RAND CORPORATION

Air Quality Analysis One

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12 August 2019

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1. Introduction:

- This analysis isolates a single, randomized week to experiment with data analysis and visualization as a start - that may be extracted to analyze the entire data set.

- The week 10/08/2018 through 10/14/2018 in Santa Monica was randomly selected, and the following metrics are examined: how area, zip code, day of the week/weekend, and time of day factor into air quality, as measured through changes in Particulate Matter 1.0, 2.5, 10.0 (ug/m3), Temperature, and Humidity.

- I intend to apply the randomized October week analysis to entire July 2018 through July 2019 data set, month by month. I intend to begin a Machine Learning Python & R certificate course this week to supplement analytical tools.

2. Sample Analysis of a Random week: 10/08 through 10/14, October 2018:

- During week of tested locations, 90025 Zip Code is most affected by 1.0, 2.5, and 10.0 Particulate Matter sizes and is of highest temperature (area not tested on weekend).

- Friday, Tuesday, Sunday (descending order) days are most affected by 1.0 PM and 2.5 PM. Friday had the second lowest humidity and temperature of the week.

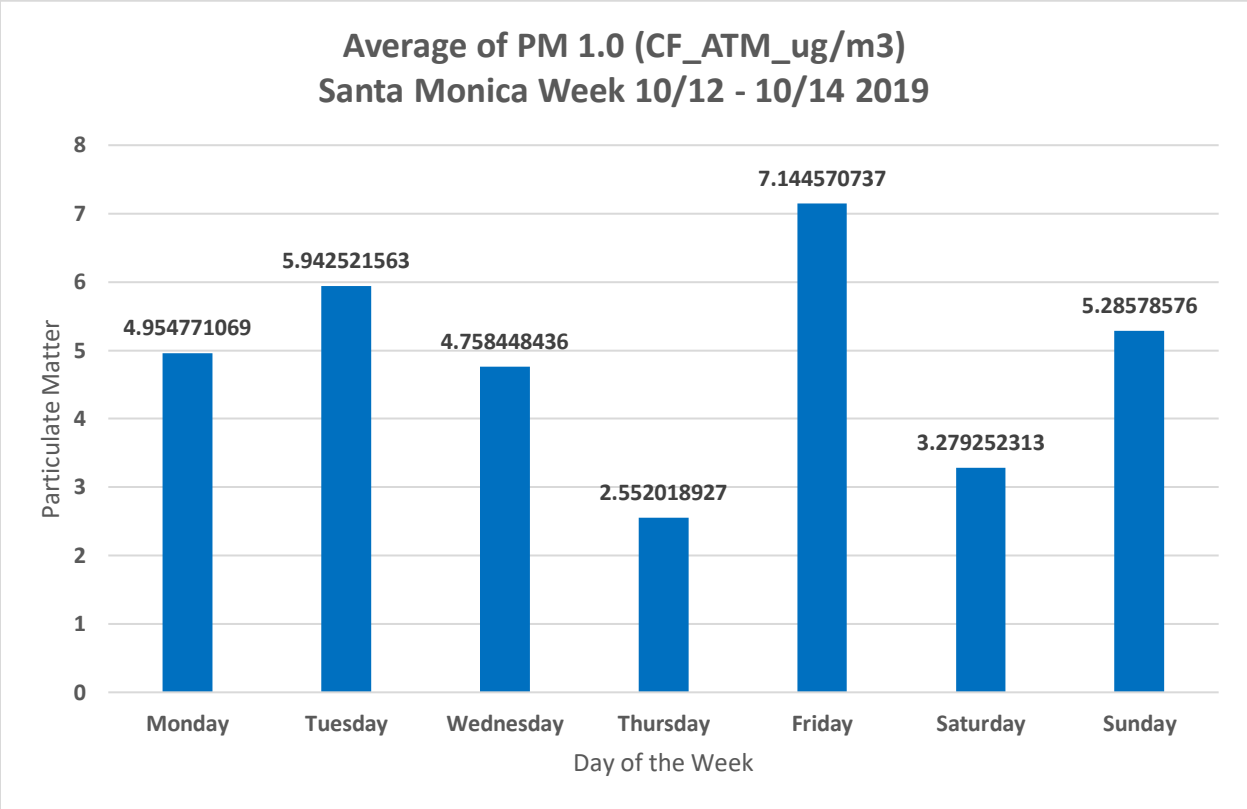
- Tuesday, Friday, Sunday (descending order) days are most affected by 10.0PM.

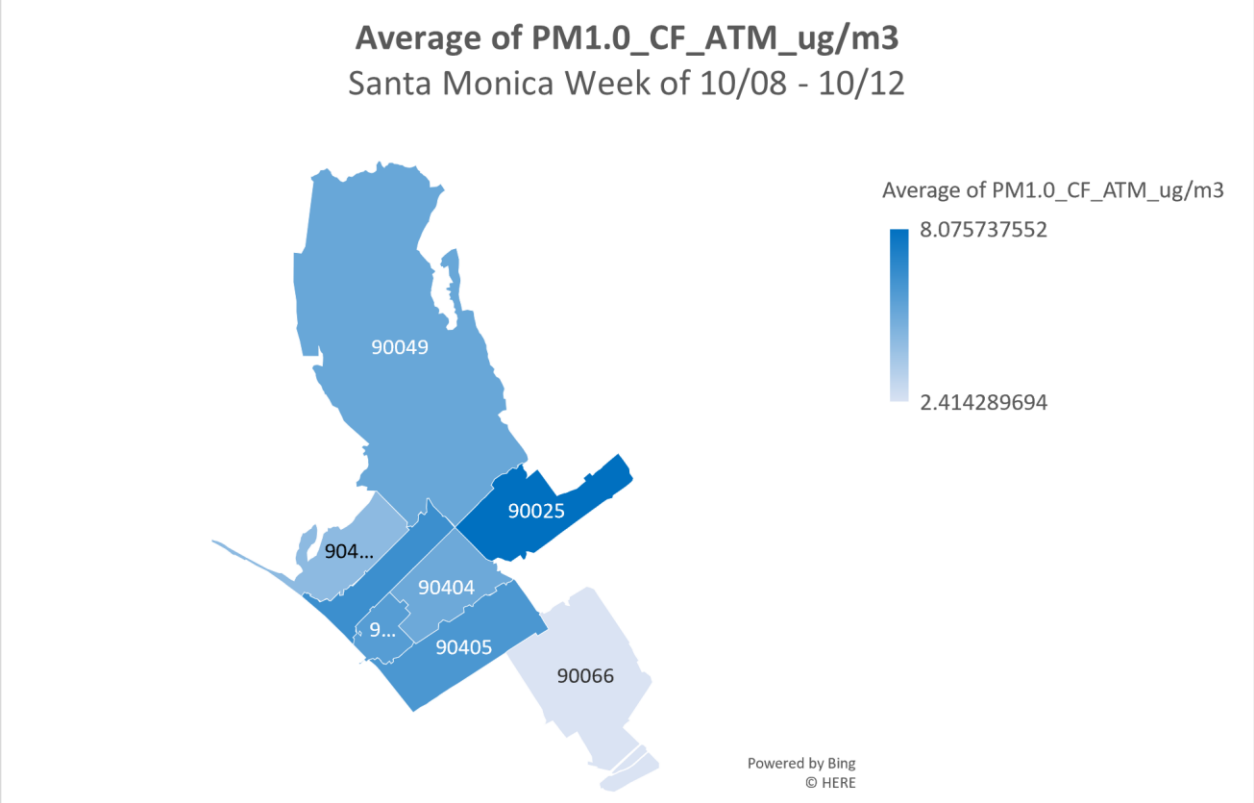
- Saturday, Thursday (ascending order) witness the lowest levels of all 1.0, 2.5, 10.0 PMs.

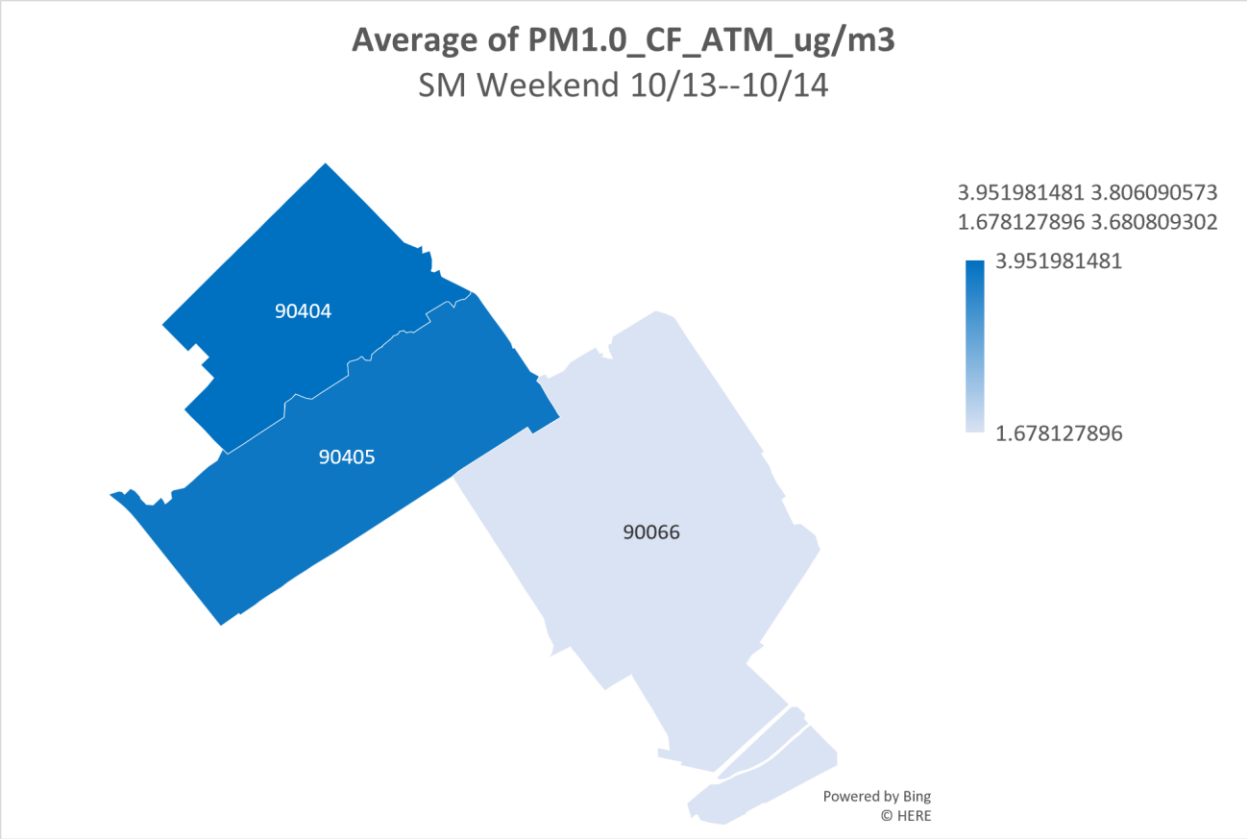
- Monday and Wednesday are of nearly equivalent levels for 1.0, 2.5, 10.0 PMs.

- Of tested Zip Codes on weekend (90404, 90405, 90066), 90404 is most affected by 1.0, 2.5, 10.0 PMs. 90404 witnesses the lowest temperature yet is most humid.

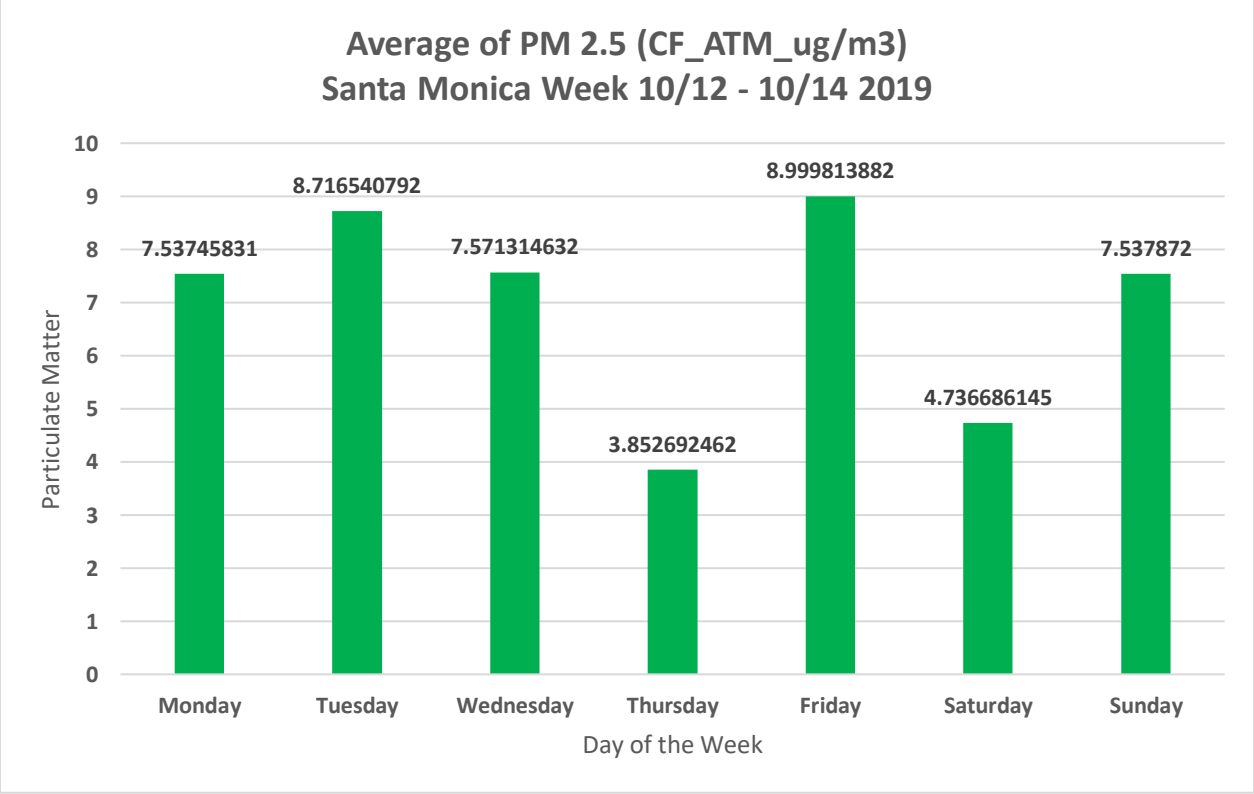
10/08 – 10/14 Average Weekday vs Average Weekend Particulate Matter 1.0:

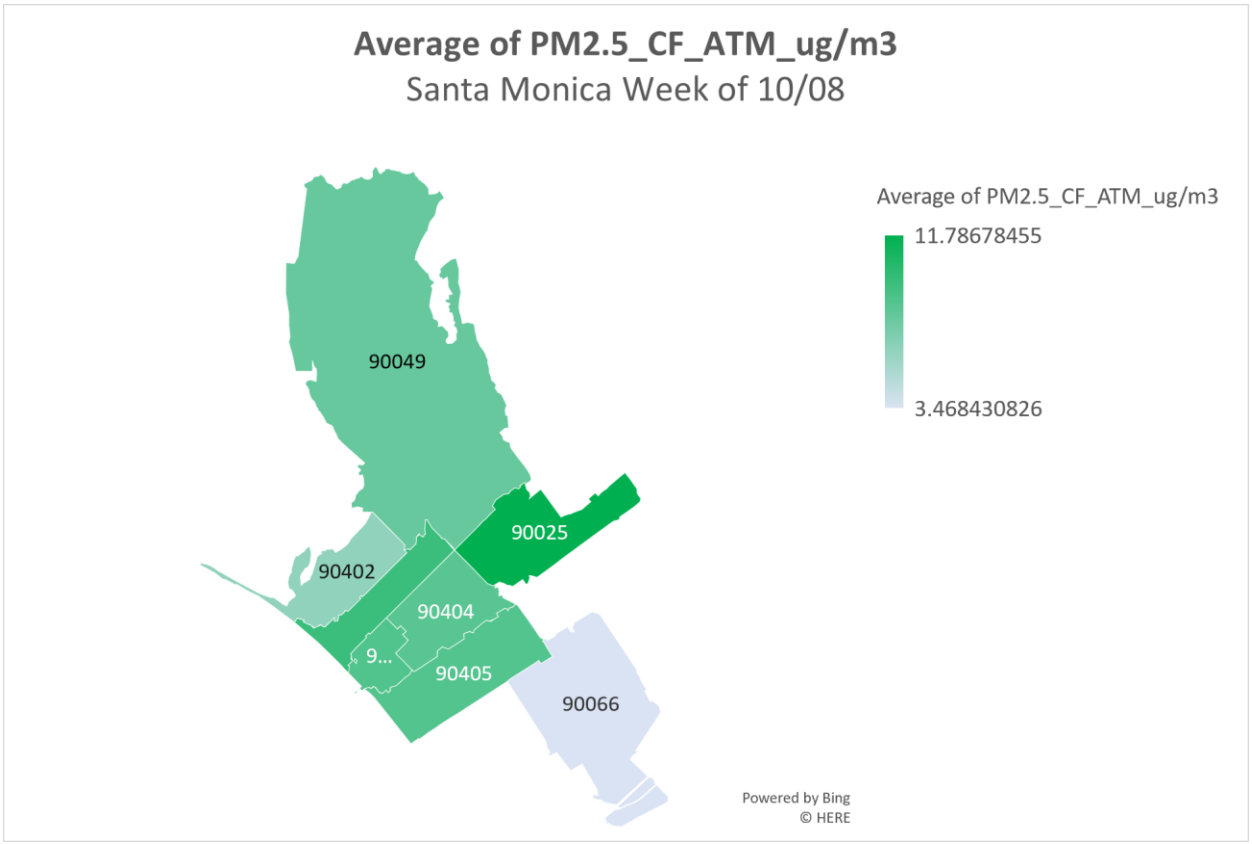


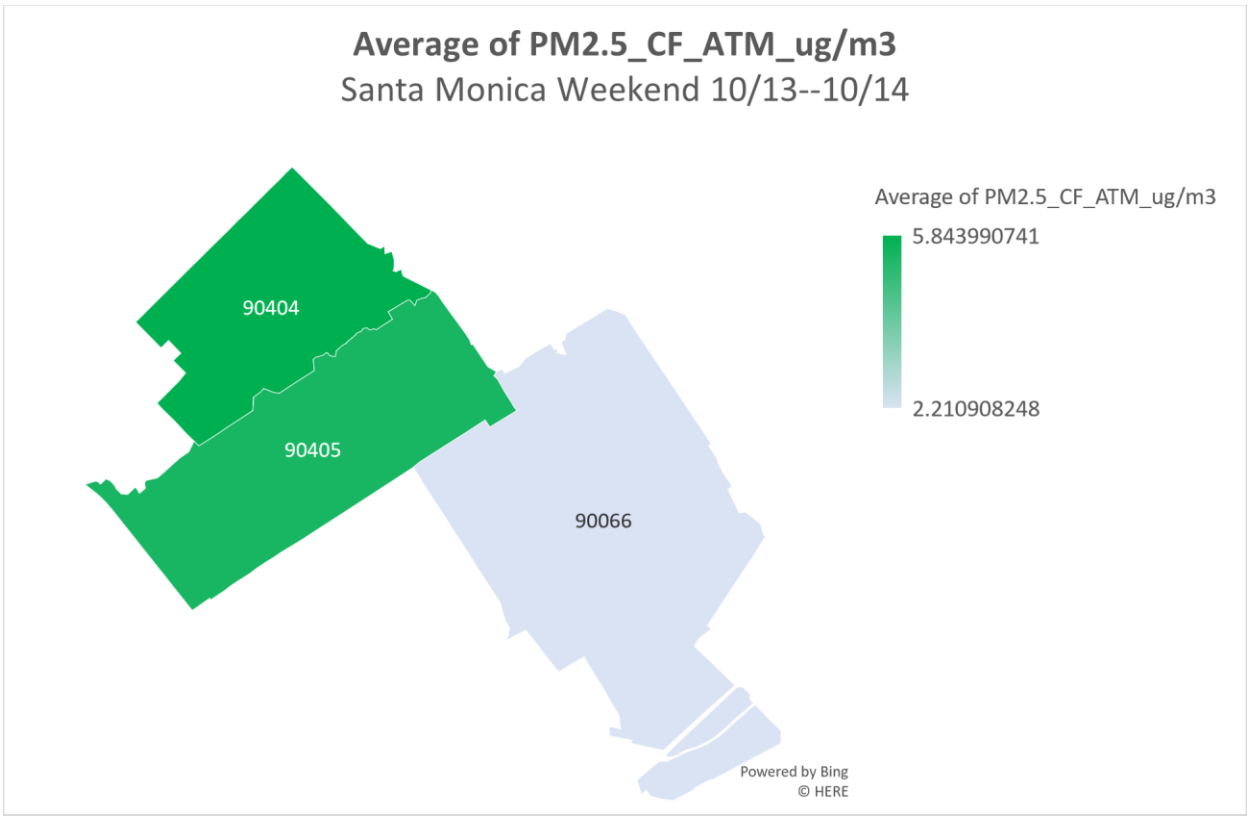




10/08 – 10/14 Average Weekday vs Average Weekend Particulate Matter 2.5:




Average of PM2.5_CF_ATM_ug/m3
Santa Monica Week of 10/08
Average of PM2.5_CF_ATM_ug/m3
11.78678455
3.468430826
90049
90025
90402
90404
9...
90405
90066
Powered by Bing
© HERE


