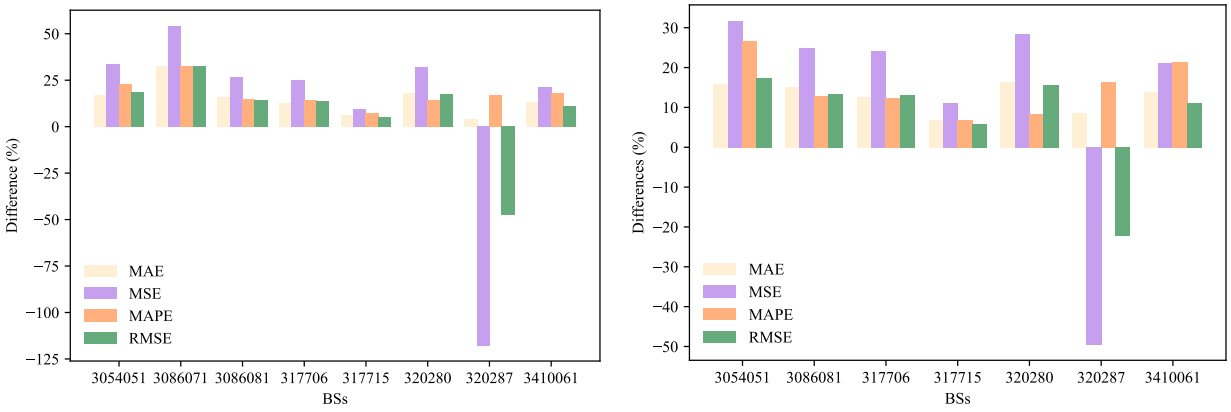

Fig. 15. Difference in prediction error when employing (**left**) calls (baseline) only data vs the same dataset (C) combined with flow and speed statistics (FSC); (**right**) NHC vs FSNHC.

B. *How much can handover statistics help?*

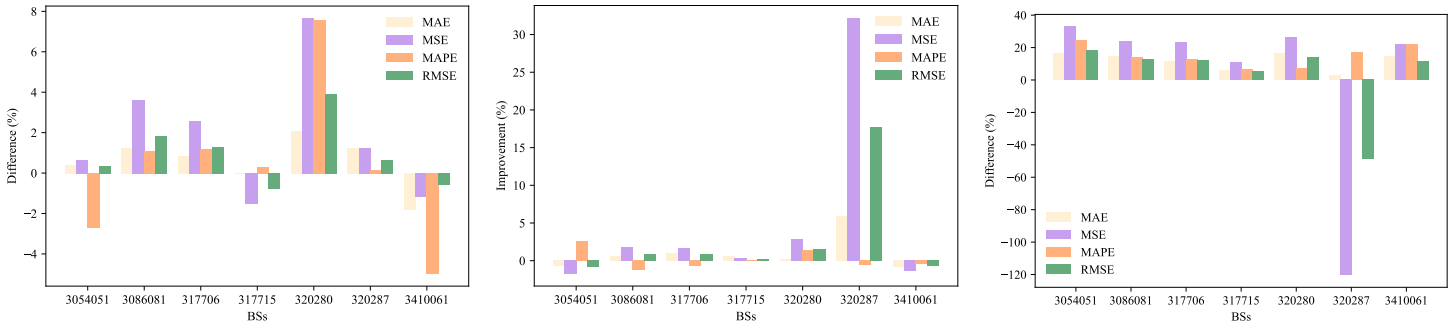

Fig. 16. (***left***) Calls (baseline) vs the same dataset augmented with new and handover calls (NHC). (**center**) FSC (baseline) vs FSNHC. (**right**) NHC dataset (baseline) vs FSC.

C. *Differences in prediction errors when using population dynamics statistics (vehicular flow estimated with errors)*

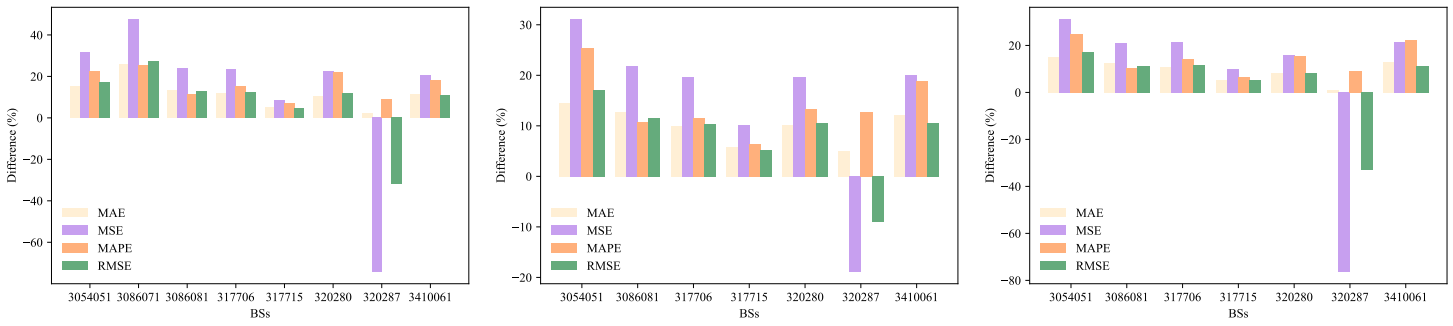

Fig. 17. (**left**) Calls vs the same data (C) augmented with vehicular flow estimated with errors and with speed statsistics $\hat{F}$SC. (**center**) NHC vs $\hat{F}$SNHC. (**right**) NHC vs $\hat{F}$SC.

V. Prediction performance results: a mixture of two log-normally distributed call durations and 4:1:2 data split

TABLE VIII
PREDICTION PERFORMANCE ON CALLS DATASET AND FLOW, SPEED, AND CALLS DATASET
A MIXTURE OF TWO LOG-NORMALLY DISTRIBUTED CALL DURATION TIMES
15-21 (7) WEEKS, 4:1:2 DATA SPLIT

BS	Calls												Flow Speed Calls											
	MAE			MSE			MAPE			RMSE			MAE			MSE			MAPE			RMSE		
	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max
3054051	0.279	0.284	0.285	0.192	0.193	0.194	135.4	140.3	145.6	0.438	0.439	0.441	0.233	0.236	0.238	0.127	0.128	0.13	114.3	116.2	117.8	0.356	0.357	0.361
3086071	0.222	0.223	0.224	0.093	0.093	0.094	97.3	98.8	100.3	0.305	0.305	0.307	0.15	0.15	0.152	0.043	0.043	0.044	65.6	66.7	68.0	0.207	0.207	0.209
3086081	0.317	0.318	0.319	0.194	0.195	0.196	131.7	135.3	139.8	0.441	0.441	0.442	0.269	0.269	0.272	0.144	0.144	0.145	115.9	117.5	121.1	0.379	0.38	0.381
317706	0.235	0.236	0.239	0.127	0.129	0.131	243.7	249.4	254.3	0.357	0.358	0.361	0.211	0.212	0.213	0.099	0.101	0.102	209.6	222.0	231.2	0.315	0.318	0.32
317715	0.246	0.248	0.249	0.136	0.136	0.137	201.0	206.3	217.4	0.368	0.369	0.369	0.23	0.231	0.234	0.121	0.122	0.123	189.2	192.6	204.5	0.348	0.349	0.351
320280	0.171	0.171	0.173	0.060	0.060	0.061	109.2	110.2	111.5	0.245	0.245	0.247	0.137	0.139	0.14	0.038	0.038	0.038	83.2	85.6	88.5	0.195	0.195	0.196
320287	0.168	0.169	0.17	0.054	0.055	0.055	84.7	86.0	87.8	0.233	0.235	0.235	0.131	0.132	0.134	0.034	0.034	0.035	69.3	71.1	74.0	0.184	0.185	0.188
3410061	0.267	0.268	0.268	0.16	0.161	0.161	124.7	126.5	132.4	0.399	0.401	0.401	0.232	0.234	0.236	0.124	0.126	0.127	108.4	109.6	113.0	0.352	0.355	0.356