Average of PM2.5_CF_ATM_ug/m3
Santa Monica Weekend 10/13--10/14
Average of PM2.5_CF_ATM_ug/m3
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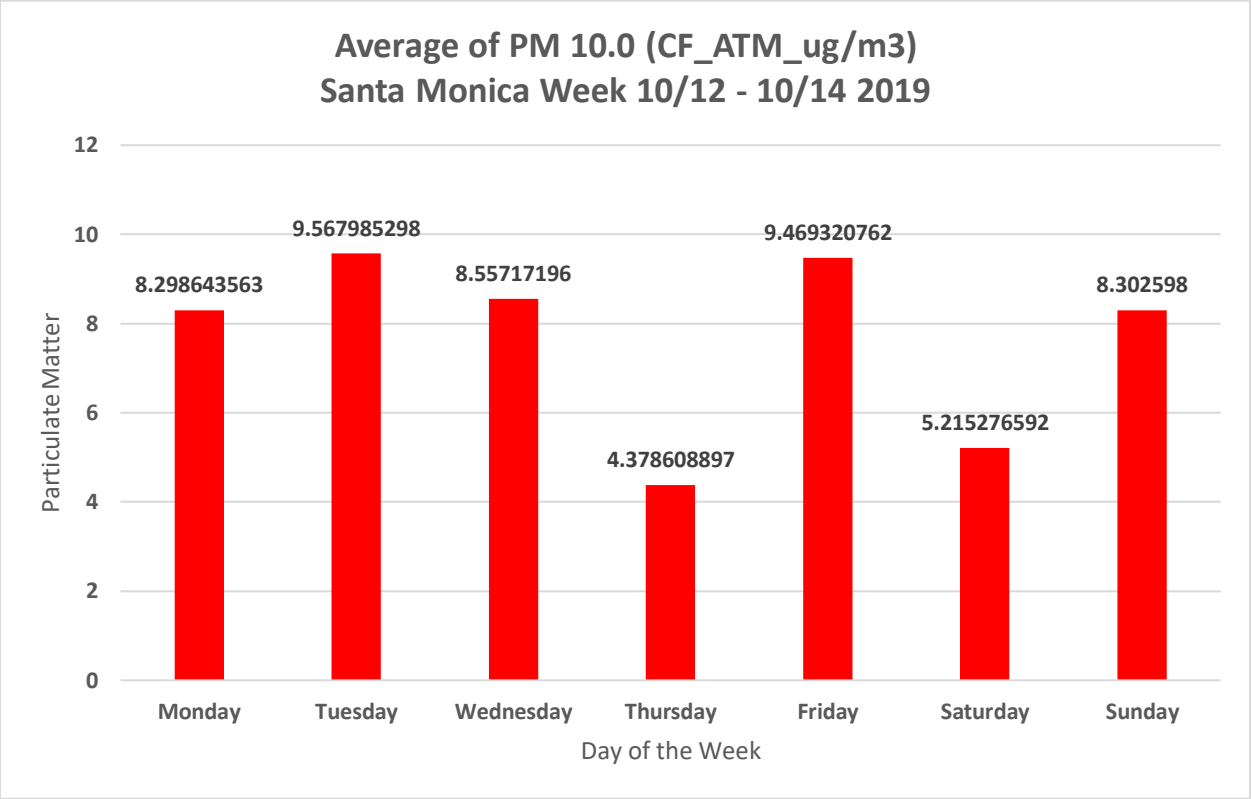
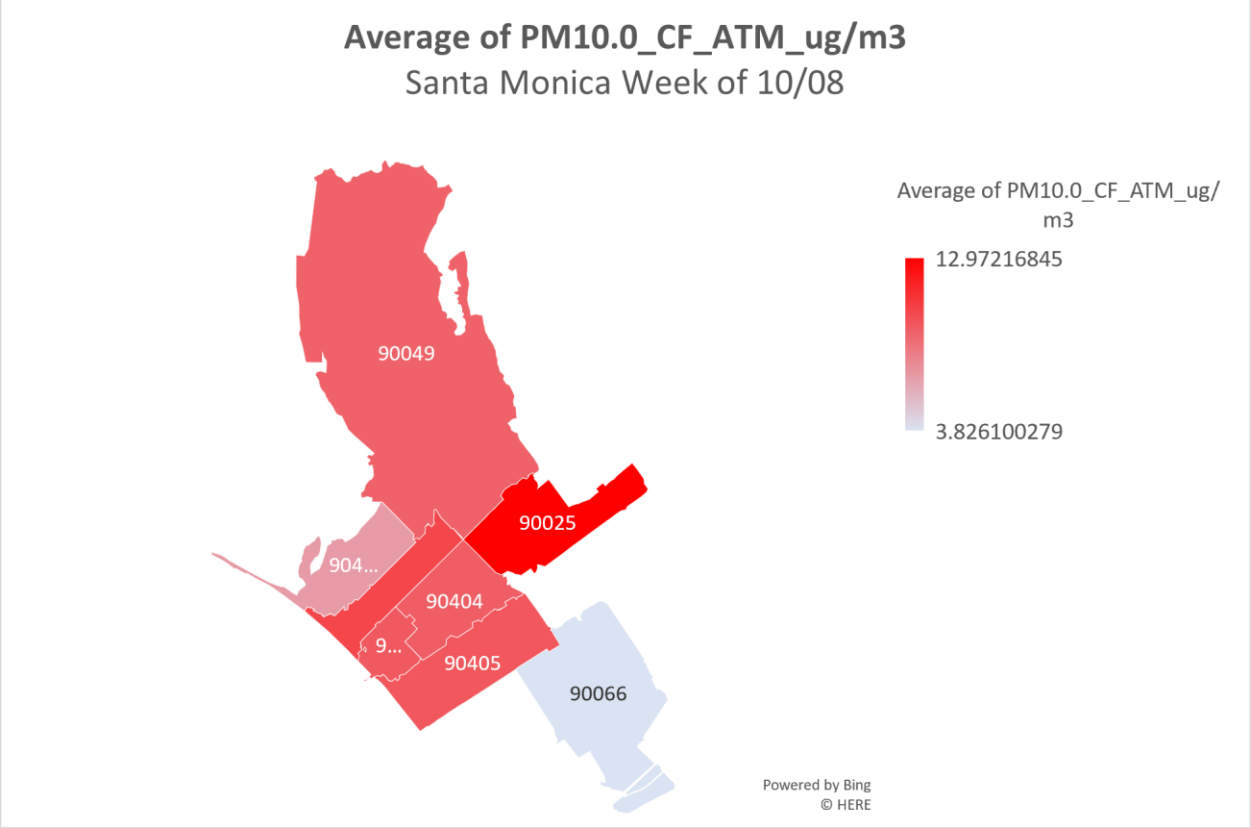
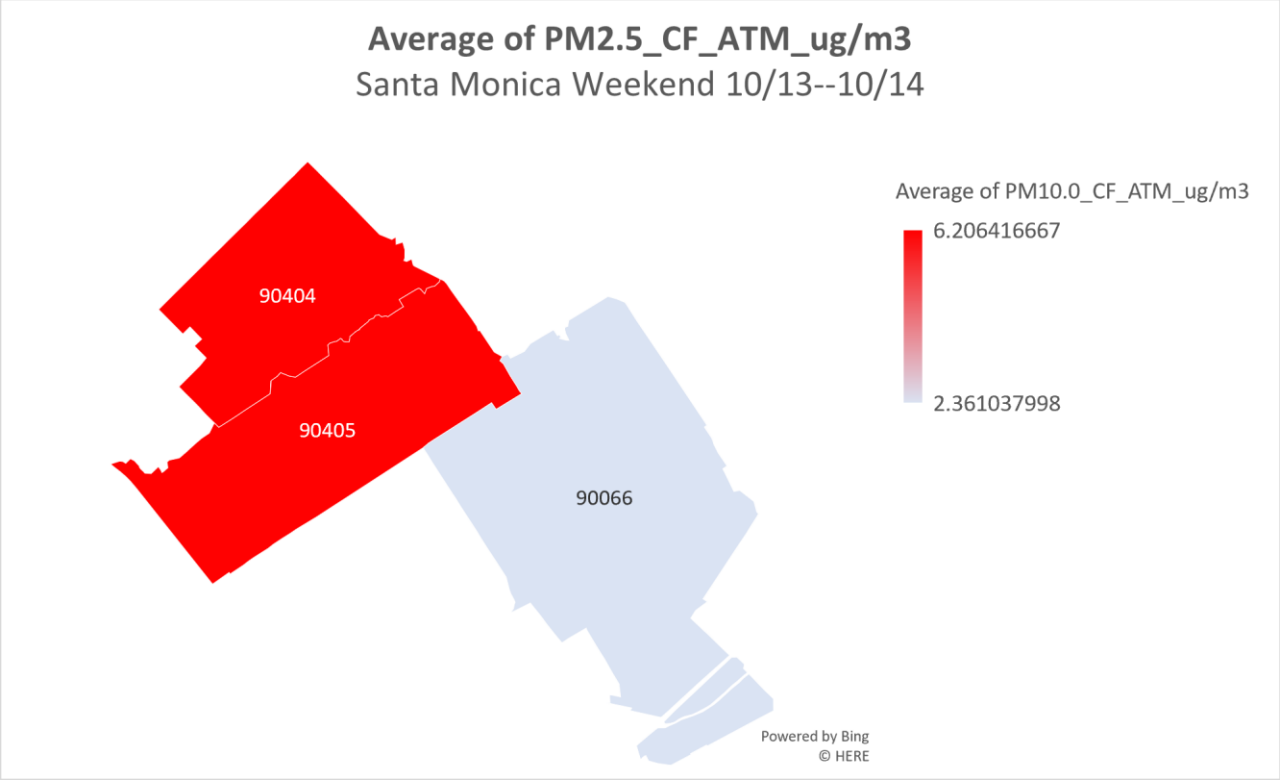
2.210908248
90404
90405
90066
Powered by Bing
© HERE

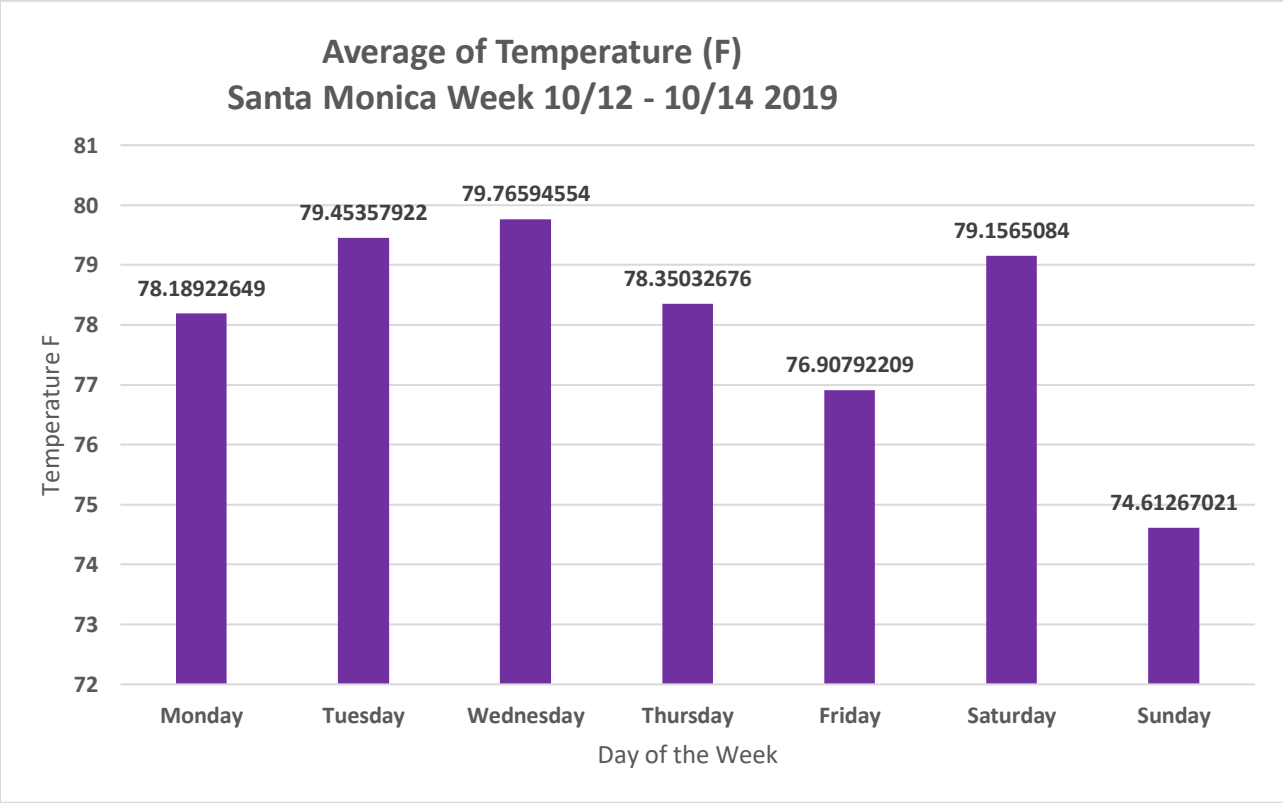
10/08 – 10/14 Average Weekday vs Average Weekend Particulate Matter 10.0:

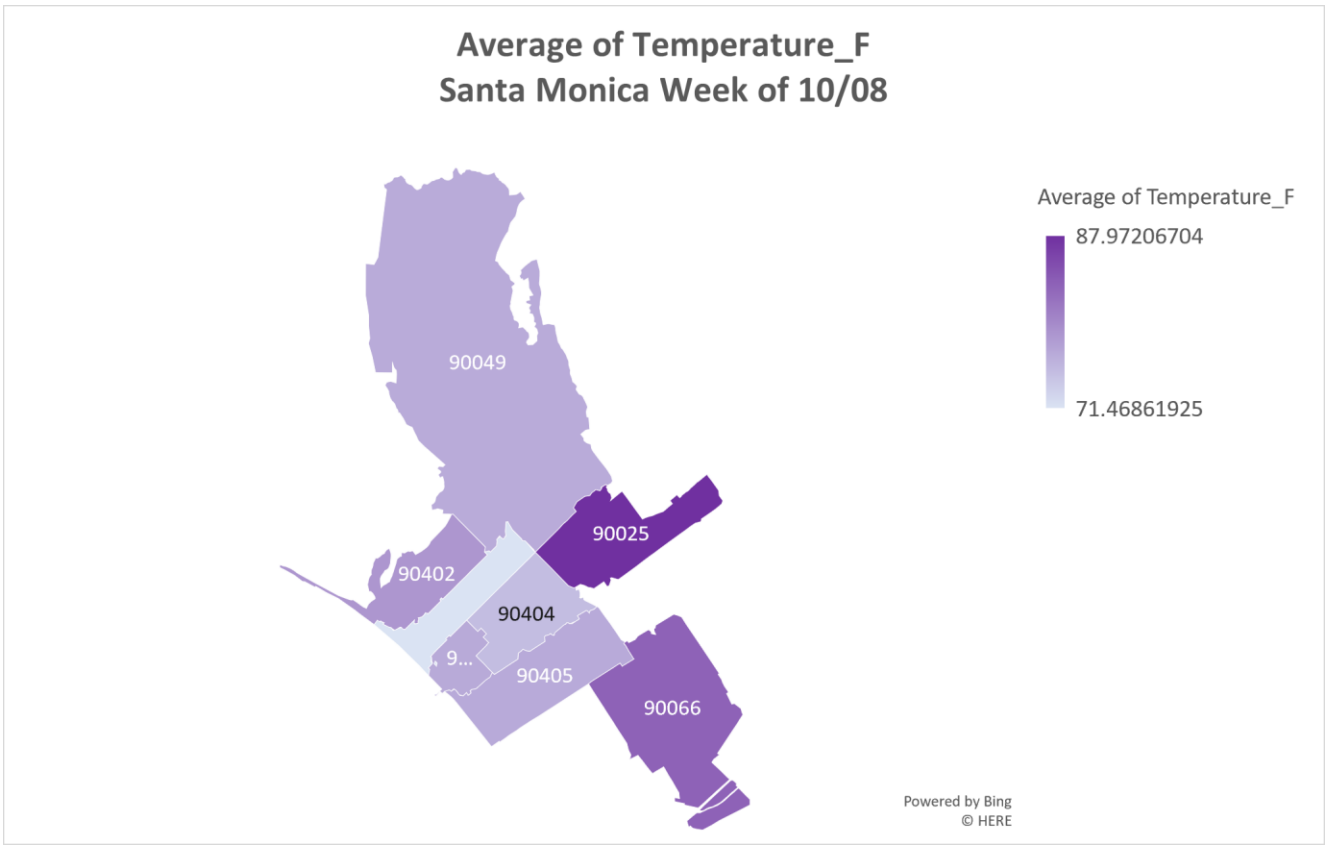






10/08 – 10/14 Average Weekday vs Average Weekend Temperature:




Average of Temperature_F
Santa Monica Week of 10/08
Average of Temperature_F
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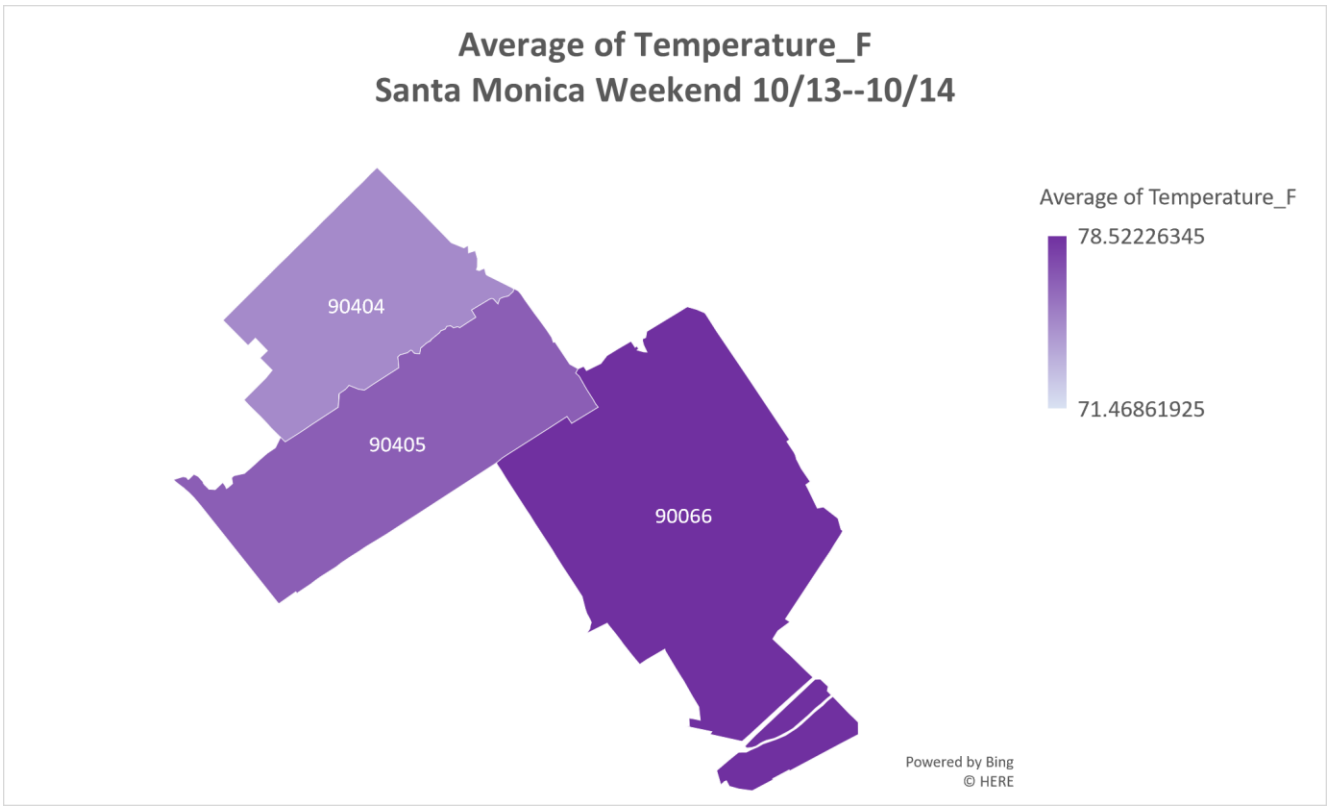
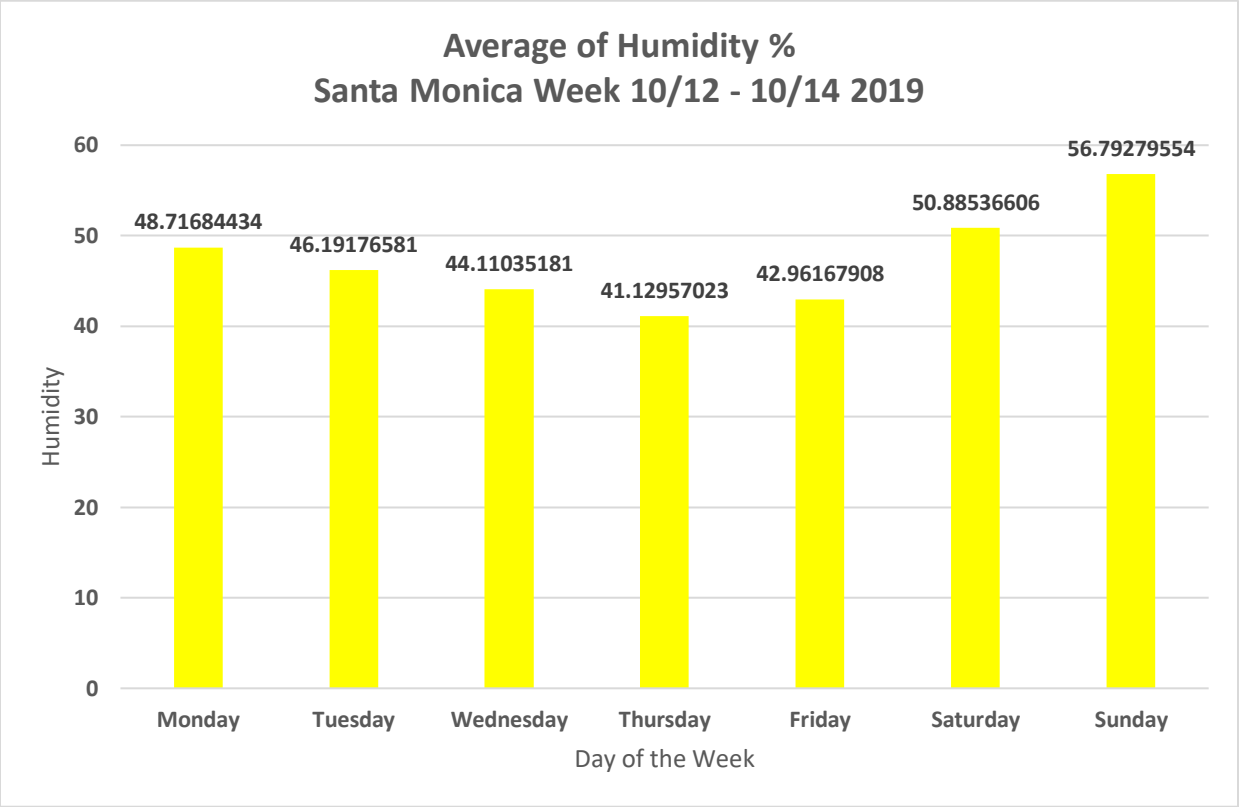
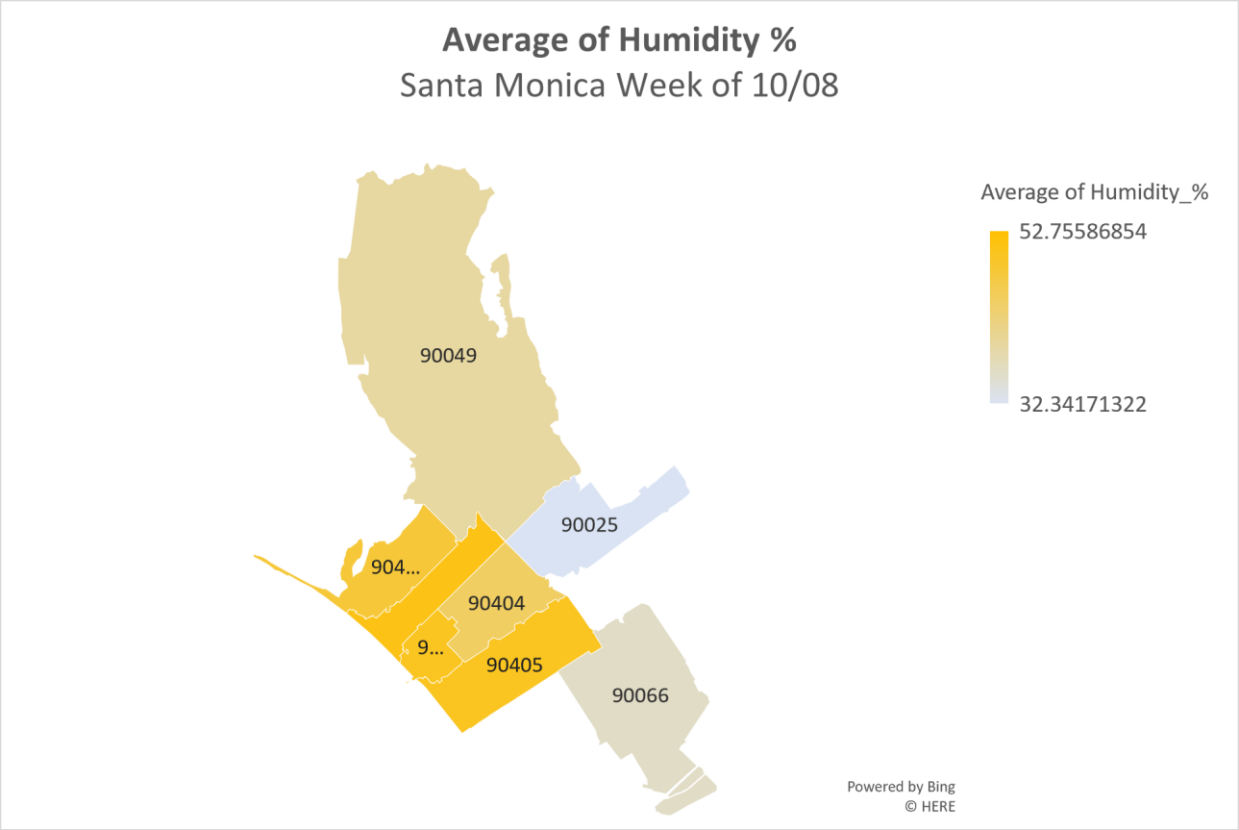
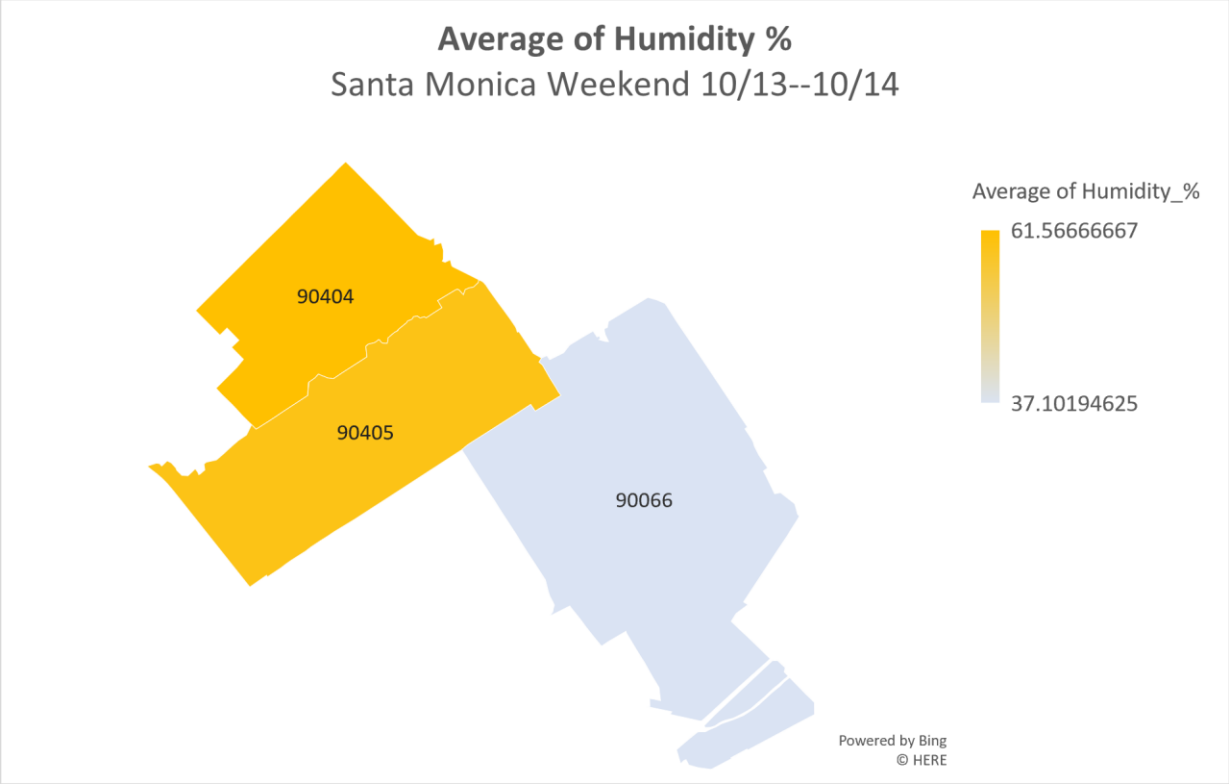
71.46861925
90049
90025
90402
90404
9...
90405
90066
Powered by Bing
© HERE


Average of Temperature_F
Santa Monica Weekend 10/13--10/14
Average of Temperature_F
78.52226345
71.46861925
90404
90405
90066
Powered by Bing
© HERE

10/08 – 10/14 Average Weekday vs Average Weekend Humidity %:






Average of Humidity %
Santa Monica Weekend 10/13--10/14
90404
90405
90066
Average of Humidity_%
61.56666667
37.10194625
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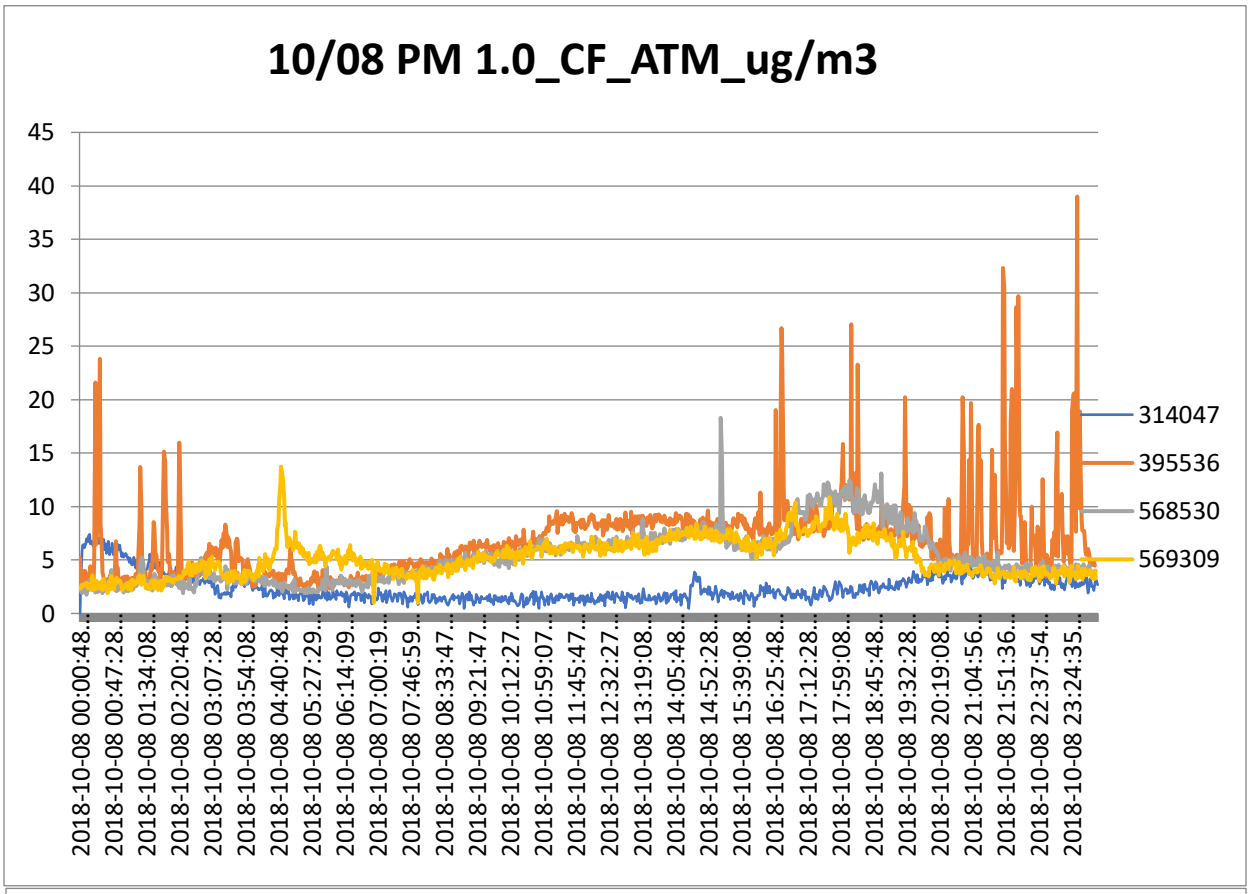
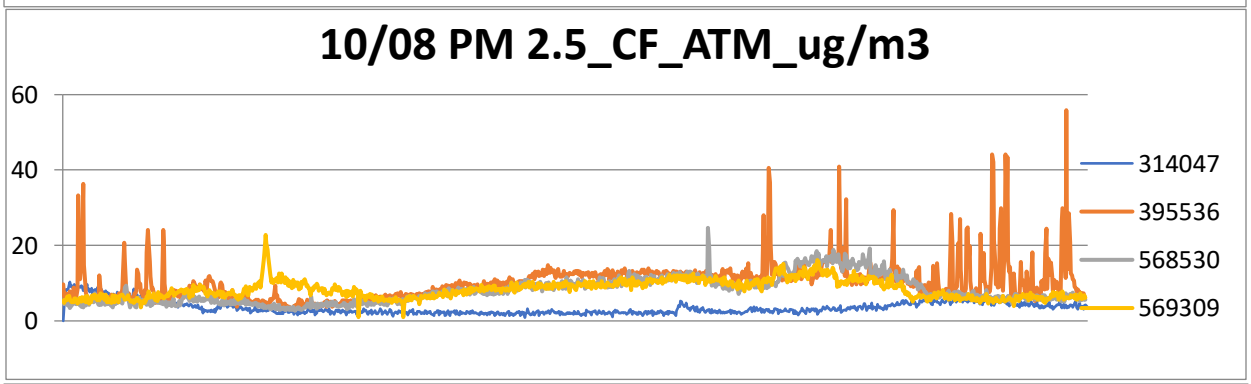
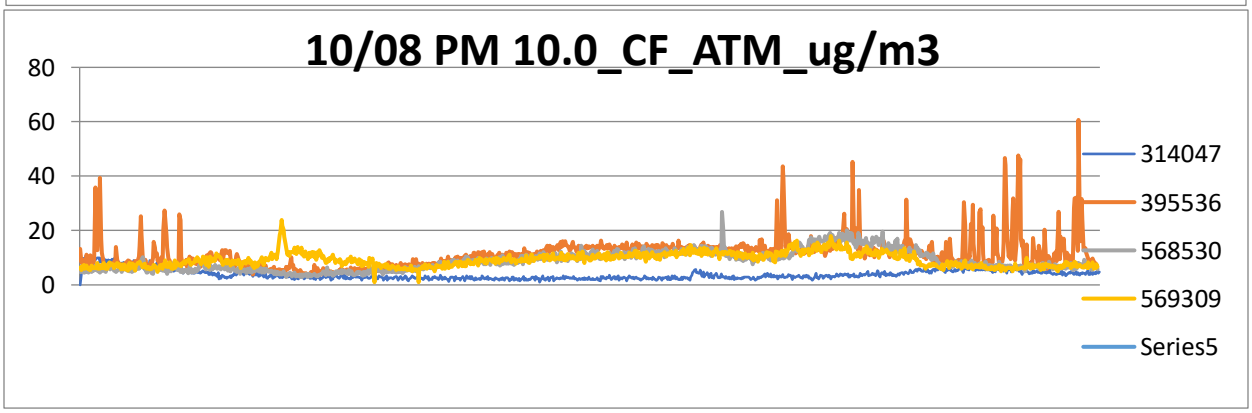
3. Sample Analysis of PM (1.0, 2.5, 10.0) by hour of random week: 10/08/18 through 10/14/18:

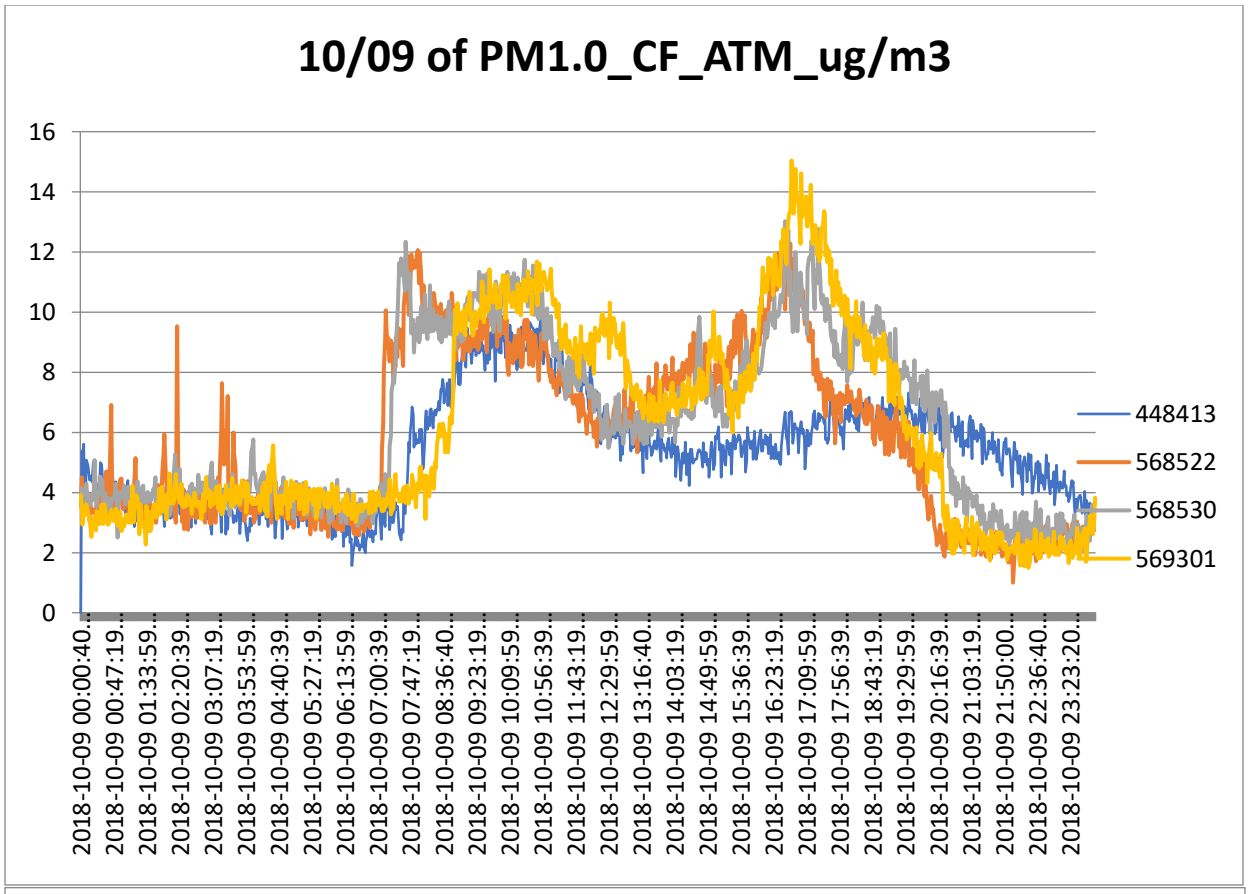
- For this week, generally behavior of one size of particulate matter is predictive of the other two.
- On Monday for Zip Code 90401 (ThingSpeakPrimaryId 395536), time ranges of highest activity of 1.0, 2.5, 10.0 PM's occurred between 00:00-02:20 and 16:25-23:24 (ascending order).
- On Tuesday for Zip Code 90402 (ThingSpeakPrimaryId 569301), time range 08:36-20:16 witnessed highest levels of 1.0, 2.5, 10.0 PM's, peaking around 17:09. This is roughly the case for Zip Codes 90405, 90404, and 90025 (90025 features an amplitude that is about half the others).
- On Wednesday for Zip Code 90066, 1.0, 2.5, 10.0 PM's all dramatically increased from effectively 0 to over 200 CF ATM ug/m3 at around 21:53, decreasing until about 23:47.
- On Thursday, similar sudden spikes in 1.0, 2.5, 10.0 PM's occurred in zip codes 90404 at 02:20 and 90049 at around 04:00.
- On Friday, Zip Code 90066 peaked at 21:58, 04:34, and 03:03 in descending order in in 1.0, 2.5, 10.0 PM's.
- On Saturday Zip Code 90404 peaked at around 17:02 until 18:36, and less intensely at 23:16.
- Sunday Zip Code 90066 and 90403 peaked 06:19 and 19:32, and 90404 peaked suddenly at 00:11. These