TABLE IX
PREDICTION PERFORMANCE ON NEW, HANDOVER, AND TOTAL CALLS DATASET AND FLOW, SPEED, NEW, HANDOVER, AND TOTAL CALLS DATASET
A MIXTURE OF TWO LOG-NORMALLY DISTRIBUTED CALL DURATION TIMES
15-21 (7) WEEKS, 4:1:2 DATA SPLIT

BS	New HO Calls												Flow Speed New HO Calls											
	MAE			MSE			MAPE			RMSE			MAE			MSE			MAPE			RMSE		
	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max
3054051	0.275	0.283	0.286	0.183	0.191	0.193	131.7	141.9	147.8	0.428	0.437	0.439	0.235	0.238	0.24	0.129	0.13	0.133	111.9	112.8	116.6	0.359	0.361	0.365
3086071	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3086081	0.312	0.314	0.319	0.19	0.19	0.191	132.4	137.4	138.2	0.436	0.436	0.437	0.268	0.27	0.272	0.143	0.143	0.144	118.2	119.5	122.9	0.378	0.378	0.379
317706	0.236	0.238	0.242	0.128	0.131	0.133	231.2	236.9	260.6	0.358	0.362	0.365	0.208	0.211	0.216	0.099	0.101	0.107	204.6	223.2	234.0	0.314	0.317	0.326
317715	0.248	0.25	0.253	0.137	0.138	0.138	207.2	213.3	228.2	0.37	0.371	0.372	0.23	0.23	0.234	0.121	0.121	0.124	193.7	196.7	204.6	0.347	0.348	0.353
320280	0.166	0.167	0.167	0.055	0.055	0.056	99.1	100.7	101.1	0.235	0.235	0.236	0.138	0.139	0.142	0.038	0.038	0.040	83.5	84.5	88.5	0.194	0.195	0.199
320287	0.168	0.169	0.169	0.054	0.055	0.055	81.6	86.6	87.2	0.232	0.234	0.234	0.13	0.132	0.133	0.033	0.034	0.036	67.7	69.4	71.8	0.183	0.185	0.189
3410061	0.265	0.269	0.271	0.16	0.161	0.164	120.0	133.4	135.8	0.4	0.401	0.405	0.233	0.234	0.237	0.125	0.126	0.127	108.7	109.6	111.8	0.354	0.355	0.356

TABLE X
PREDICTION PERFORMANCE WITH GAUSSIAN NOISE ADDED TO THE FLOW
A MIXTURE OF TWO LOG-NORMALLY DISTRIBUTED CALL DURATION TIMES
15-21 (7) WEEKS, 4:1:2 DATA SPLIT

BS	Flow Speed Calls												Flow Speed New HO Calls											
	MAE			MSE			MAPE			RMSE			MAE			MSE			MAPE			RMSE		
	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max
3054051	0.235	0.237	0.244	0.129	0.131	0.141	112.6	116.4	118.3	0.359	0.363	0.375	0.237	0.24	0.245	0.128	0.132	0.134	113.0	116.3	121.3	0.358	0.364	0.366
3086071	0.165	0.165	0.166	0.049	0.050	0.050	72.4	73.1	74.4	0.222	0.223	0.223	-	-	-	-	-	-	-	-	-	-	-	-
3086081	0.276	0.277	0.281	0.149	0.149	0.151	122.2	126.1	132.0	0.386	0.386	0.389	0.275	0.275	0.277	0.147	0.148	0.15	122.6	125.3	129.1	0.383	0.385	0.388
317706	0.213	0.215	0.223	0.101	0.104	0.113	207.5	219.0	247.8	0.317	0.322	0.336	0.212	0.212	0.216	0.099	0.102	0.104	214.1	220.2	222.5	0.315	0.319	0.323
317715	0.233	0.233	0.235	0.123	0.123	0.124	195.8	196.2	197.5	0.351	0.351	0.352	0.233	0.234	0.236	0.123	0.123	0.125	186.5	199.9	202.5	0.351	0.351	0.354
320280	0.148	0.149	0.152	0.043	0.043	0.044	94.7	97.3	98.0	0.207	0.208	0.21	0.147	0.15	0.151	0.042	0.044	0.044	92.4	94.6	96.4	0.206	0.209	0.21
320287	0.142	0.143	0.145	0.039	0.039	0.040	73.5	75.7	76.3	0.196	0.198	0.201	0.142	0.144	0.146	0.039	0.039	0.040	74.2	74.9	76.5	0.196	0.198	0.201
3410061	0.234	0.236	0.237	0.126	0.127	0.129	103.2	109.3	110.6	0.355	0.357	0.36	0.236	0.236	0.237	0.126	0.127	0.129	104.4	107.9	111.6	0.356	0.357	0.359

A. *Prediction error reduction when using population dynamics statistics*

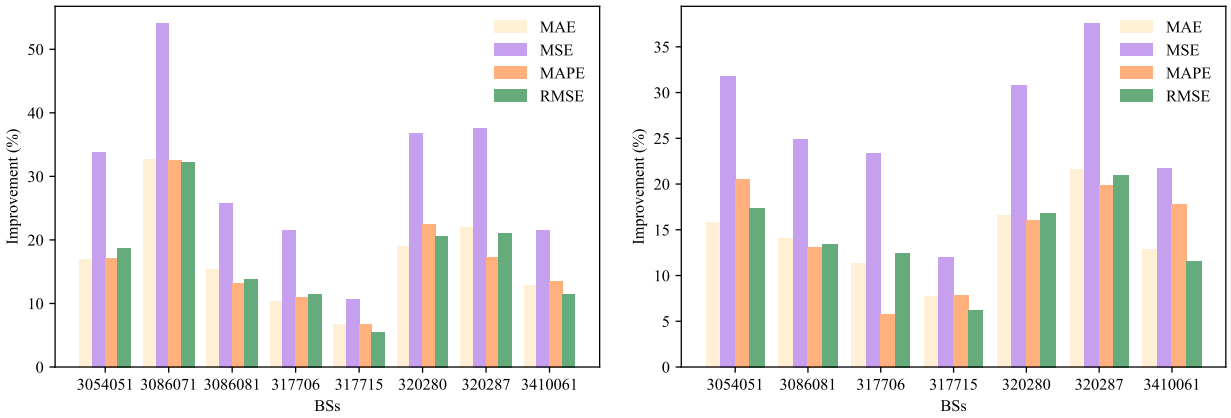

Fig. 18. Improvement in prediction when employing (**left**) calls vs the same data combined with flow and speed statistics (FSC); (**right**) NHC vs FSNHC.