10/08-10/14 PM (1.0, 2.5, 3.0) by Hour








10/09 of PM1.0_CF_ATM_ug/m3
16
14
12
10
8
6
4
2
0
448413
568522
568530
569301
2018-10-09 00:00:40..
2018-10-09 00:47:19..
2018-10-09 01:33:59..
2018-10-09 02:20:39..
2018-10-09 03:07:19..
2018-10-09 03:53:59..
2018-10-09 04:40:39..
2018-10-09 05:27:19..
2018-10-09 06:13:59..
2018-10-09 07:00:39..
2018-10-09 07:47:19..
2018-10-09 08:36:40..
2018-10-09 09:23:19..
2018-10-09 10:09:59..
2018-10-09 10:56:39..
2018-10-09 11:43:19..
2018-10-09 12:29:59..
2018-10-09 13:16:40..
2018-10-09 14:03:19..
2018-10-09 14:49:59..
2018-10-09 15:36:39..
2018-10-09 16:23:19..
2018-10-09 17:09:59..
2018-10-09 17:56:39..
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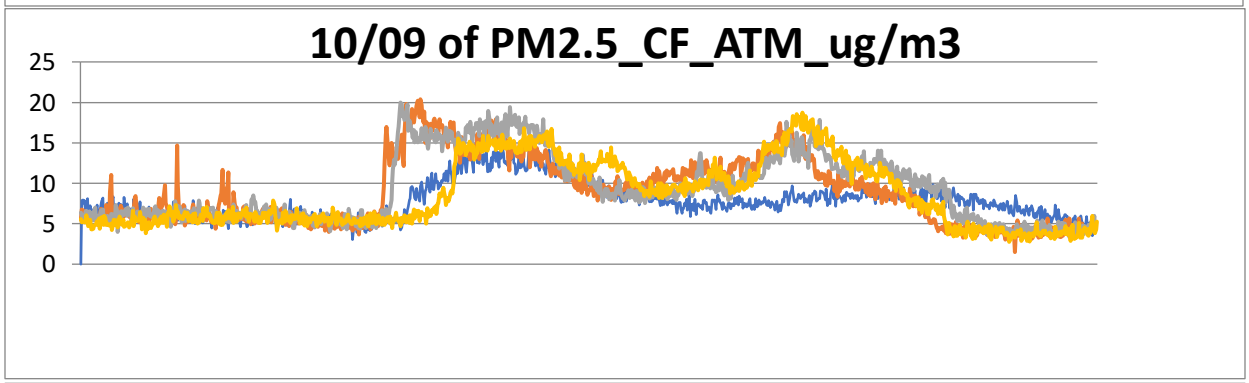
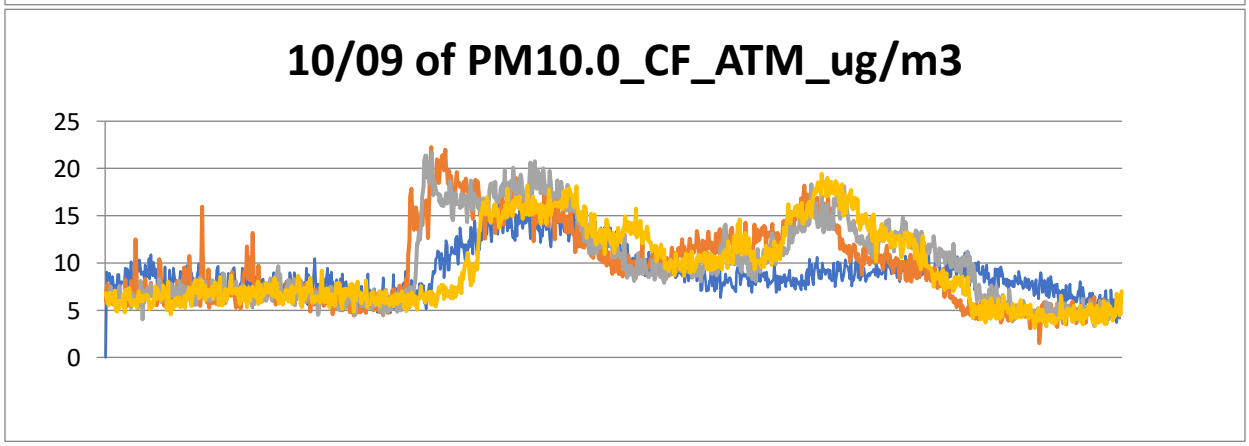
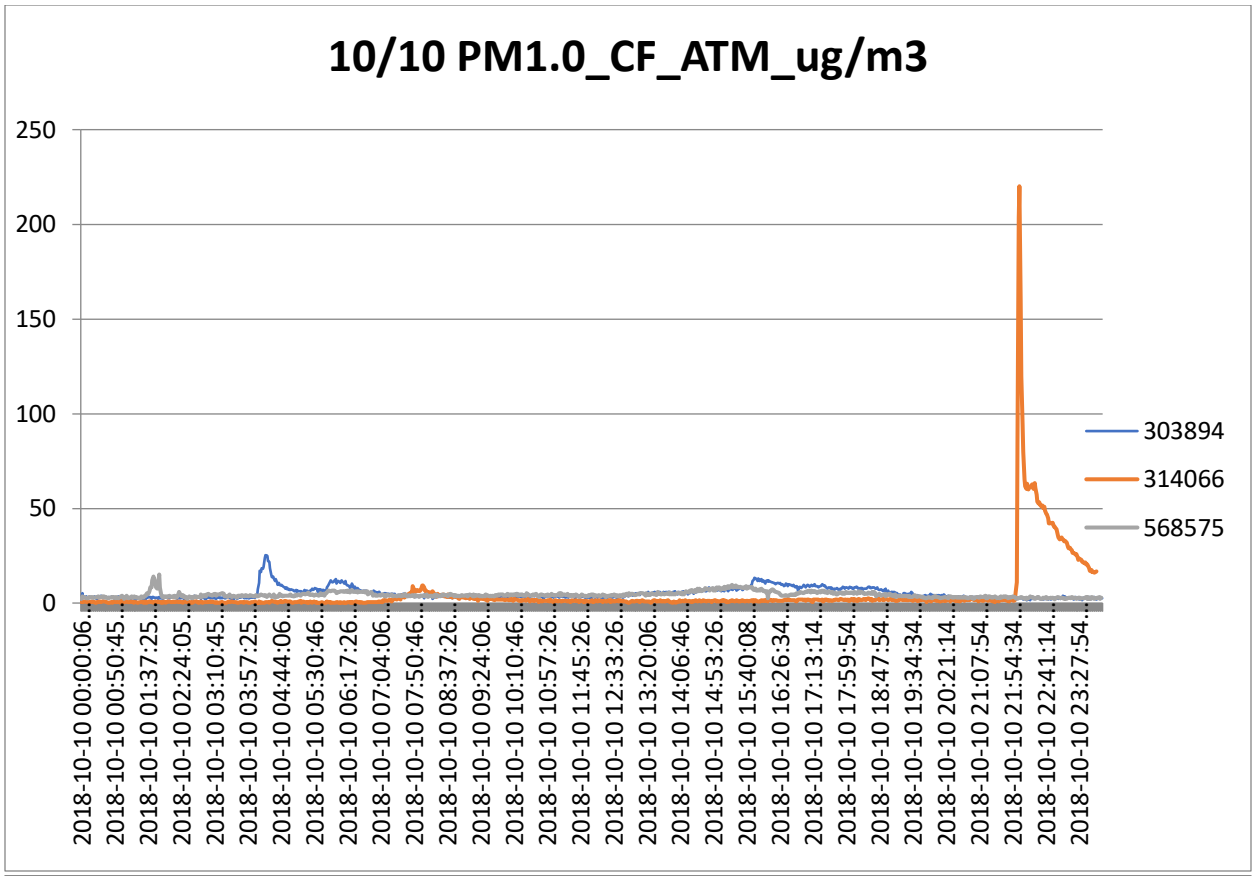
2018-10-09 19:29:59..
2018-10-09 20:16:39..
2018-10-09 21:03:19..
2018-10-09 21:50:00..
2018-10-09 22:36:40..
2018-10-09 23:23:20..


10/09 of PM2.5_CF_ATM_ug/m3
25
20
15
10
5
0


10/09 of PM10.0_CF_ATM_ug/m3
25
20
15
10
5
0


10/10 PM1.0_CF_ATM_ug/m3
250
200
150
100
50
0
303894
314066
568575
2018-10-10 00:00:06
2018-10-10 00:50:45
2018-10-10 01:37:25
2018-10-10 02:24:05
2018-10-10 03:10:45
2018-10-10 03:57:25
2018-10-10 04:44:06
2018-10-10 05:30:46
2018-10-10 06:17:26
2018-10-10 07:04:06
2018-10-10 07:50:46
2018-10-10 08:37:26
2018-10-10 09:24:06
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2018-10-10 14:06:46
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2018-10-10 15:40:08
2018-10-10 16:26:34
2018-10-10 17:13:14
2018-10-10 17:59:54
2018-10-10 18:47:54
2018-10-10 19:34:34
2018-10-10 20:21:14
2018-10-10 21:07:54
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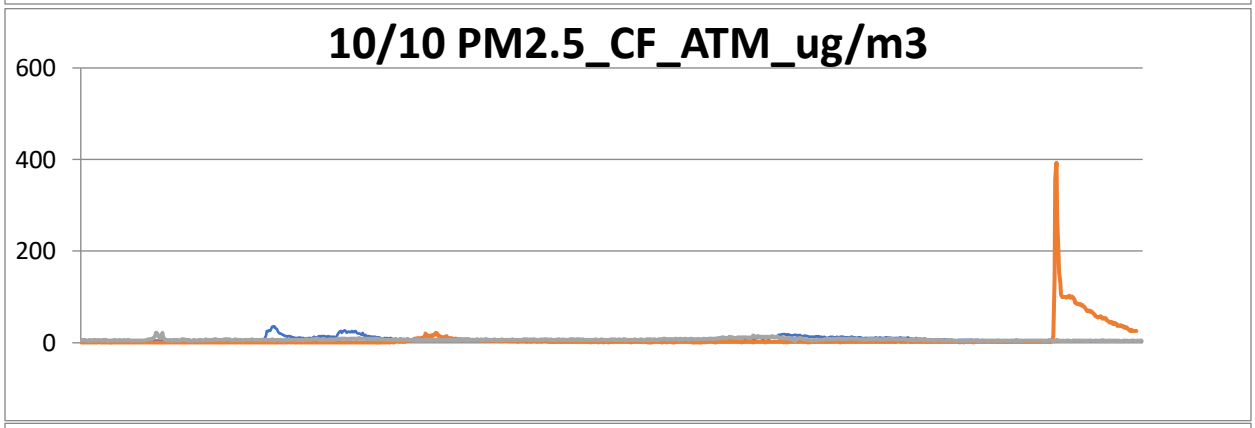
2018-10-10 22:41:14
2018-10-10 23:27:54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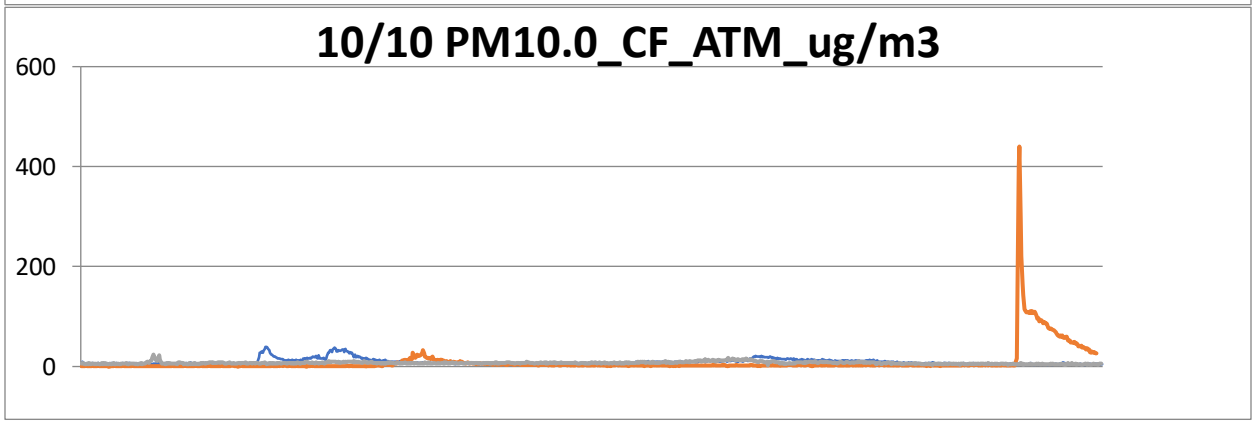
400
200
0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200
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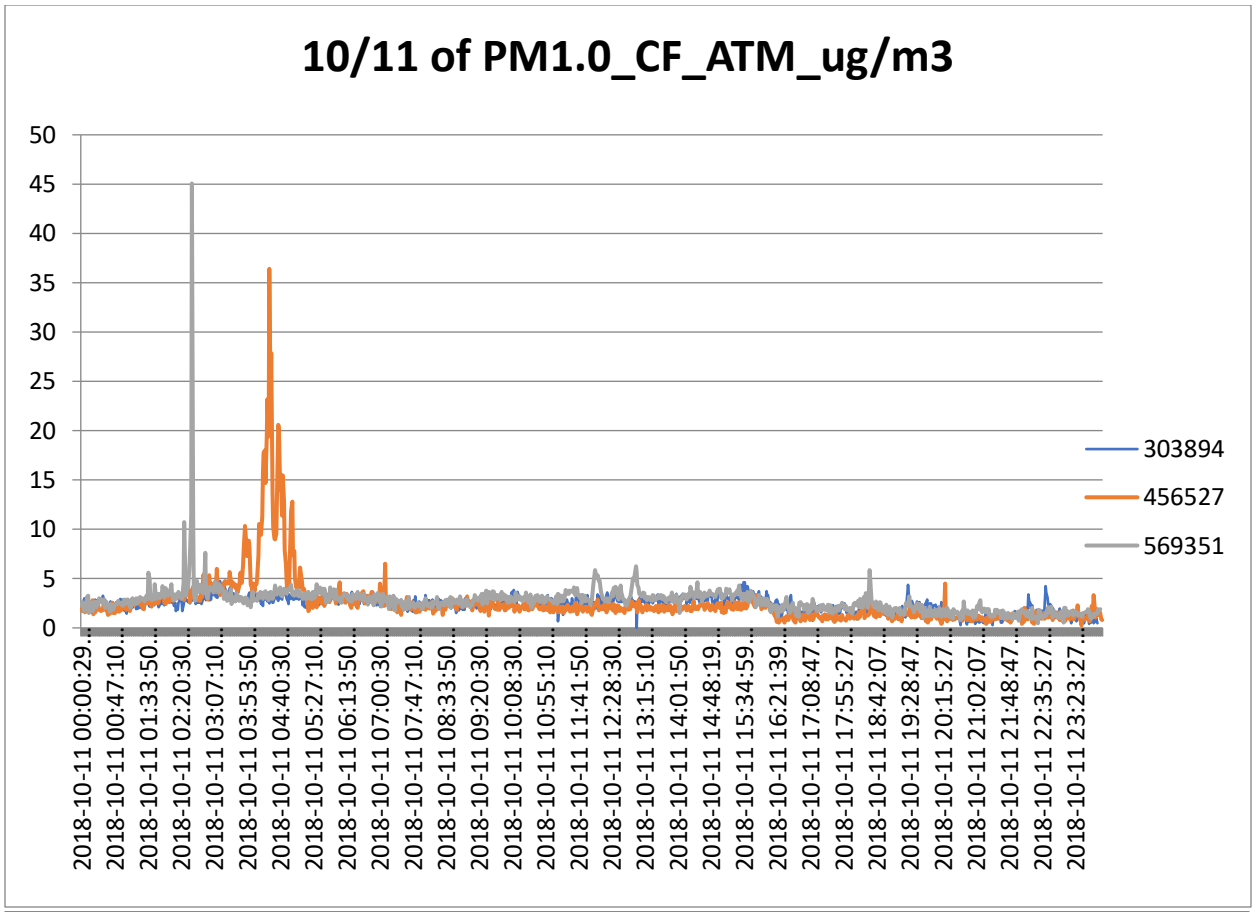
10/11 of PM1.0_CF_ATM_ug/m3
50
45
40
35
30
25
20
15
10
5
0
303894
456527
569351
2018-10-11 00:00:29...
2018-10-11 00:47:10...
2018-10-11 01:33:50...
2018-10-11 02:20:30...
2018-10-11 03:07:10...
2018-10-11 03:53:50...
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2018-10-11 19:28:47...
2018-10-11 20:15:27...
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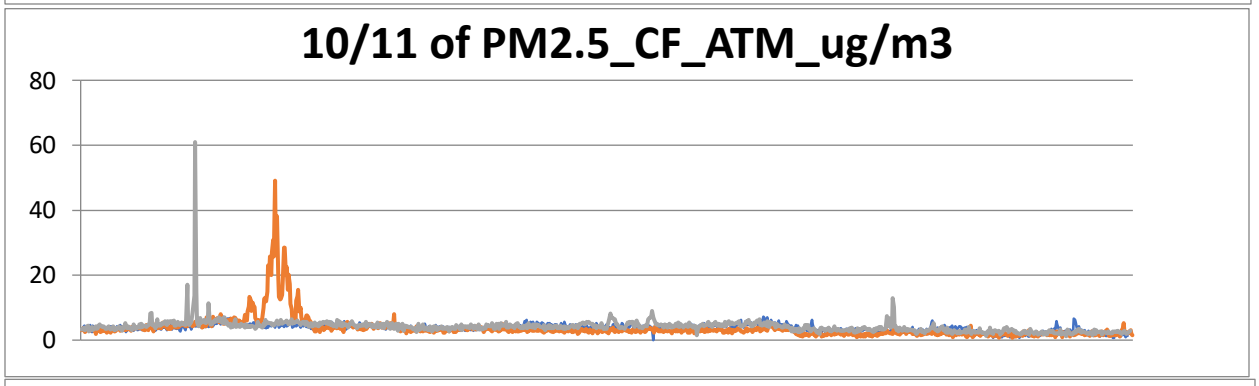
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40
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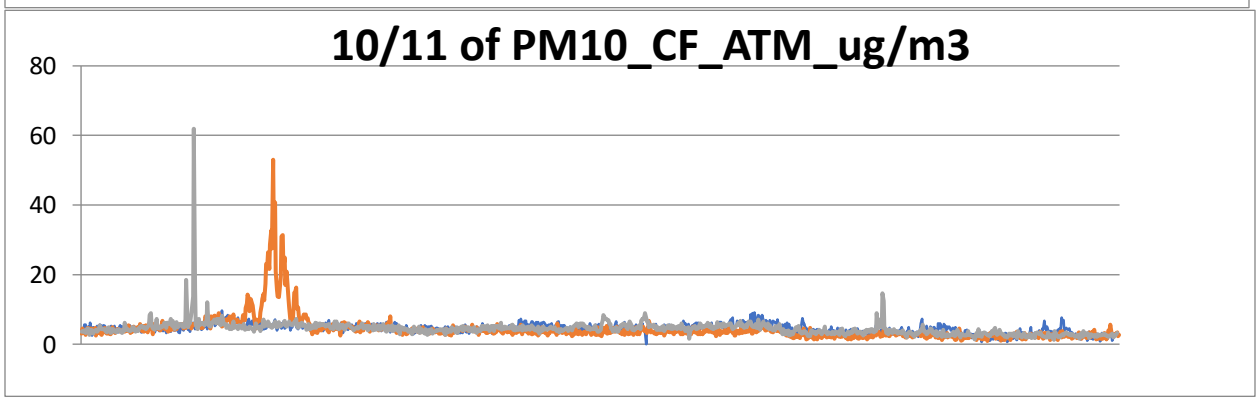
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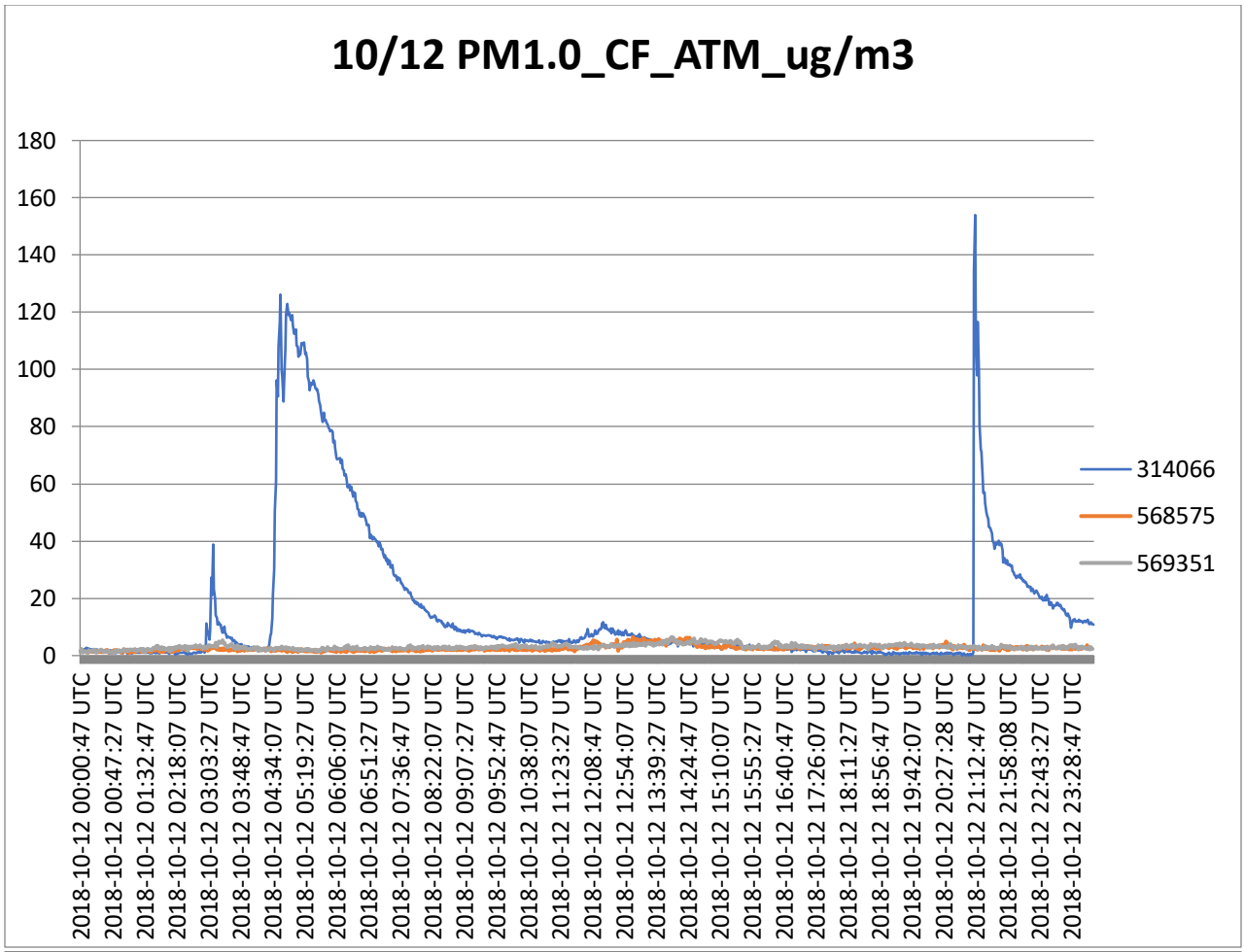
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120
100
80
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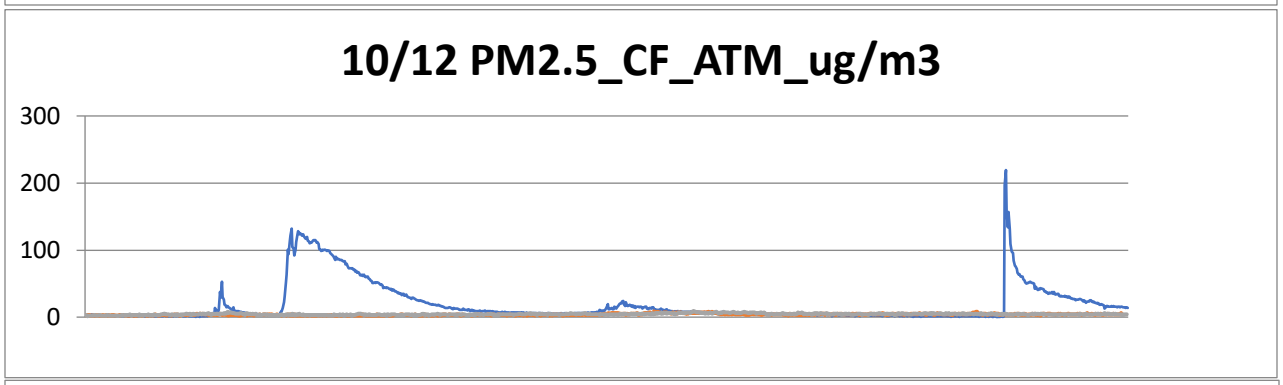
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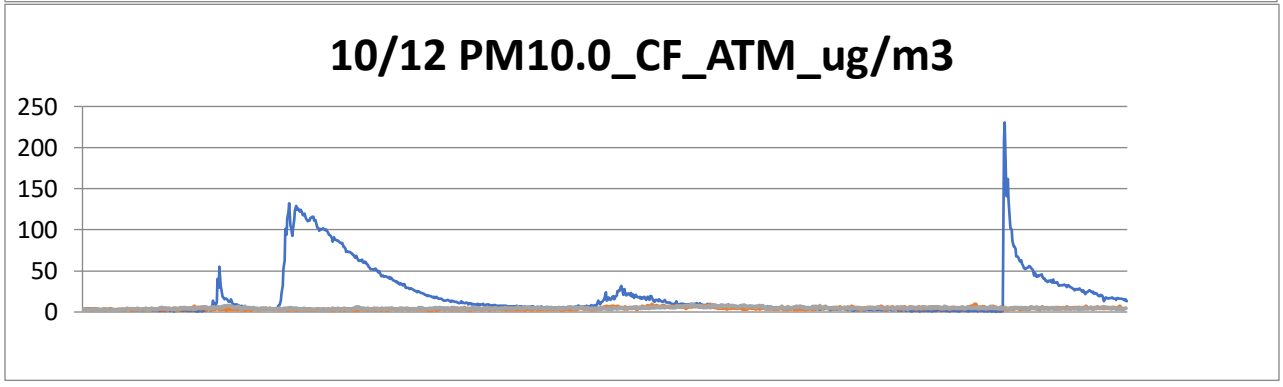
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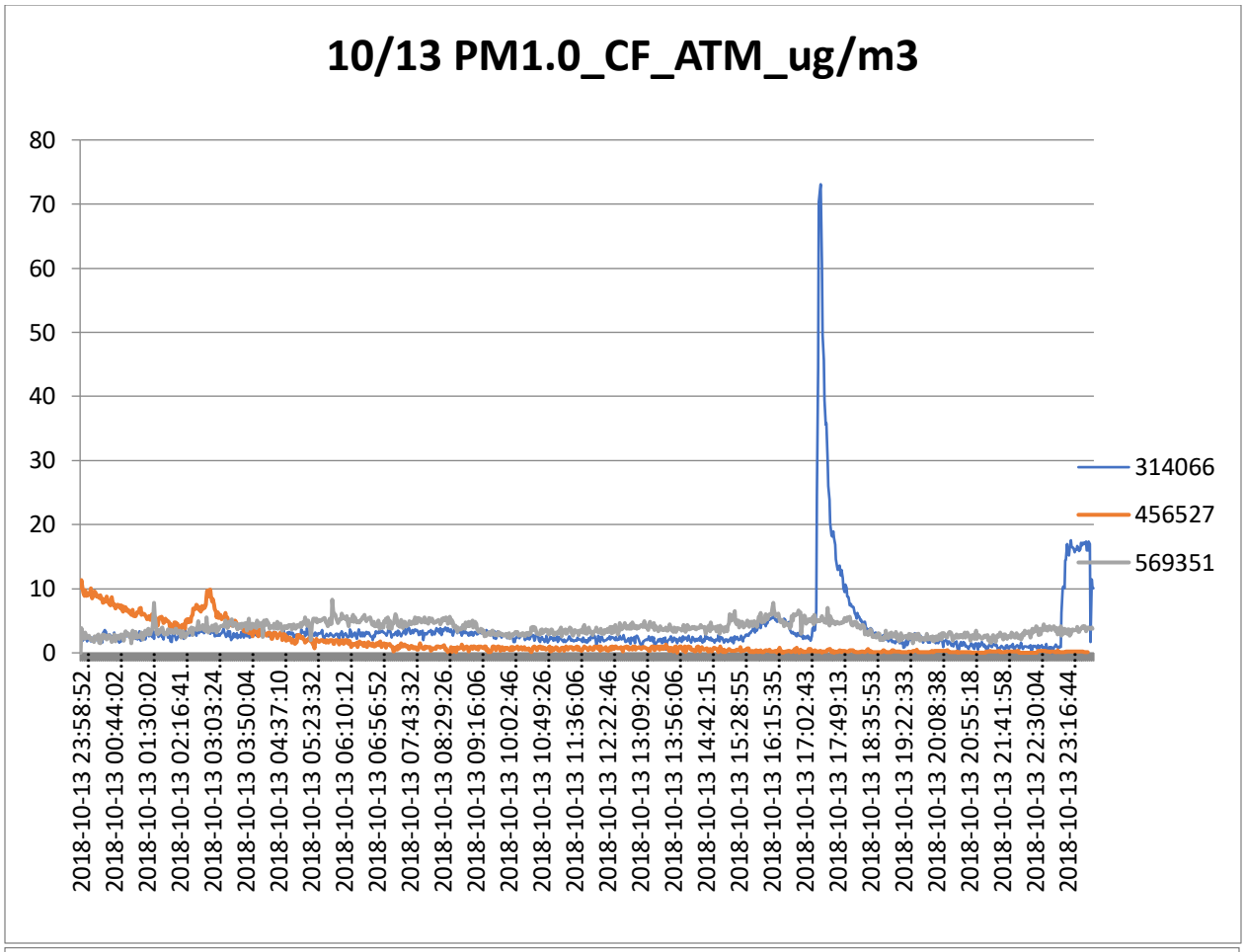
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2018-10-13 23:58:52
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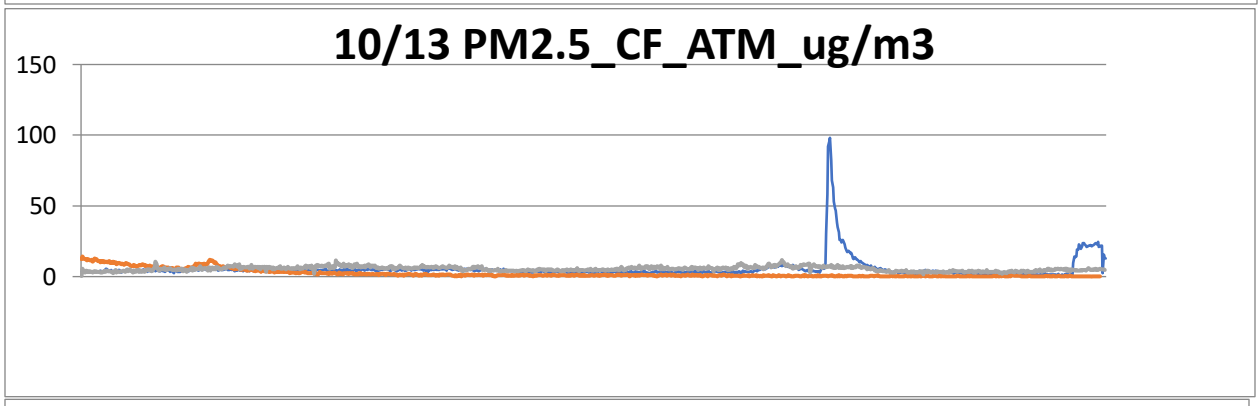
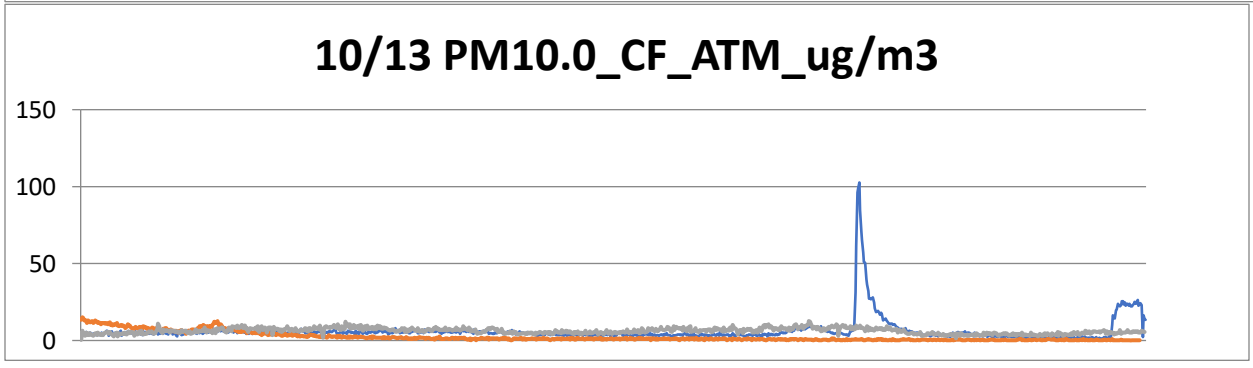
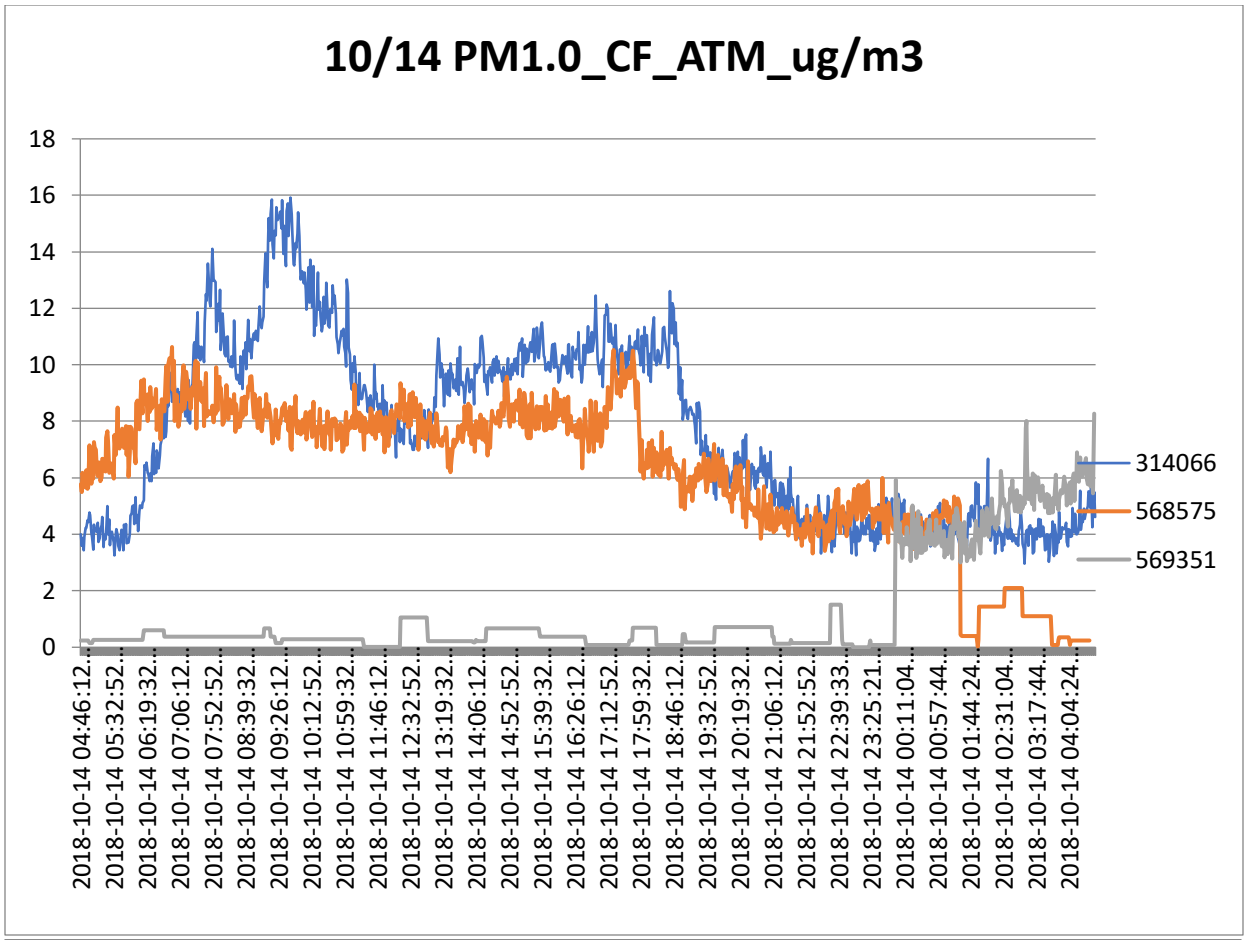
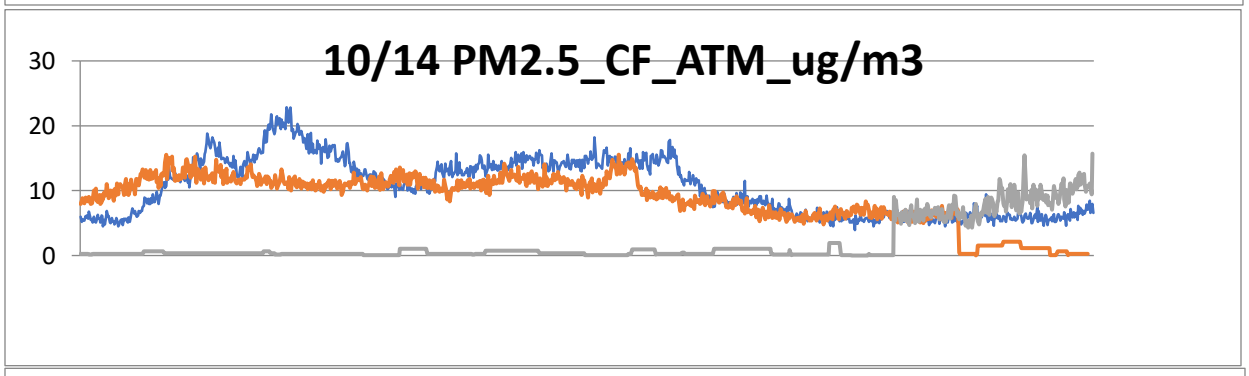
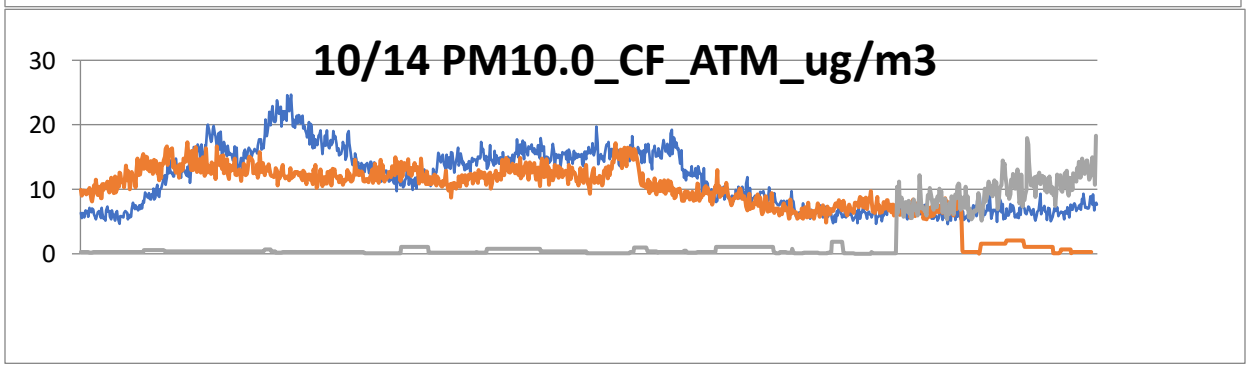
569351


10/13 PM2.5_CF_ATM_ug/m3
150
100
50
0


10/13 PM10.0_CF_ATM_ug/m3
150
100
50
0


10/14 PM1.0_CF_ATM_ug/m3
18
16
14
12
10
8
6
4
2
0
2018-10-14 04:46:12
2018-10-14 05:32:52
2018-10-14 06:19:32
2018-10-14 07:06:12
2018-10-14 07:52:52
2018-10-14 08:39:32
2018-10-14 09:26:12
2018-10-14 10:12:52
2018-10-14 10:59:32
2018-10-14 11:46:12
2018-10-14 12:32:52
2018-10-14 13:19:32
2018-10-14 14:06:12
2018-10-14 14:52:52
2018-10-14 15:39:32
2018-10-14 16:26:12
2018-10-14 17:12:52
2018-10-14 17:59:32
2018-10-14 18:46:12
2018-10-14 19:32:52
2018-10-14 20:19:32
2018-10-14 21:06:12
2018-10-14 21:52:52
2018-10-14 22:39:33
2018-10-14 23:25:21
2018-10-14 00:11:04
2018-10-14 00:57:44
2018-10-14 01:44:24
2018-10-14 02:31:04
2018-10-14 03:17:44
2018-10-14 04:04:24
314066
568575
569351


10/14 PM2.5_CF_ATM_ug/m3
30
20
10
0


10/14 PM10.0_CF_ATM_ug/m3
30
20
10
0

3. Descriptive Statistics

Santa Monica Air Quality Data Analysis

PM1.0_CF_ATM_ug/m3	
Mean	8.268892
Standard Error	0.014125
Median	4.77
Mode	1
Standard Deviation	14.46236
Sample Variance	209.1597
Kurtosis	217.7524
Skewness	10.71164
Range	617.54
Minimum	0
Maximum	617.54
Sum	8669032
Count	1048391
Confidence Level(95.0%)	0.027684

PM2.5_CF_ATM_ug/m3	
Mean	13.06398
Standard Error	0.023575
Median	7.11
Mode	0.11
Standard Deviation	24.13916
Sample Variance	582.6988
Kurtosis	625.0895
Skewness	14.94293
Range	2497.25
Minimum	0
Maximum	2497.25
Sum	13696159
Count	1048391
Confidence Level(95.0%)	0.046207

PM10.0_CF_ATM_ug/m3	
Mean	14.69179
Standard Error	0.027551
Median	7.95
Mode	1
Standard Deviation	28.20938
Sample Variance	795.7692
Kurtosis	853.8595
Skewness	16.81847
Range	3383.65
Minimum	0
Maximum	3383.65
Sum	15402740
Count	1048391
Confidence Level(95.0%)	0.053998

UptimeMinutes	
Mean	2793.829
Standard Error	5.688051
Median	801
Mode	0
Standard Deviation	5824.562
Sample Variance	33925522
Kurtosis	18.45844
Skewness	3.948633
Range	54583
Minimum	0
Maximum	54583
Sum	2.93E+09
Count	1048575
Confidence Level(95.0%)	11.14839

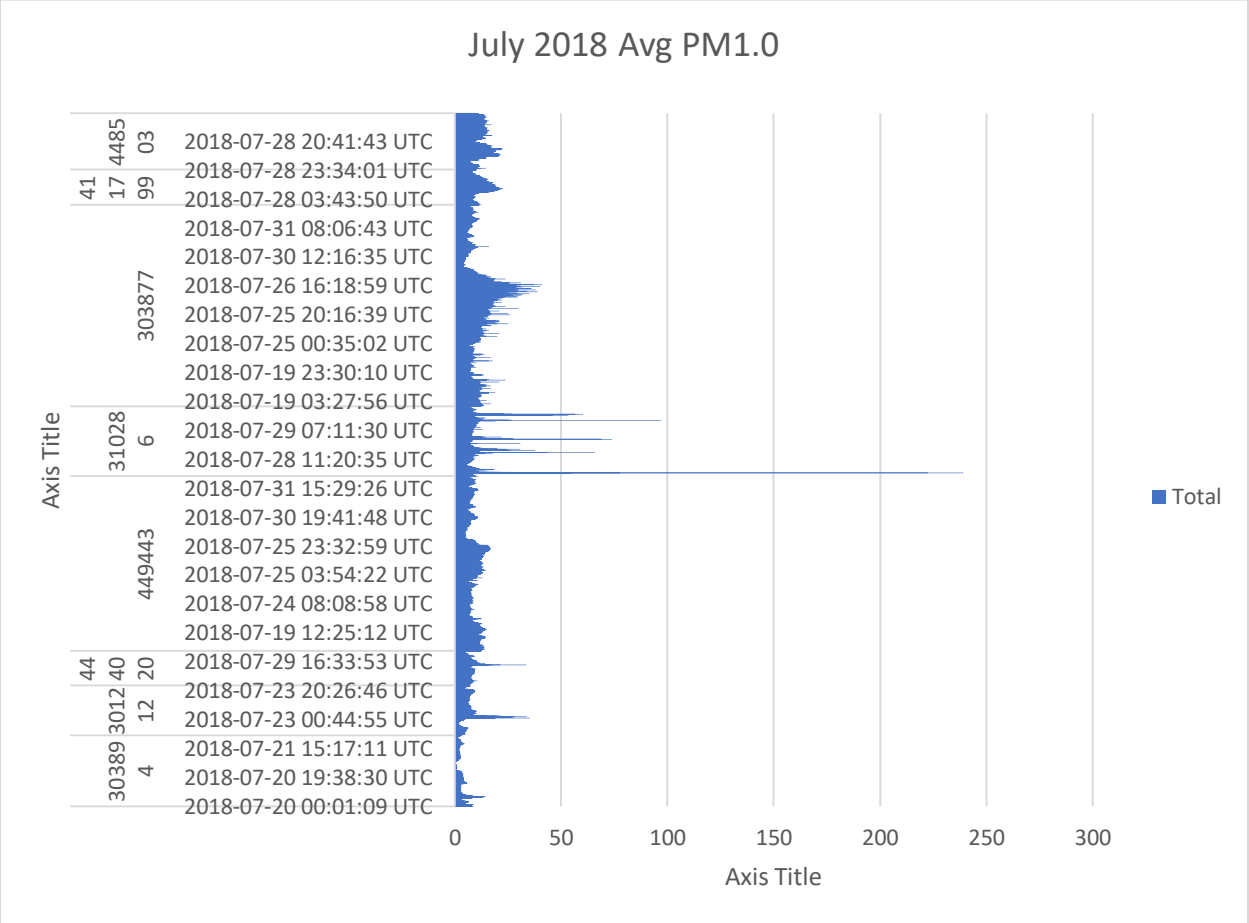
ADC		Temperature_F	
Mean	-62.0922	Mean	75.2907
Standard Error	0.020944		
Median	-64	*Some flawed data showed temp as exponentially large so generated mean manually.	
Mode	31		
Standard Deviation	21.44681		
Sample Variance	459.9657		
Kurtosis	8.994232		
Skewness	2.562871		
Range	128		
Minimum	-97		
Maximum	31		
Sum	-6.5E+07		
Count	1048575		
Confidence Level(95.0%)	0.04105		