B. *How much can handover statistics help?*

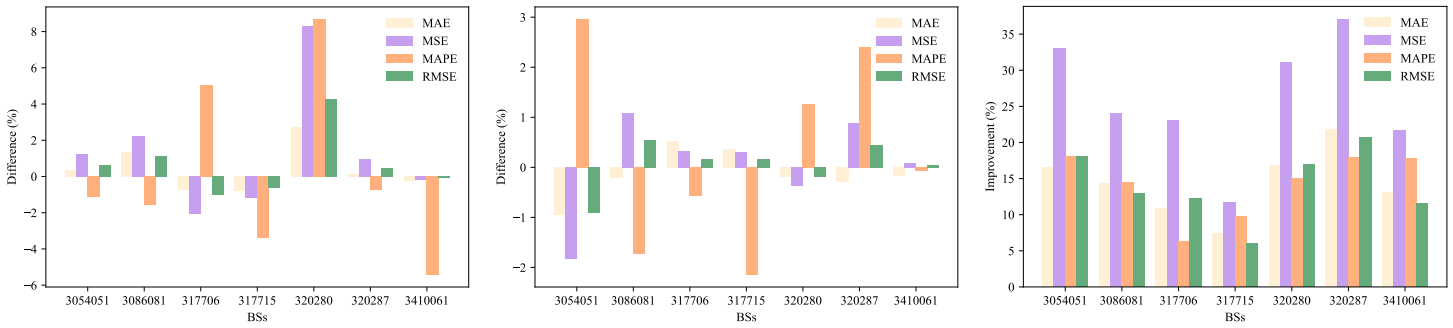

Fig. 19. (**left**) Calls (C) vs the same data (C) augmented with new and handover calls (NHC). (**center**) FSC vs FSNHC. (**right**) NHC dataset vs FSC.

C. *Prediction error reduction when the vehicular flow is estimated with errors*

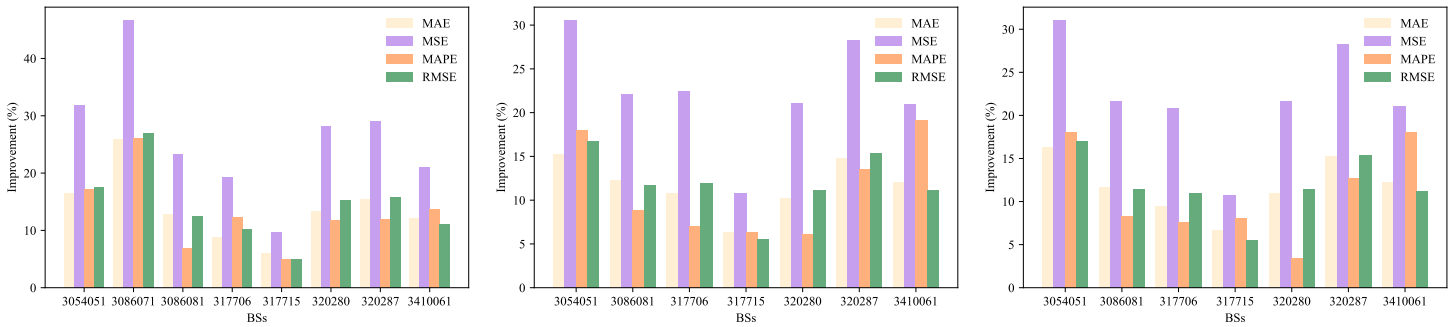

Fig. 20. (**left**) Calls (C) vs the same data (C) augmented with vehicular flow estimated with errors and with speed metrics $\hat{F}$SC. (**center**) NHC vs $\hat{F}$SNHC. (**right**) NHC vs $\hat{F}$SC.

VI. Prediction performance results: exponentially distributed call duration and 12:6:6 data split

Exponential call duration time with mean 1 minute. For each error measure — MAE, MSE, MAPE, and RMSE — the minimum, median and maximum of 5 simulation runs are reported.

TABLE XI
PREDICTION PERFORMANCE ON CALLS DATASET AND FLOW, SPEED AND CALLS DATASET
EXPONENTIALLY DISTRIBUTED CALL DURATION TIME
24 WEEKS, 12:6:6 DATA SPLIT

BS	Calls												Flow Speed Calls											
	MAE			MSE			MAPE			RMSE			MAE			MSE			MAPE			RMSE		
	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max
3054051	0.483	0.493	0.5	0.584	0.6	0.607	129.7	135.9	141.6	0.764	0.775	0.779	0.317	0.319	0.336	0.231	0.234	0.246	82.5	85.3	92.8	0.48	0.484	0.496
3086071	0.282	0.283	0.283	0.151	0.152	0.152	2084.6	2107.8	2113.4	0.389	0.389	0.389	0.187	0.187	0.189	0.066	0.066	0.066	1347.1	1376.6	1387.7	0.257	0.257	0.257
3086081	0.396	0.398	0.402	0.315	0.315	0.318	103.9	105.0	106.4	0.561	0.561	0.564	0.327	0.331	0.334	0.217	0.218	0.222	87.5	88.0	93.7	0.466	0.467	0.471
317706	0.159	0.162	0.164	0.064	0.066	0.069	127.4	132.2	135.7	0.254	0.258	0.262	0.1	0.103	0.109	0.024	0.027	0.038	80.3	82.1	84.7	0.154	0.164	0.194
317715	0.27	0.274	0.278	0.147	0.151	0.152	108.0	110.1	113.0	0.384	0.388	0.389	0.207	0.207	0.21	0.086	0.087	0.087	77.1	77.6	80.4	0.294	0.295	0.296
320280	0.073	0.082	0.086	0.011	0.012	0.012	38.3	38.6	39.9	0.103	0.109	0.111	0.049	0.053	0.055	0.005	0.005	0.005	26.2	27.1	28.7	0.068	0.070	0.071
320287	0.058	0.058	0.059	0.007	0.007	0.007	55.5	56.3	58.3	0.082	0.082	0.084	0.041	0.041	0.042	0.003	0.003	0.004	42.4	43.0	43.5	0.058	0.059	0.060
3410061	0.398	0.402	0.408	0.335	0.343	0.349	104.6	109.7	116.9	0.579	0.586	0.59	0.295	0.297	0.3	0.187	0.188	0.189	72.5	73.0	73.6	0.432	0.433	0.434

TABLE XII
PREDICTION PERFORMANCE ON NEW, HO, AND TOTAL CALLS DATASET AND FLOW, SPEED, NEW, HO AND TOTAL CALLS DATASET
EXPONENTIALLY DISTRIBUTED CALL DURATION TIME
24 WEEKS, 12:6:6 DATA SPLIT