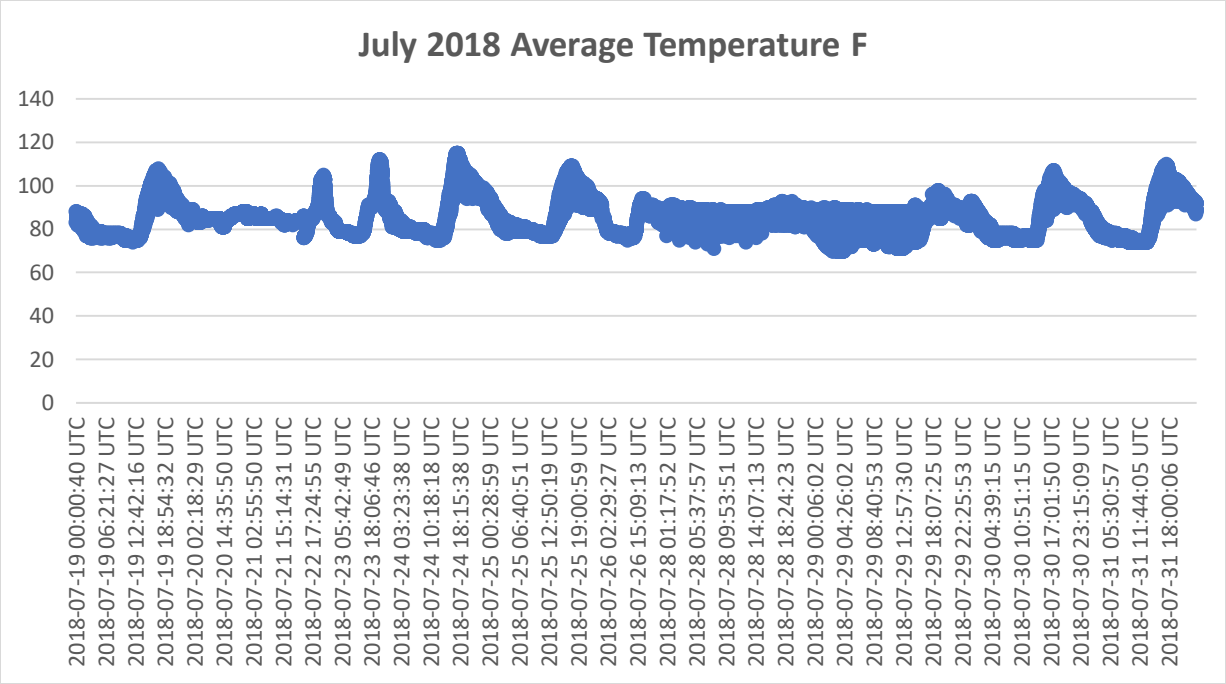
Humidity_%		PM2.5_CF_1_ug/m3	
Mean	44.95242	Mean	11.83538
Standard Error	0.015858	Standard Error	0.016831
Median	45	Median	7.11
Mode	42	Mode	0.11
Standard Deviation	16.12178	Standard Deviation	17.2351
Sample Variance	259.9118	Sample Variance	297.0487
Kurtosis	57.44505	Kurtosis	463.9136
Skewness	4.334535	Skewness	11.86733
Range	255	Range	1663.8
Minimum	0	Minimum	0
Maximum	255	Maximum	1663.8
Sum	46459046	Sum	12410038
Count	1033516	Count	1048554
Confidence Level(95.0%)	0.031082	Confidence Level(95.0%)	0.0329888A1:E71390430238

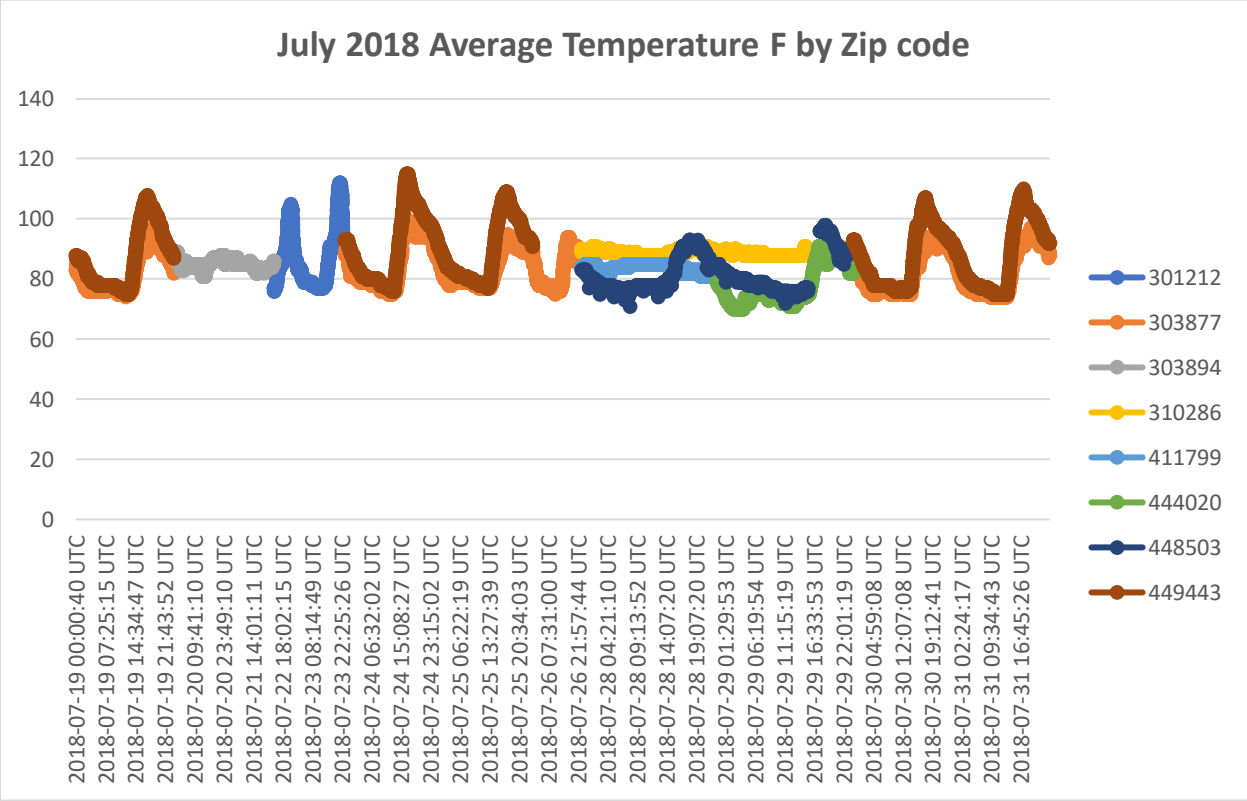
4. Moving Forward: Beginning to Analyze by Month, July 2018 through July 2019

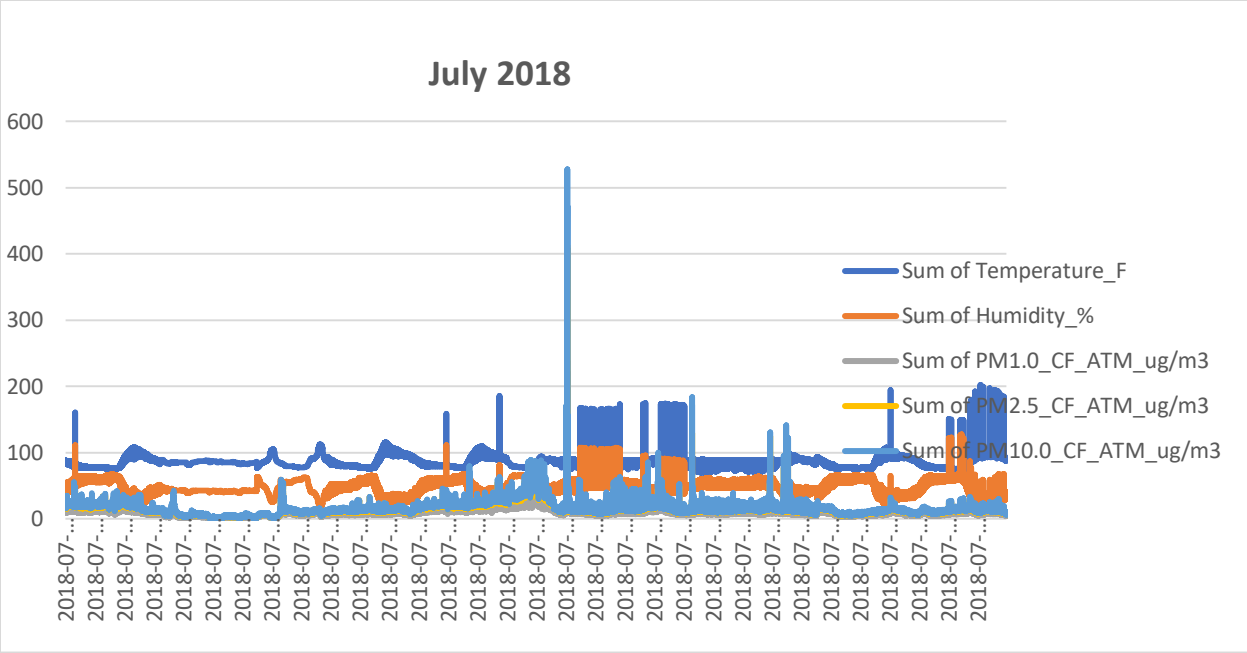
*Including sample data I've begun to work with.

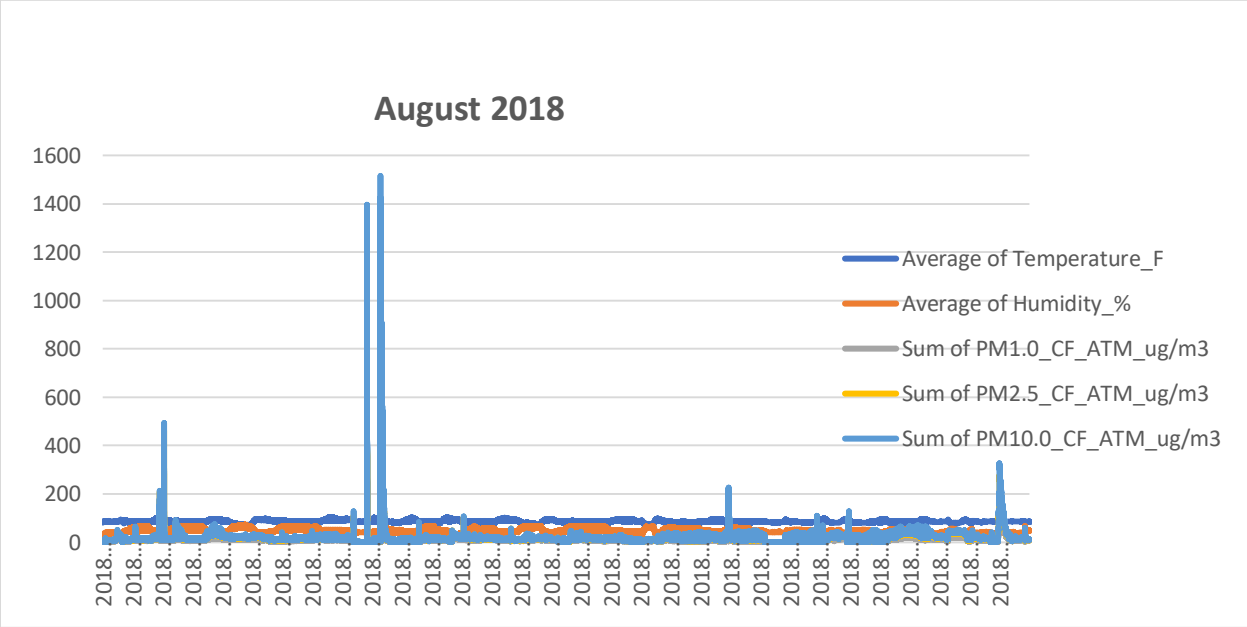
In July 18, zip Code 90066 had highest levels of 1.0 PM, peaking the 28th at nearly 250 CF_ATM_ug/m3.




July 2018 Average Temperature F
140
120
100
80
60
40
20
0
2018-07-19 00:00:40 UTC
2018-07-19 06:21:27 UTC
2018-07-19 12:42:16 UTC
2018-07-19 18:54:32 UTC
2018-07-20 02:18:29 UTC
2018-07-20 14:35:50 UTC
2018-07-21 02:55:50 UTC
2018-07-21 15:14:31 UTC
2018-07-22 17:24:55 UTC
2018-07-23 05:42:49 UTC
2018-07-23 18:06:46 UTC
2018-07-24 03:23:38 UTC
2018-07-24 10:18:18 UTC
2018-07-24 18:15:38 UTC
2018-07-25 00:28:59 UTC
2018-07-25 06:40:51 UTC
2018-07-25 12:50:19 UTC
2018-07-25 19:00:59 UTC
2018-07-26 02:29:27 UTC
2018-07-26 15:09:13 UTC
2018-07-28 01:17:52 UTC
2018-07-28 05:37:57 UTC
2018-07-28 09:53:51 UTC
2018-07-28 14:07:13 UTC
2018-07-28 18:24:23 UTC
2018-07-29 00:06:02 UTC
2018-07-29 04:26:02 UTC
2018-07-29 08:40:53 UTC
2018-07-29 12:57:30 UTC
2018-07-29 18:07:25 UTC
2018-07-29 22:25:53 UTC
2018-07-30 04:39:15 UTC
2018-07-30 10:51:15 UTC
2018-07-30 17:01:50 UTC
2018-07-30 23:15:09 UTC
2018-07-31 05:30:57 UTC
2018-07-31 11:44:05 UTC
2018-07-31 18:00:06 UTC

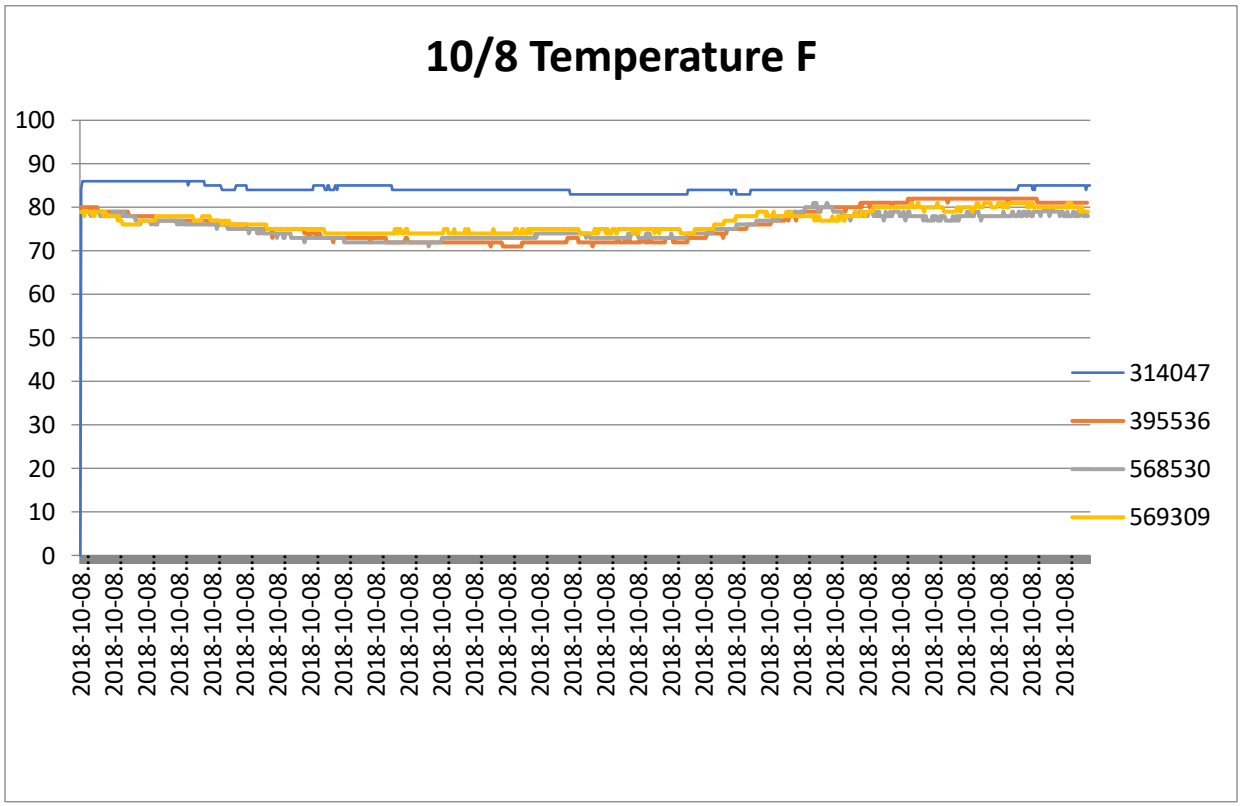

July 2018 Average Temperature F by Zip code
140
120
100
80
60
40
20
0
2018-07-19 00:00:40 UTC
2018-07-19 07:25:15 UTC
2018-07-19 14:34:47 UTC
2018-07-19 21:43:52 UTC
2018-07-20 09:41:10 UTC
2018-07-20 23:49:10 UTC
2018-07-21 14:01:11 UTC
2018-07-22 18:02:15 UTC
2018-07-23 08:14:49 UTC
2018-07-23 22:25:26 UTC
2018-07-24 06:32:02 UTC
2018-07-24 15:08:27 UTC
2018-07-24 23:15:02 UTC
2018-07-25 06:22:19 UTC
2018-07-25 13:27:39 UTC
2018-07-25 20:34:03 UTC
2018-07-26 07:31:00 UTC
2018-07-26 21:57:44 UTC
2018-07-28 04:21:10 UTC
2018-07-28 09:13:52 UTC
2018-07-28 14:07:20 UTC
2018-07-28 19:07:20 UTC
2018-07-29 01:29:53 UTC
2018-07-29 06:19:54 UTC
2018-07-29 11:15:19 UTC
2018-07-29 16:33:53 UTC
2018-07-29 22:01:19 UTC
2018-07-30 04:59:08 UTC
2018-07-30 12:07:08 UTC
2018-07-30 19:12:41 UTC
2018-07-31 02:24:17 UTC
2018-07-31 09:34:43 UTC
2018-07-31 16:45:26 UTC
301212
303877
303894
310286
411799
444020
448503
449443

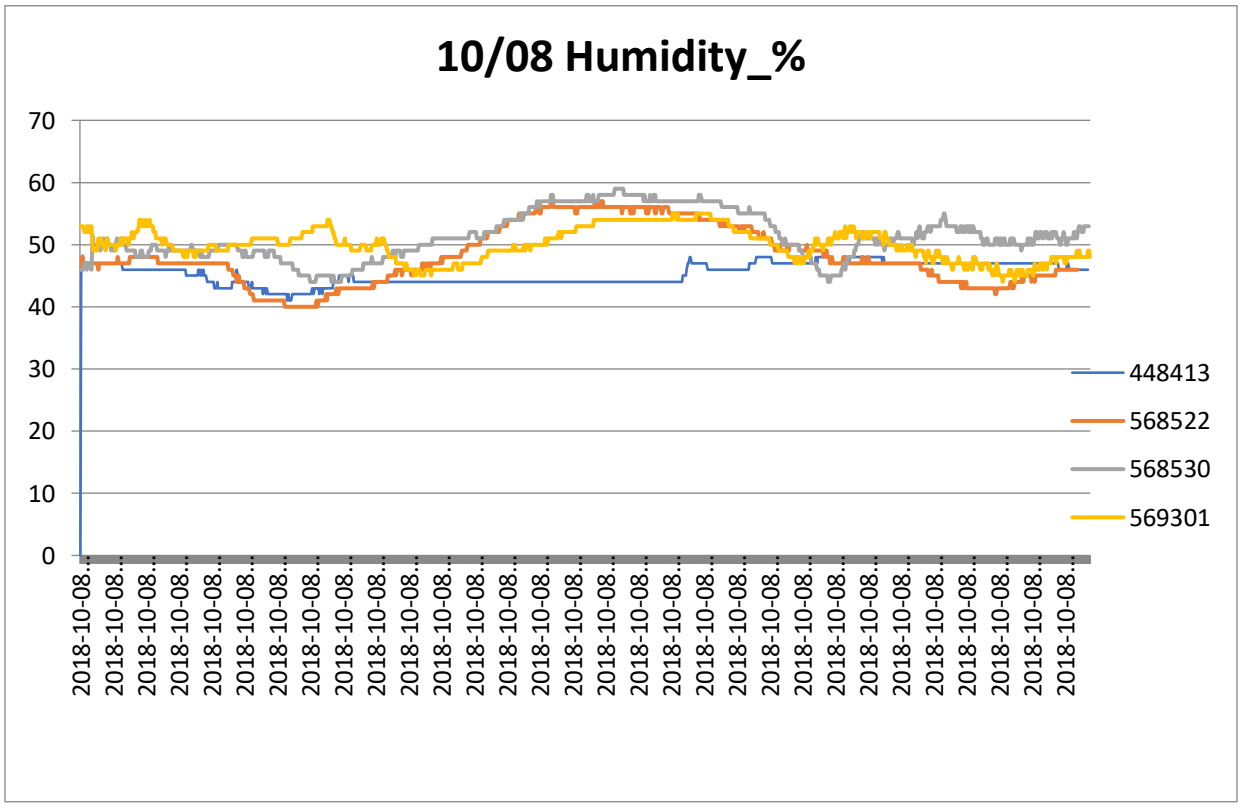


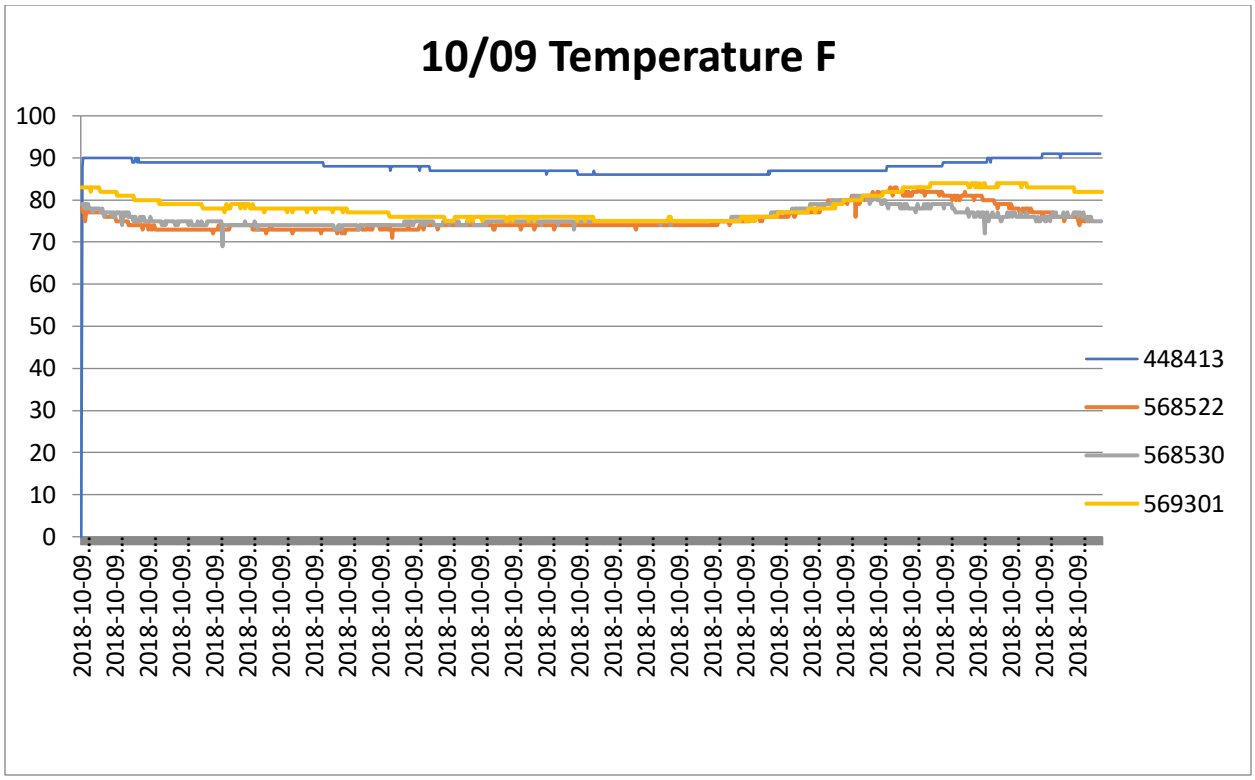


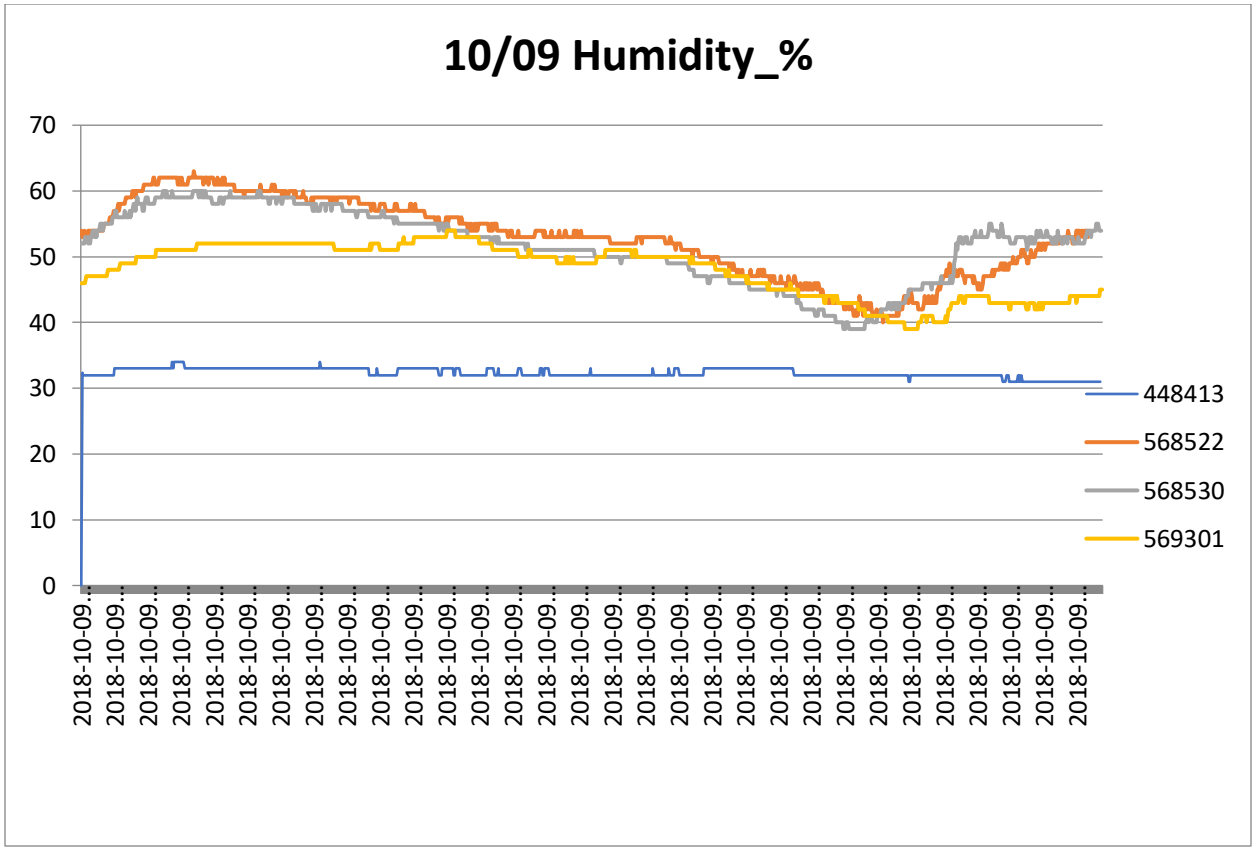
*Not including every month or chart to not overwhelm length.

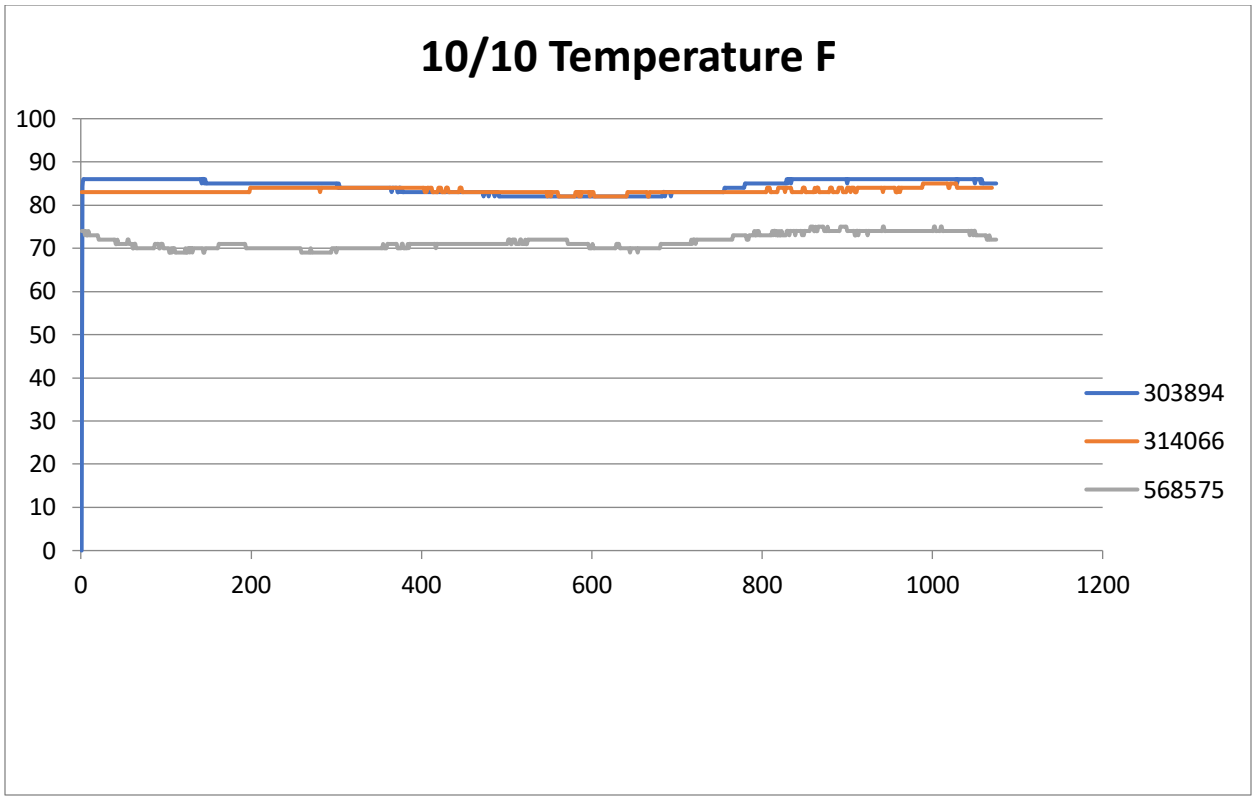
5. For reference: Analysis of 10/08-10/14 Temperature and Humidity by Hour:

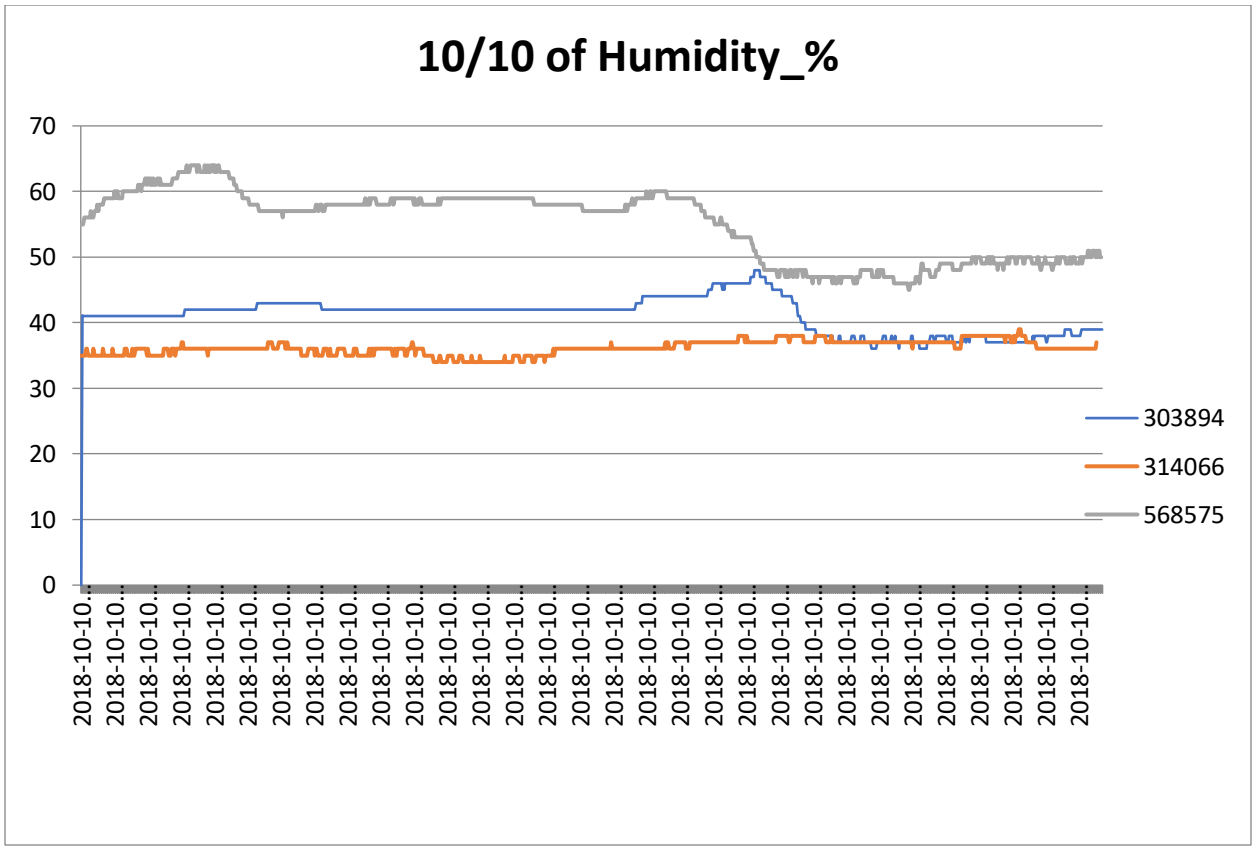


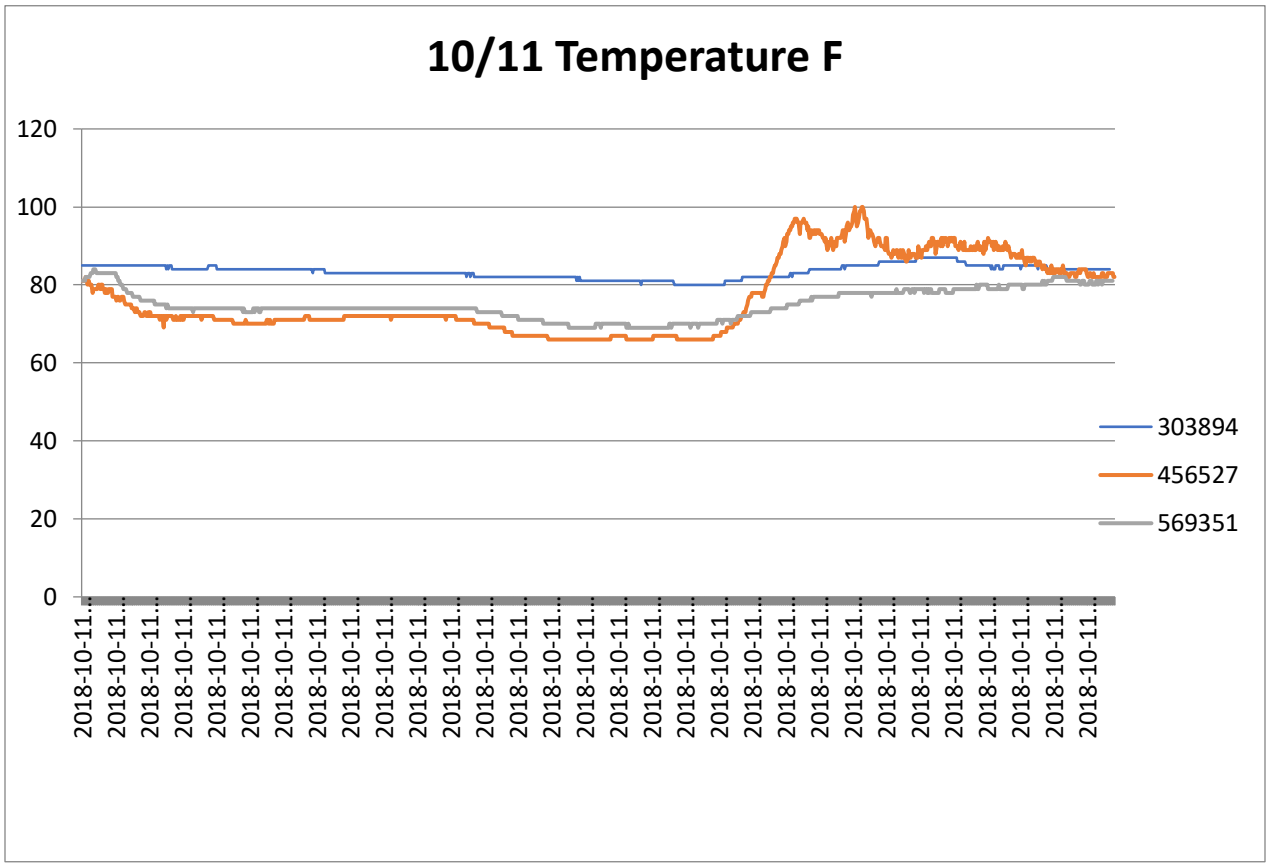


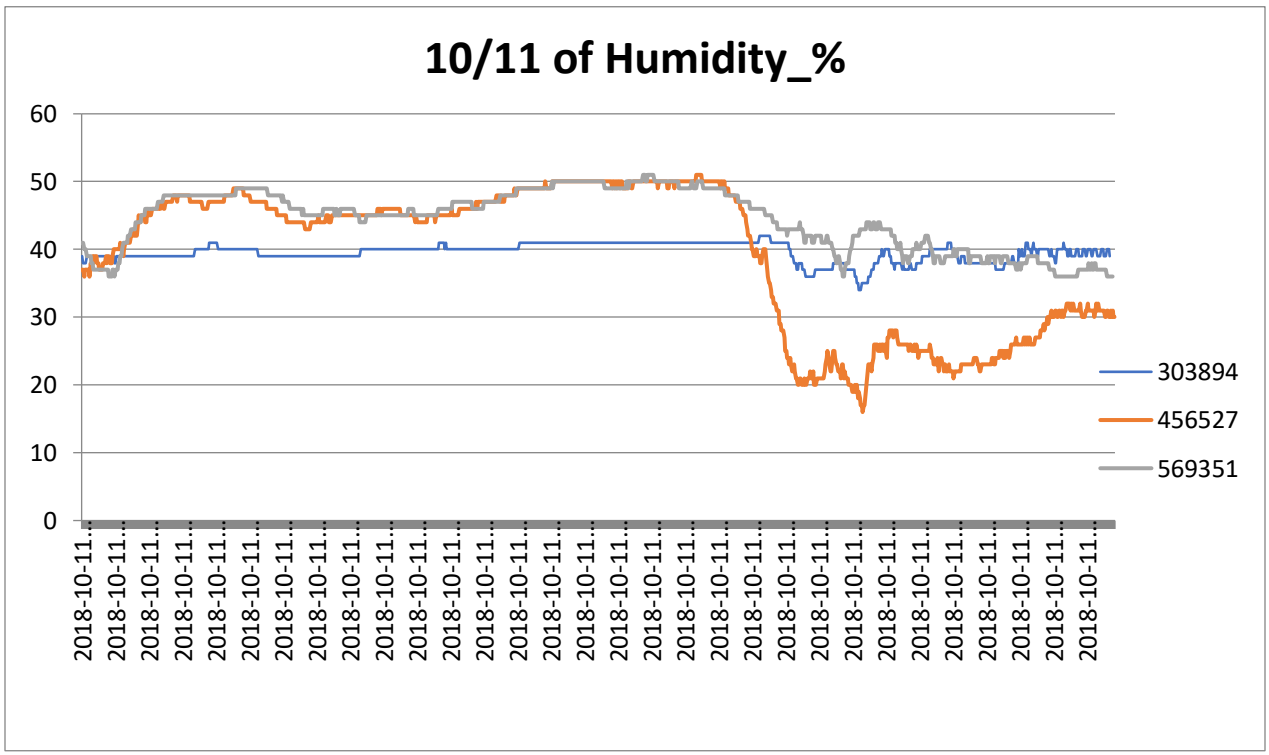

10/09 Temperature F
100
90
80
70
60
50
40
30
20
10
0
2018-10-09...
448413
568522
568530
569301