BS	New HO Calls												Flow Speed New HO Calls											
	MAE			MSE			MAPE			RMSE			MAE			MSE			MAPE			RMSE		
	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max
3054051	0.481	0.485	0.489	0.588	0.596	0.604	124.2	125.4	130.6	0.767	0.772	0.777	0.324	0.327	0.335	0.239	0.245	0.253	85.2	87.4	93.5	0.489	0.495	0.503
3086071	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3086081	0.392	0.393	0.394	0.308	0.309	0.31	98.4	101.3	104.9	0.555	0.556	0.557	0.329	0.33	0.331	0.218	0.219	0.222	87.2	87.8	91.2	0.467	0.467	0.471
317706	0.155	0.159	0.163	0.062	0.063	0.065	130.9	131.7	137.5	0.25	0.251	0.254	0.099	0.102	0.103	0.023	0.026	0.028	81.0	81.5	81.7	0.152	0.16	0.167
317715	0.269	0.271	0.277	0.147	0.149	0.149	105.4	109.8	111.7	0.384	0.386	0.386	0.208	0.209	0.214	0.087	0.088	0.089	75.6	79.9	80.7	0.296	0.297	0.299
320280	0.073	0.082	0.091	0.010	0.011	0.013	35.4	37.4	39.1	0.102	0.107	0.113	0.047	0.049	0.053	0.004	0.005	0.005	24.7	25.1	25.6	0.067	0.067	0.069
320287	0.057	0.058	0.059	0.006	0.007	0.007	54.3	54.7	55.3	0.080	0.081	0.082	0.041	0.042	0.044	0.003	0.004	0.004	43.6	44.4	44.6	0.059	0.061	0.064
3410061	0.399	0.407	0.408	0.339	0.341	0.357	105.5	109.4	116.1	0.582	0.584	0.597	0.296	0.3	0.301	0.188	0.189	0.193	72.9	73.2	76.8	0.433	0.435	0.439

TABLE XIII
PREDICTION PERFORMANCE WITH GAUSSIAN NOISE ADDED TO THE FLOW
EXPONENTIALLY DISTRIBUTED CALL DURATION TIME
24 WEEKS, 12:6:6 DATA SPLIT

BS	Flow Speed Calls												Flow Speed New HO Calls											
	MAE			MSE			MAPE			RMSE			MAE			MSE			MAPE			RMSE		
	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max
3054051	0.323	0.324	0.333	0.235	0.237	0.244	85.6	86.4	93.2	0.485	0.487	0.493	0.326	0.327	0.338	0.24	0.242	0.258	85.4	87.0	91.5	0.49	0.492	0.508
3086071	0.204	0.204	0.205	0.075	0.075	0.076	1474.0	1483.0	1498.3	0.274	0.274	0.275	-	-	-	-	-	-	-	-	-	-	-	-
3086081	0.336	0.338	0.339	0.224	0.225	0.226	87.9	88.6	91.0	0.474	0.475	0.476	0.335	0.336	0.338	0.224	0.226	0.226	87.3	88.0	88.5	0.474	0.475	0.475
317706	0.108	0.109	0.11	0.027	0.027	0.028	86.3	87.6	88.7	0.163	0.165	0.168	0.109	0.111	0.113	0.029	0.036	0.037	85.0	86.8	89.3	0.171	0.189	0.193
317715	0.216	0.216	0.217	0.093	0.093	0.094	78.7	80.0	81.0	0.304	0.305	0.306	0.218	0.218	0.22	0.093	0.094	0.094	80.8	81.9	83.3	0.305	0.306	0.307
320280	0.060	0.061	0.066	0.006	0.007	0.007	30.9	31.5	32.2	0.079	0.081	0.084	0.059	0.062	0.065	0.006	0.007	0.007	28.5	29.2	30.7	0.078	0.081	0.082
320287	0.046	0.047	0.048	0.004	0.004	0.005	44.2	45.1	46.5	0.064	0.065	0.068	0.047	0.047	0.048	0.004	0.004	0.005	44.7	45.0	45.8	0.066	0.067	0.067
3410061	0.306	0.307	0.316	0.195	0.195	0.197	73.2	74.1	77.3	0.441	0.442	0.444	0.307	0.307	0.31	0.195	0.196	0.197	74.8	75.4	75.9	0.442	0.443	0.444

A. *Prediction error reduction when using population dynamics statistics*

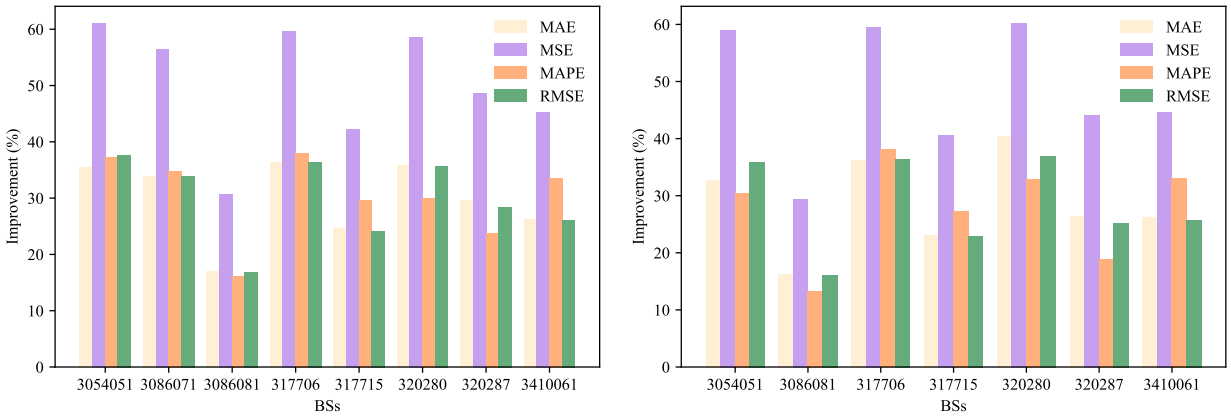

Fig. 21. Improvement in prediction when employing (**left**) calls vs the same data (C) combined with flow and speed statistics (FSC); (**right**) NHC vs FSNHC.

B. *How much can handover statistics help?*

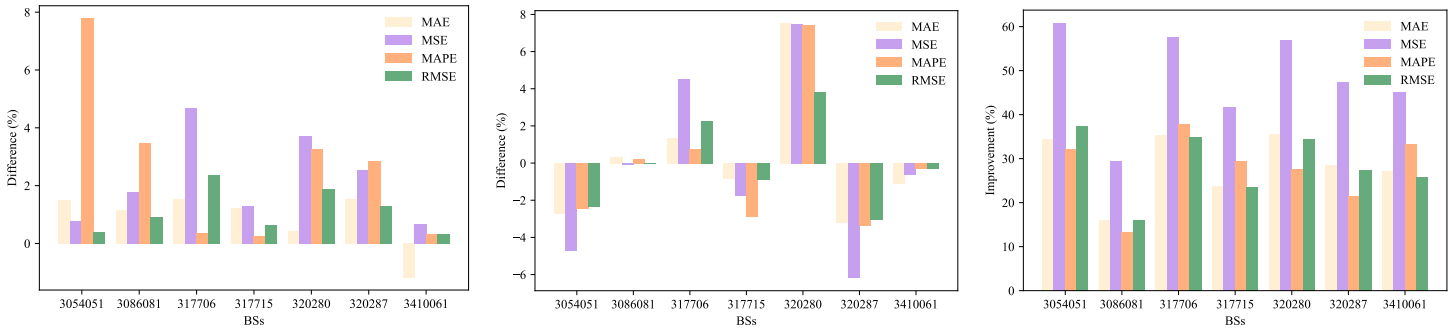

Fig. 22. (**left**) Calls (baseline) vs the same data (C) augmented with new and handover calls (NHC). (**center**) FSC vs FSNHC. (**right**) NHC dataset vs FSC.

C. *Prediction error reduction when the vehicular flow is estimated with errors*

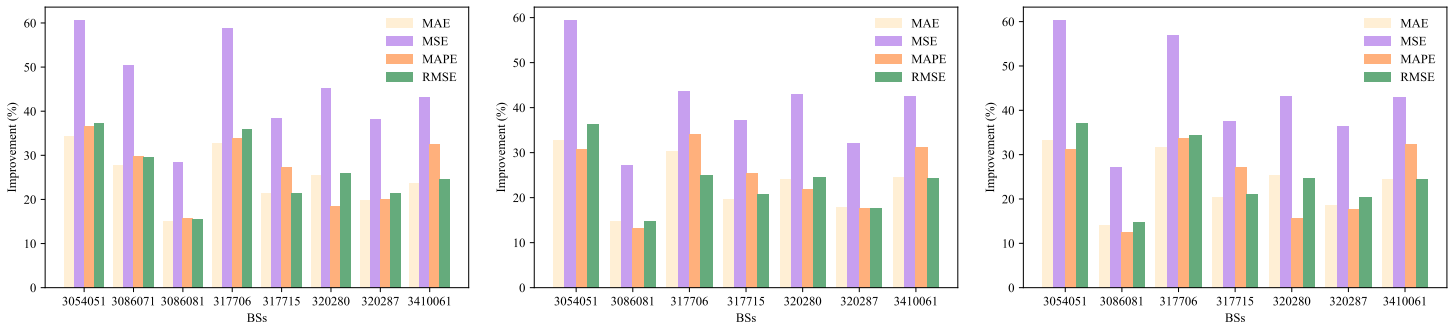

Fig. 23. (**left**) Calls vs the same data (C) augmented with vehicular flow estimated with errors and speed $\hat{F}$SC. (**center**) NHC vs $\hat{F}$SNHC. (**right**) NHC vs $\hat{F}$SC.

VII. Prediction performance results: exponentially distributed call duration and 3:2:2 data split

TABLE XIV
PREDICTION PERFORMANCE ON CALLS DATASET AND FLOW, SPEED AND CALLS DATASET
EXPONENTIALLY DISTRIBUTED CALL DURATION TIME
15-21 (7) WEEKS, 3:2:2 DATA SPLIT

BS	Calls												Flow Speed Calls											
	MAE			MSE			MAPE			RMSE			MAE			MSE			MAPE			RMSE		
	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max
3054051	0.339	0.341	0.345	0.277	0.283	0.286	125.5	130.7	136.8	0.526	0.532	0.534	0.223	0.224	0.227	0.108	0.111	0.111	86.8	89.8	90.6	0.329	0.333	0.334
3086071	0.227	0.228	0.228	0.096	0.096	0.096	99.6	100.0	102.4	0.309	0.309	0.31	0.15	0.15	0.15	0.042	0.042	0.042	73.1	73.7	74.7	0.205	0.205	0.206
3086081	0.329	0.33	0.333	0.211	0.212	0.213	329.3	339.5	349.5	0.459	0.461	0.461	0.27	0.271	0.272	0.148	0.148	0.149	258.9	264.0	269.8	0.384	0.385	0.386
317706	0.233	0.234	0.237	0.123	0.126	0.128	206.9	212.0	229.2	0.35	0.356	0.357	0.154	0.156	0.164	0.051	0.051	0.056	134.8	138.0	141.1	0.225	0.227	0.237
317715	0.3	0.302	0.304	0.178	0.179	0.18	123.0	126.6	130.1	0.422	0.423	0.424	0.231	0.233	0.236	0.111	0.112	0.113	89.9	91.6	92.5	0.334	0.335	0.337
320280	0.186	0.187	0.188	0.073	0.073	0.074	90.6	93.0	94.8	0.27	0.271	0.271	0.126	0.126	0.128	0.032	0.033	0.033	64.9	65.8	68.1	0.179	0.18	0.181
320287	0.176	0.176	0.179	0.061	0.061	0.062	80.6	81.4	82.1	0.247	0.247	0.248	0.138	0.145	0.154	0.060	0.082	0.124	52.1	52.6	53.6	0.244	0.287	0.352
3410061	0.302	0.305	0.307	0.19	0.191	0.192	108.8	114.4	117.8	0.436	0.437	0.438	0.225	0.228	0.23	0.109	0.11	0.111	80.1	81.0	82.8	0.331	0.331	0.333

TABLE XV
PREDICTION PERFORMANCE ON NEW, HO, AND TOTAL CALLS DATASET AND FLOW, SPEED, NEW, HO, AND TOTAL CALLS DATASET
EXPONENTIALLY DISTRIBUTED CALL DURATION TIME
15-21 (7) WEEKS, 3:2:2 DATA SPLIT

BS	New HO Calls												Flow Speed New HO Calls											
	MAE			MSE			MAPE			RMSE			MAE			MSE			MAPE			RMSE		
	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max
3054051	0.339	0.34	0.345	0.272	0.276	0.278	119.1	135.5	136.6	0.522	0.526	0.527	0.222	0.224	0.23	0.11	0.111	0.113	88.6	91.2	93.1	0.332	0.333	0.337
3086071	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3086081	0.325	0.327	0.332	0.207	0.208	0.208	320.6	326.6	338.7	0.455	0.456	0.456	0.27	0.272	0.272	0.147	0.147	0.148	257.5	262.1	264.6	0.383	0.383	0.384
317706	0.226	0.234	0.238	0.111	0.119	0.122	191.6	210.0	237.7	0.333	0.345	0.349	0.156	0.159	0.165	0.053	0.055	0.061	133.7	138.8	144.1	0.23	0.234	0.247
317715	0.297	0.304	0.306	0.177	0.178	0.181	123.0	126.1	132.4	0.421	0.422	0.425	0.231	0.232	0.234	0.111	0.112	0.113	90.2	91.3	93.4	0.334	0.335	0.336
320280	0.185	0.185	0.188	0.071	0.072	0.073	88.1	88.9	91.5	0.266	0.268	0.271	0.127	0.128	0.14	0.032	0.034	0.040	66.2	68.1	76.2	0.18	0.185	0.2
320287	0.173	0.173	0.177	0.059	0.059	0.061	79.1	81.2	83.9	0.242	0.243	0.246	0.142	0.147	0.15	0.060	0.083	0.088	52.5	52.9	57.1	0.246	0.288	0.296
3410061	0.303	0.308	0.311	0.193	0.193	0.197	112.2	114.8	123.7	0.439	0.439	0.444	0.225	0.228	0.231	0.11	0.111	0.112	80.7	81.0	82.3	0.331	0.334	0.335