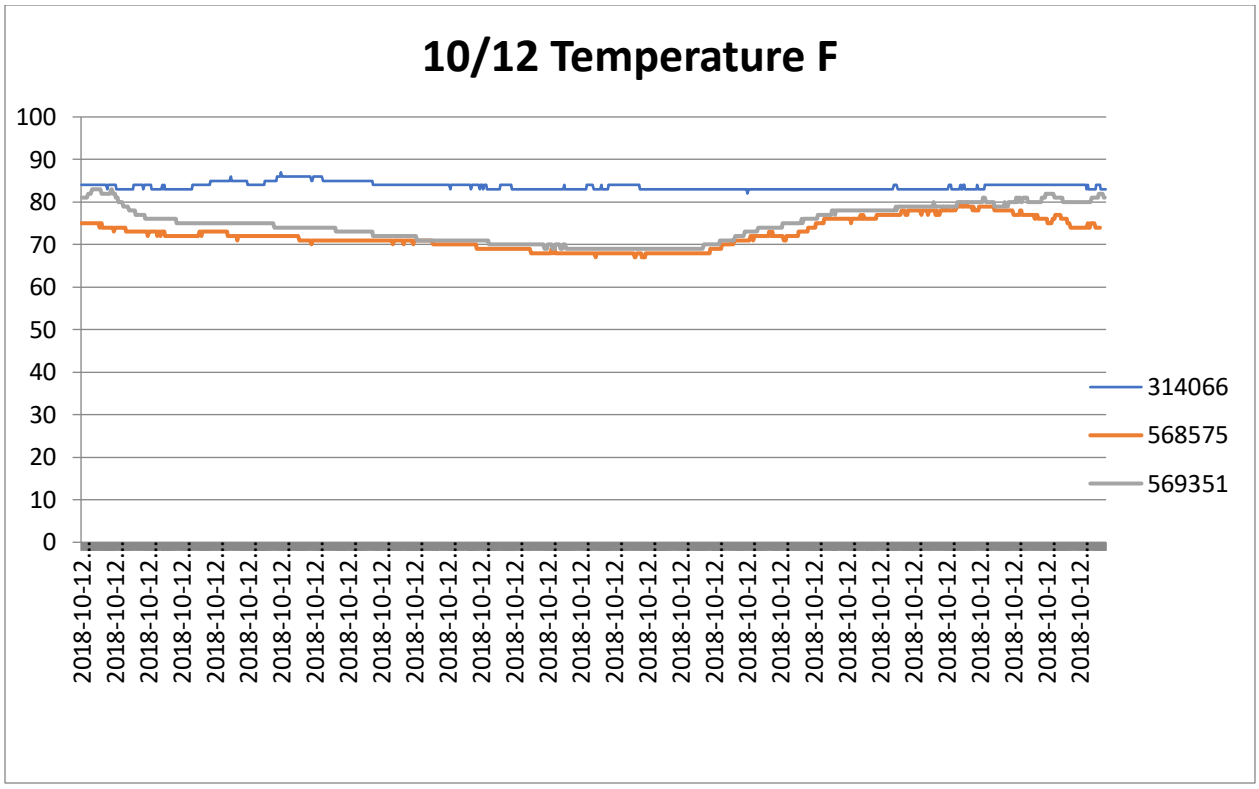

10/09 Humidity_%
70
60
50
40
30
20
10
0
2018-10-09...
448413
568522
568530
569301

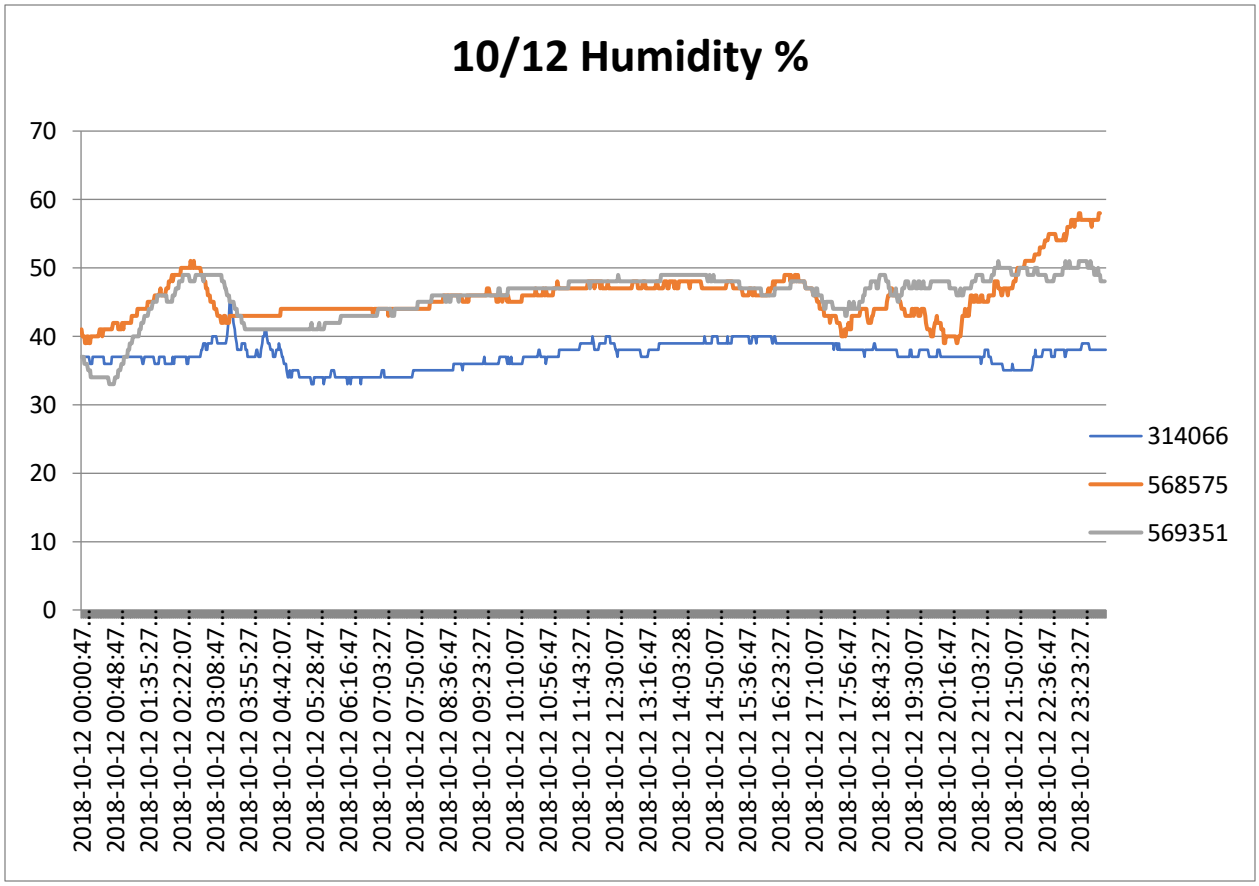

10/10 Temperature F
100
90
80
70
60
50
40
30
20
10
0
0
200
400
600
800
1000
1200
303894
314066
568575

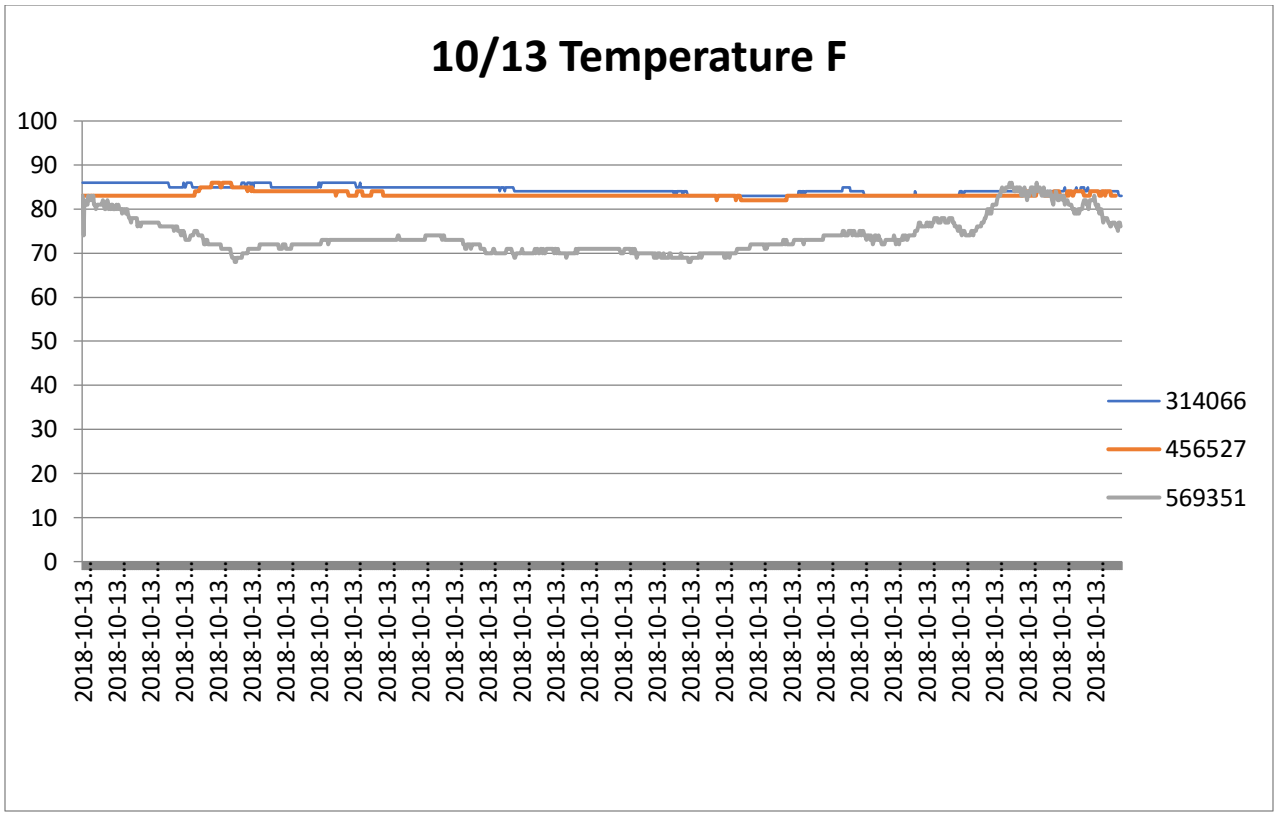

10/10 of Humidity_%
70
60
50
40
30
20
10
0
2018-10-10...
303894
314066
568575

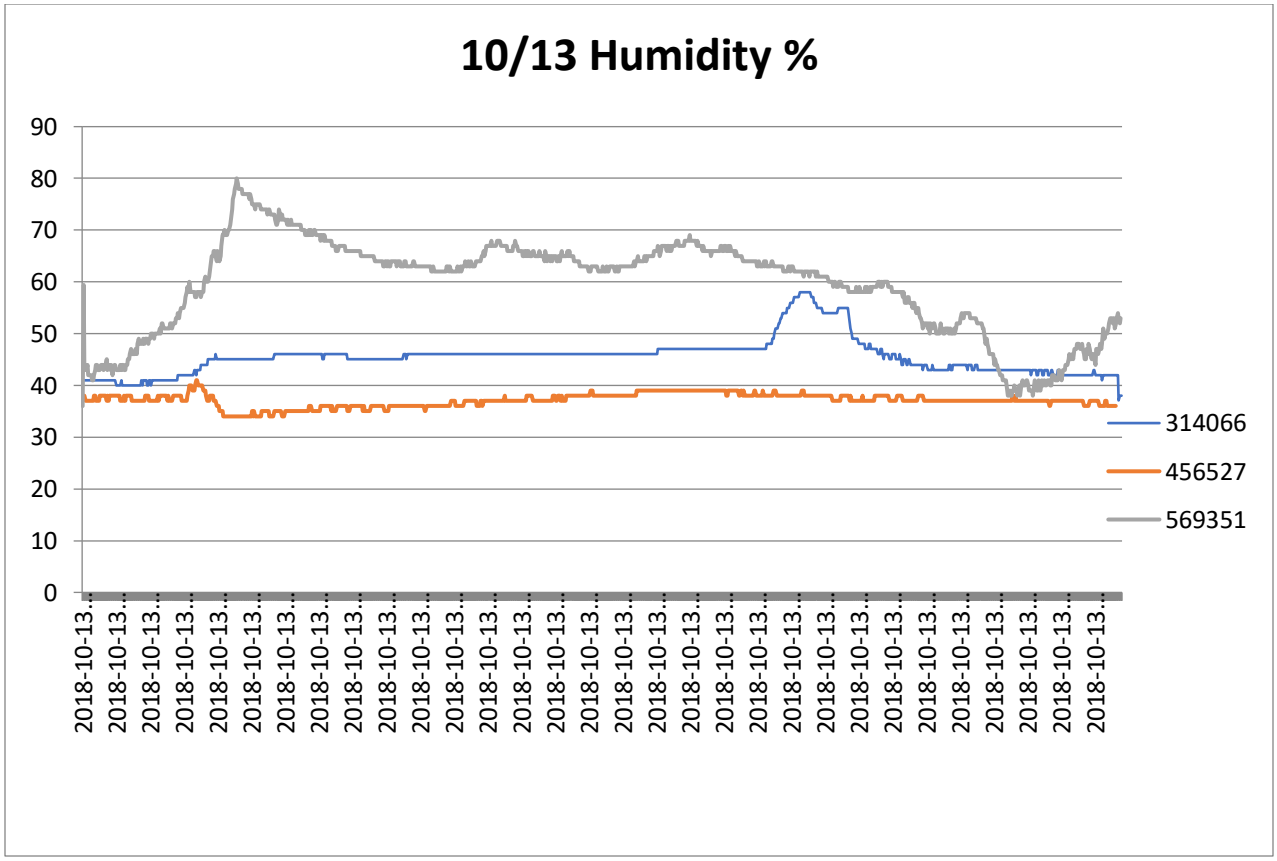

10/11 Temperature F
120
100
80
60
40
20
0
303894
456527
569351

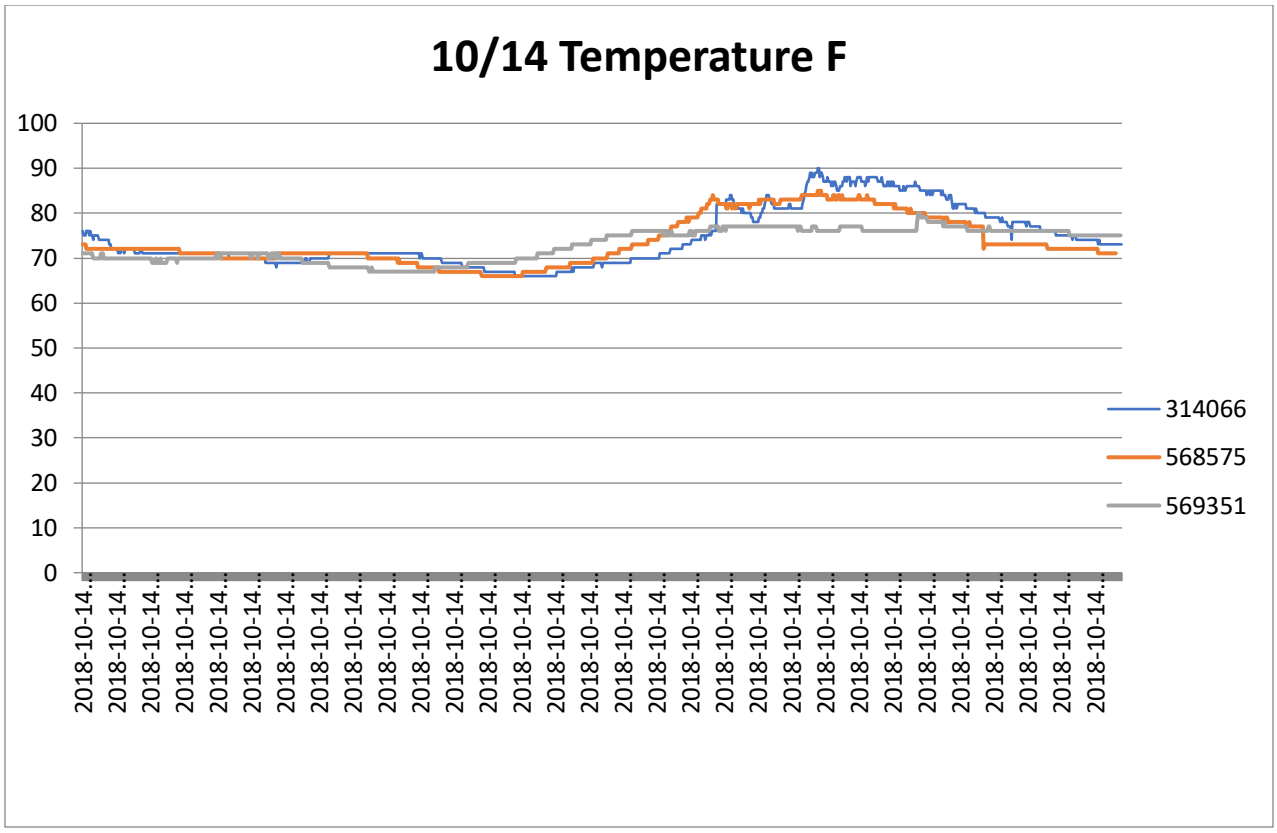

10/11 of Humidity_%
60
50
40
30
20
10
0
303894
456527
569351

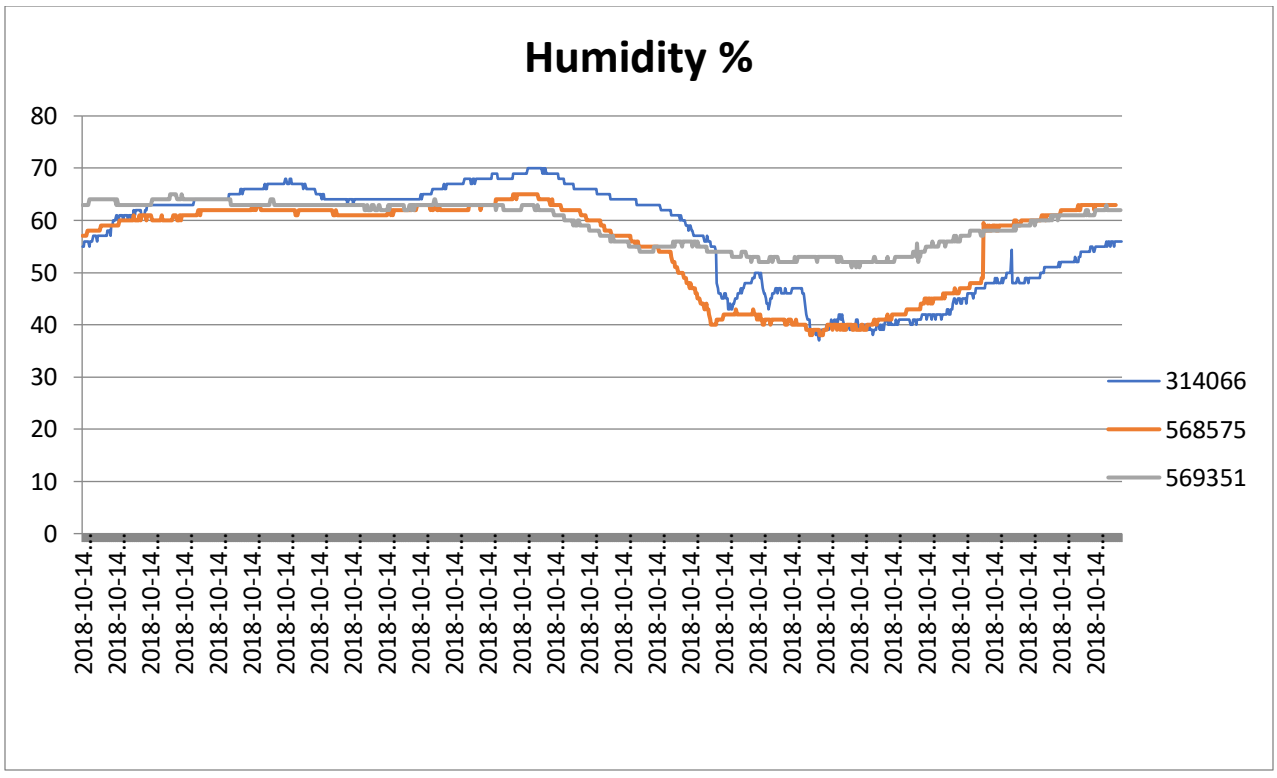

10/12 Temperature F
100
90
80
70
60
50
40
30
20
10
0
2018-10-12...
314066
568575
569351


10/12 Humidity %
70
60
50
40
30
20
10
0
2018-10-12 00:00:47...
2018-10-12 00:48:47...
2018-10-12 01:35:27...
2018-10-12 02:22:07...
2018-10-12 03:08:47...
2018-10-12 03:55:27...
2018-10-12 04:42:07...
2018-10-12 05:28:47...
2018-10-12 06:16:47...
2018-10-12 07:03:27...
2018-10-12 07:50:07...
2018-10-12 08:36:47...
2018-10-12 09:23:27...
2018-10-12 10:10:07...
2018-10-12 10:56:47...
2018-10-12 11:43:27...
2018-10-12 12:30:07...
2018-10-12 13:16:47...
2018-10-12 14:03:28...
2018-10-12 14:50:07...
2018-10-12 15:36:47...
2018-10-12 16:23:27...
2018-10-12 17:10:07...
2018-10-12 17:56:47...
2018-10-12 18:43:27...
2018-10-12 19:30:07...
2018-10-12 20:16:47...
2018-10-12 21:03:27...
2018-10-12 21:50:07...
2018-10-12 22:36:47...
2018-10-12 23:23:27...
314066
568575
569351


10/13 Temperature F
100
90
80
70
60
50
40
30
20
10
0
2018-10-13...
314066
456527
569351


10/13 Humidity %
90
80
70
60
50
40
30
20
10
0
2018-10-13...
314066
456527
569351


10/14 Temperature F
100
90
80
70
60
50
40
30
20
10
0
2018-10-14...
314066
568575
569351


Humidity %
80
70
60
50
40
30
20
10
0
2018-10-14...
314066
568575
569351