TABLE XVI
PREDICTION PERFORMANCE WITH GAUSSIAN NOISE ADDED TO THE FLOW
EXPONENTIALLY DISTRIBUTED CALL DURATION TIME
15-21 (7) WEEKS, 3:2:2 DATA SPLIT

BS	Flow Speed Calls												Flow Speed New HO Calls											
	MAE			MSE			MAPE			RMSE			MAE			MSE			MAPE			RMSE		
	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max
3054051	0.228	0.23	0.231	0.113	0.113	0.115	90.9	91.2	92.4	0.336	0.336	0.338	0.226	0.229	0.231	0.114	0.115	0.123	90.8	92.7	95.6	0.337	0.34	0.351
3086071	0.164	0.165	0.166	0.048	0.048	0.048	79.0	79.4	80.6	0.219	0.22	0.22	-	-	-	-	-	-	-	-	-	-	-	-
3086081	0.277	0.278	0.279	0.153	0.153	0.153	258.2	260.6	263.6	0.391	0.391	0.391	0.276	0.277	0.279	0.151	0.151	0.153	254.2	261.4	266.6	0.389	0.389	0.391
317706	0.168	0.169	0.17	0.057	0.058	0.059	140.6	147.3	151.0	0.238	0.24	0.242	0.246	0.247	0.25	0.121	0.122	0.123	93.0	96.5	100.4	0.348	0.349	0.35
317715	0.245	0.246	0.247	0.121	0.122	0.123	91.8	96.3	97.9	0.348	0.349	0.351	0.148	0.148	0.149	0.043	0.044	0.046	71.7	73.5	75.9	0.208	0.21	0.214
320280	0.145	0.146	0.147	0.041	0.041	0.043	73.1	74.6	75.6	0.201	0.203	0.208	0.148	0.148	0.149	0.043	0.044	0.046	71.7	73.5	75.9	0.208	0.21	0.214
320287	0.153	0.161	0.169	0.061	0.084	0.126	59.9	61.3	63.3	0.246	0.29	0.355	0.156	0.161	0.175	0.066	0.085	0.138	60.9	61.7	64.8	0.257	0.291	0.371
3410061	0.232	0.233	0.237	0.113	0.115	0.116	81.0	82.1	83.0	0.336	0.338	0.34	0.232	0.235	0.237	0.114	0.115	0.117	80.5	81.3	84.1	0.337	0.339	0.342

A. *Difference in prediction error when using population dynamics statistics*

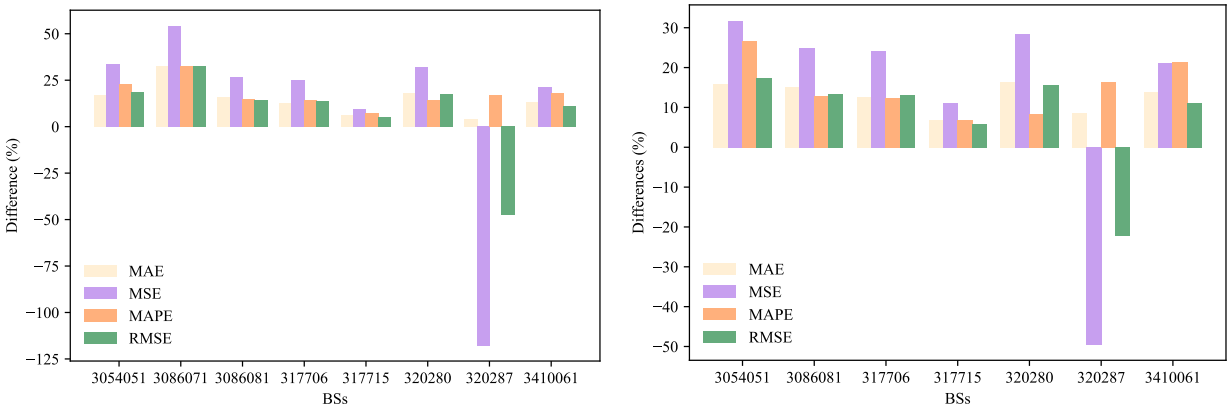

Fig. 24. Difference in prediction error when employing (**left**) calls (baseline) only data vs the same dataset (C) combined with flow and speed statistics (FSC); (**right**) NHC vs FSNHC.

B. *How much can handover statistics help?*

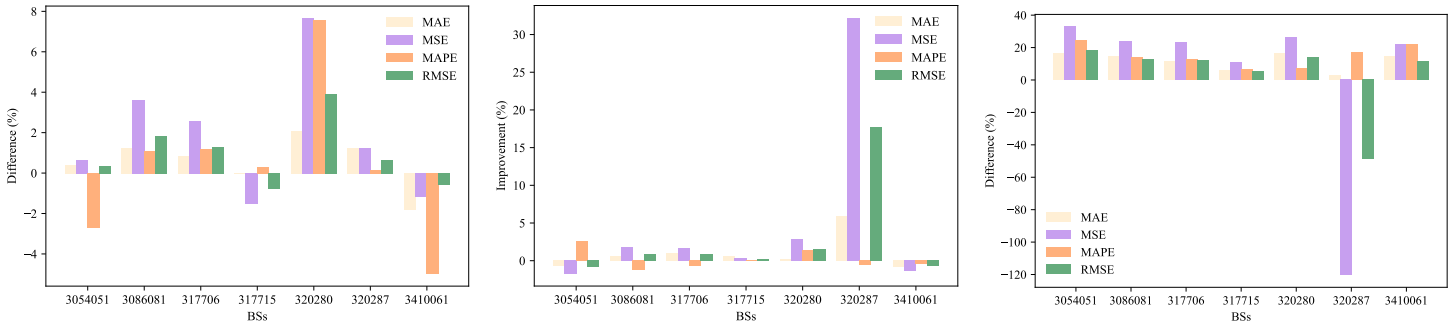

Fig. 25. (***left***) Calls (baseline) vs the same dataset augmented with new and handover calls (NHC). (**center**) FSC (baseline) vs FSNHC. (**right**) NHC dataset (baseline) vs FSC.

C. *Differences in prediction errors when using population dynamics statistics (vehicular flow estimated with errors)*

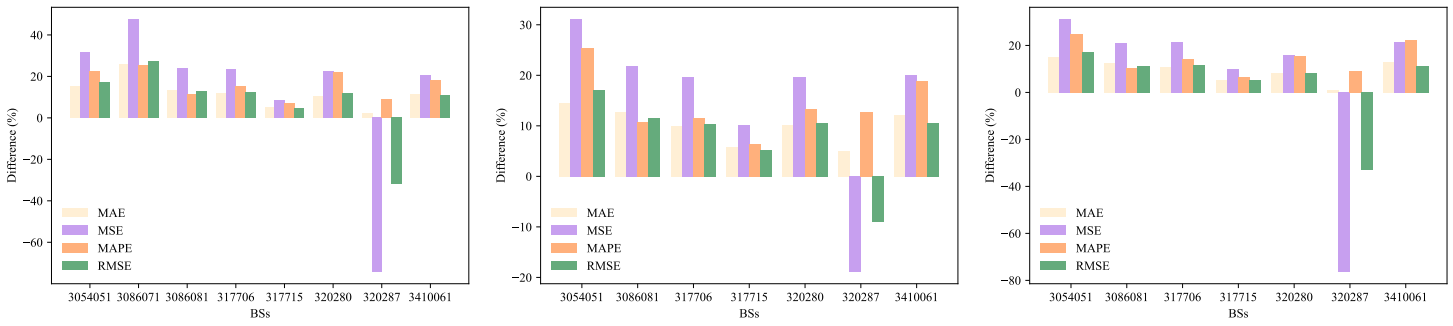

Fig. 26. (**left**) Calls vs the same data (C) augmented with vehicular flow estimated with errors and with speed statsistics $\hat{F}$SC. (**center**) NHC vs $\hat{F}$SNHC. (**right**) NHC vs $\hat{F}$SC.

VIII. Prediction performance results: exponentially distributed call duration and 4:1:2 data split

TABLE XVII
PREDICTION PERFORMANCE ON CALLS DATASET AND FLOW, SPEED AND CALLS DATASET
EXPONENTIALLY DISTRIBUTED CALL DURATION TIME
15-21 (7) WEEKS, 4:1:2 DATA SPLIT

BS	Calls												Flow Speed Calls											
	MAE			MSE			MAPE			RMSE			MAE			MSE			MAPE			RMSE		
	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max
3054051	0.337	0.342	0.345	0.265	0.269	0.271	157.9	162.6	165.3	0.515	0.518	0.52	0.223	0.224	0.225	0.109	0.109	0.112	111.4	114.1	117.0	0.33	0.33	0.335
3086071	0.227	0.228	0.228	0.095	0.096	0.096	104.7	105.7	107.6	0.309	0.309	0.309	0.15	0.15	0.151	0.042	0.042	0.043	74.3	75.1	75.7	0.205	0.206	0.206
3086081	0.329	0.331	0.333	0.214	0.214	0.216	460.1	486.5	496.8	0.463	0.463	0.464	0.272	0.273	0.274	0.149	0.15	0.151	381.4	388.5	398.7	0.386	0.388	0.389
317706	0.238	0.241	0.248	0.13	0.132	0.132	158.1	172.7	178.1	0.36	0.363	0.364	0.16	0.161	0.166	0.054	0.056	0.059	107.6	109.0	116.4	0.232	0.236	0.242
317715	0.299	0.3	0.302	0.178	0.179	0.181	121.4	123.7	127.8	0.422	0.423	0.425	0.232	0.233	0.234	0.111	0.111	0.112	87.2	90.7	92.2	0.333	0.334	0.335
320280	0.18	0.181	0.182	0.068	0.068	0.069	172.6	178.3	183.1	0.26	0.261	0.262	0.12	0.121	0.122	0.029	0.029	0.030	117.3	121.8	129.3	0.17	0.17	0.172
320287	0.173	0.174	0.175	0.059	0.059	0.059	125.8	128.9	130.7	0.243	0.244	0.244	0.121	0.123	0.125	0.029	0.030	0.031	75.1	76.2	77.3	0.171	0.174	0.177
3410061	0.299	0.3	0.303	0.187	0.188	0.189	139.6	144.3	146.3	0.433	0.434	0.434	0.225	0.226	0.228	0.108	0.109	0.11	104.1	105.4	108.1	0.328	0.33	0.332

TABLE XVIII
PREDICTION PERFORMANCE ON NEW, HO, AND TOTAL CALLS DATASET AND FLOW, SPEED, NEW, HO, AND TOTAL CALLS DATASET
EXPONENTIALLY DISTRIBUTED CALL DURATION TIME
15-21 (7) WEEKS, 4:1:2 DATA SPLIT

BS	New HO Calls												Flow Speed New HO Calls											
	MAE			MSE			MAPE			RMSE			MAE			MSE			MAPE			RMSE		
	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max
3054051	0.335	0.337	0.34	0.262	0.264	0.268	149.6	163.5	164.7	0.512	0.514	0.517	0.221	0.223	0.23	0.108	0.11	0.113	110.7	112.8	117.0	0.329	0.332	0.336
3086071	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3086081	0.326	0.328	0.33	0.21	0.21	0.211	471.4	489.6	502.5	0.458	0.458	0.46	0.271	0.272	0.276	0.148	0.149	0.151	383.4	387.9	407.7	0.384	0.387	0.389
317706	0.229	0.235	0.237	0.114	0.124	0.125	155.1	169.4	171.7	0.338	0.351	0.354	0.158	0.16	0.165	0.053	0.054	0.055	103.9	108.5	109.0	0.23	0.233	0.235
317715	0.298	0.299	0.299	0.177	0.177	0.178	121.2	122.1	123.9	0.42	0.421	0.422	0.231	0.233	0.237	0.111	0.112	0.112	85.6	89.8	92.6	0.334	0.335	0.335
320280	0.178	0.179	0.183	0.066	0.067	0.070	175.2	176.4	181.0	0.258	0.259	0.264	0.121	0.122	0.125	0.029	0.03	0.031	115.0	124.9	127.5	0.171	0.173	0.175
320287	0.17	0.171	0.173	0.057	0.057	0.057	123.0	127.9	128.2	0.238	0.238	0.239	0.122	0.124	0.125	0.03	0.030	0.031	74.1	75.4	79.0	0.173	0.174	0.176
3410061	0.3	0.304	0.312	0.188	0.189	0.199	136.3	143.7	147.0	0.434	0.435	0.446	0.228	0.228	0.229	0.109	0.111	0.112	102.9	104.4	106.2	0.331	0.333	0.335

TABLE XIX
PREDICTION PERFORMANCE WITH GAUSSIAN NOISE ADDED TO THE FLOW
EXPONENTIALLY DISTRIBUTED CALL DURATION TIME
15-21 (7) WEEKS, 4:1:2 DATA SPLIT

BS	Flow Speed Calls												Flow Speed New HO Calls											
	MAE			MSE			MAPE			RMSE			MAE			MSE			MAPE			RMSE		
	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max	min	mdn	max
3054051	0.229	0.23	0.232	0.114	0.115	0.115	111.7	115.1	119.8	0.337	0.338	0.339	0.229	0.23	0.24	0.114	0.115	0.116	114.6	116.7	118.4	0.337	0.339	0.34
3086071	0.165	0.165	0.165	0.048	0.048	0.048	80.7	81.7	83.9	0.219	0.22	0.22	-	-	-	-	-	-	-	-	-	-	-	-
3086081	0.279	0.279	0.283	0.154	0.154	0.157	383.7	393.3	405.7	0.392	0.393	0.397	0.278	0.281	0.281	0.152	0.153	0.155	381.8	388.2	397.2	0.39	0.392	0.394
317706	0.172	0.173	0.175	0.060	0.061	0.062	111.6	111.9	118.4	0.245	0.246	0.248	0.171	0.175	0.182	0.060	0.062	0.063	111.1	115.3	117.6	0.244	0.248	0.251
317715	0.244	0.244	0.247	0.12	0.12	0.121	92.0	93.5	97.6	0.346	0.347	0.348	0.244	0.245	0.246	0.12	0.12	0.121	90.5	94.0	95.4	0.346	0.347	0.349
320280	0.14	0.14	0.141	0.038	0.038	0.039	142.1	143.9	147.4	0.194	0.195	0.197	0.14	0.14	0.142	0.038	0.038	0.039	133.2	138.2	143.6	0.196	0.196	0.197
320287	0.139	0.139	0.142	0.036	0.037	0.038	94.7	96.9	104.0	0.191	0.192	0.194	0.137	0.138	0.14	0.035	0.036	0.037	92.1	97.3	98.4	0.188	0.191	0.192
3410061	0.231	0.234	0.236	0.111	0.112	0.115	103.6	104.9	106.1	0.334	0.335	0.339	0.233	0.235	0.239	0.113	0.115	0.117	102.6	105.4	109.1	0.336	0.339	0.341

A. *Prediction error reduction when using population dynamics statistics*

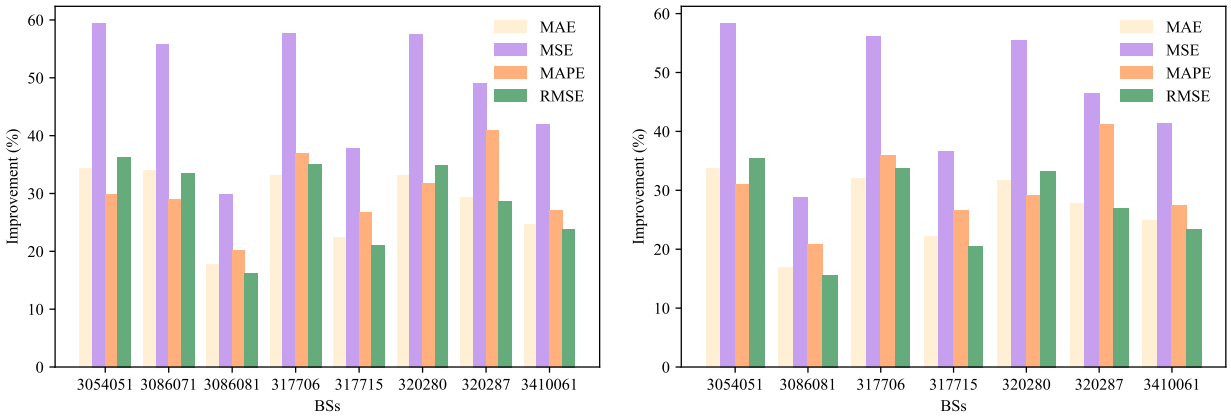

Fig. 27. Improvement in prediction when employing (**left**) calls vs the same data combined with flow and speed statistics (FSC); (**right**) NHC vs FSNHC.

B. *How much can handover statistics help?*

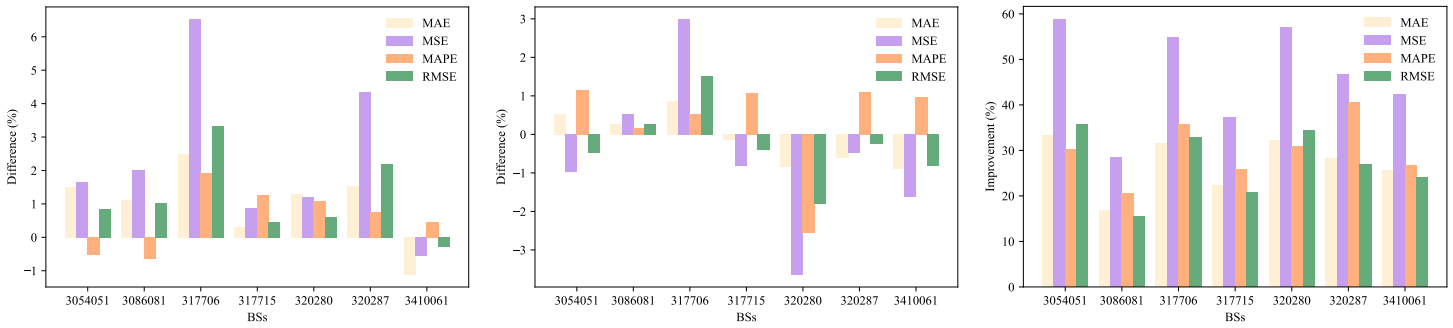

Fig. 28. (**left**) Calls (C) vs the same data (C) augmented with new and handover calls (NHC). (**center**) FSC vs FSNHC. (**right**) NHC dataset vs FSC.

C. *Prediction error reduction when the vehicular flow is estimated with errors*

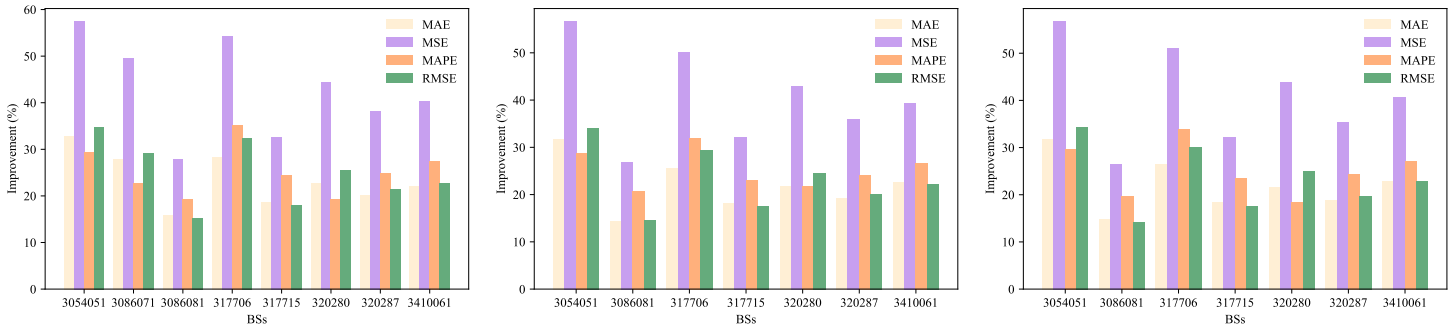

Fig. 29. (**left**) Calls (C) vs the same data (C) augmented with vehicular flow estimated with errors and with speed metrics $\hat{F}$SC. (**center**) NHC vs $\hat{F}$SNHC. (**right**) NHC vs $\hat{F}$SC.