The Effect of the Time of Day on Muon Count

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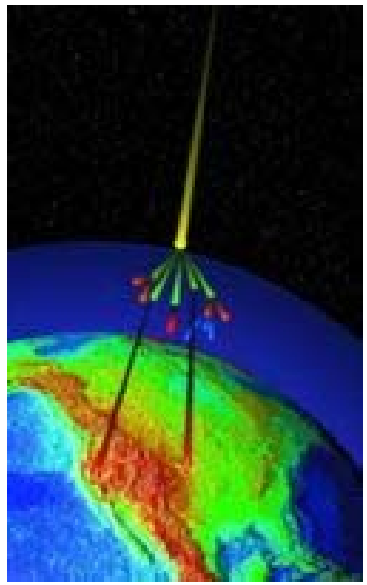
What we know…

As we all know, muons are formed when solar winds collide with the Earth's atmosphere. This impact creates muon and muon showers.



The Question…

The question is, will daylight hours, when we are facing the Sun, prove to yield a greater muon rate?

This question give rise to an even greater question, does the Sun produce enough solar wind to cause a noticeable increase in muon production?

Sample of data collected at Canandaigua using our paddles

Interval	End Date	End Time	Counts	Sigma Rate (Hz)	Pressure(kPa)	Rate(Hz)
0	4/13/2006	19:00:00	11803	0.030178	97	3.278611
1	4/13/2006	20:00:00	12018	0.030452	97	3.338333
2	4/13/2006	21:00:00	11844	0.030231	97	3.29
3	4/13/2006	22:00:00	12000	0.030429	97	3.333333
4	4/13/2006	23:00:00	11801	0.030176	97	3.278056
5	4/13/2006	0:00:00	11815	0.030194	97	3.281944
6	4/13/2006	1:00:00	12071	0.030519	97.1	3.353056
7	4/13/2006	2:00:00	11983	0.030407	97	3.328611
8	4/13/2006	3:00:00	11895	0.030296	97	3.304167
9	4/13/2006	4:00:00	12039	0.030478	97	3.344167
10	4/13/2006	5:00:00	12079	0.030529	96.9	3.355278
11	4/14/2006	6:00:00	12076	0.030525	96.8	3.354444
12	4/14/2006	7:00:00	11987	0.030413	96.8	3.329722

We also gathered data from the large muon detector here at the University of Rochester during the same time interval. We then compared this data to the data gathered with our smaller classroom sized paddle back in Canandaigua.

This giant paddle measures 0.75 m by 3.00 m and is located in the attic of the Bausch and Lomb Hall (the physics building).

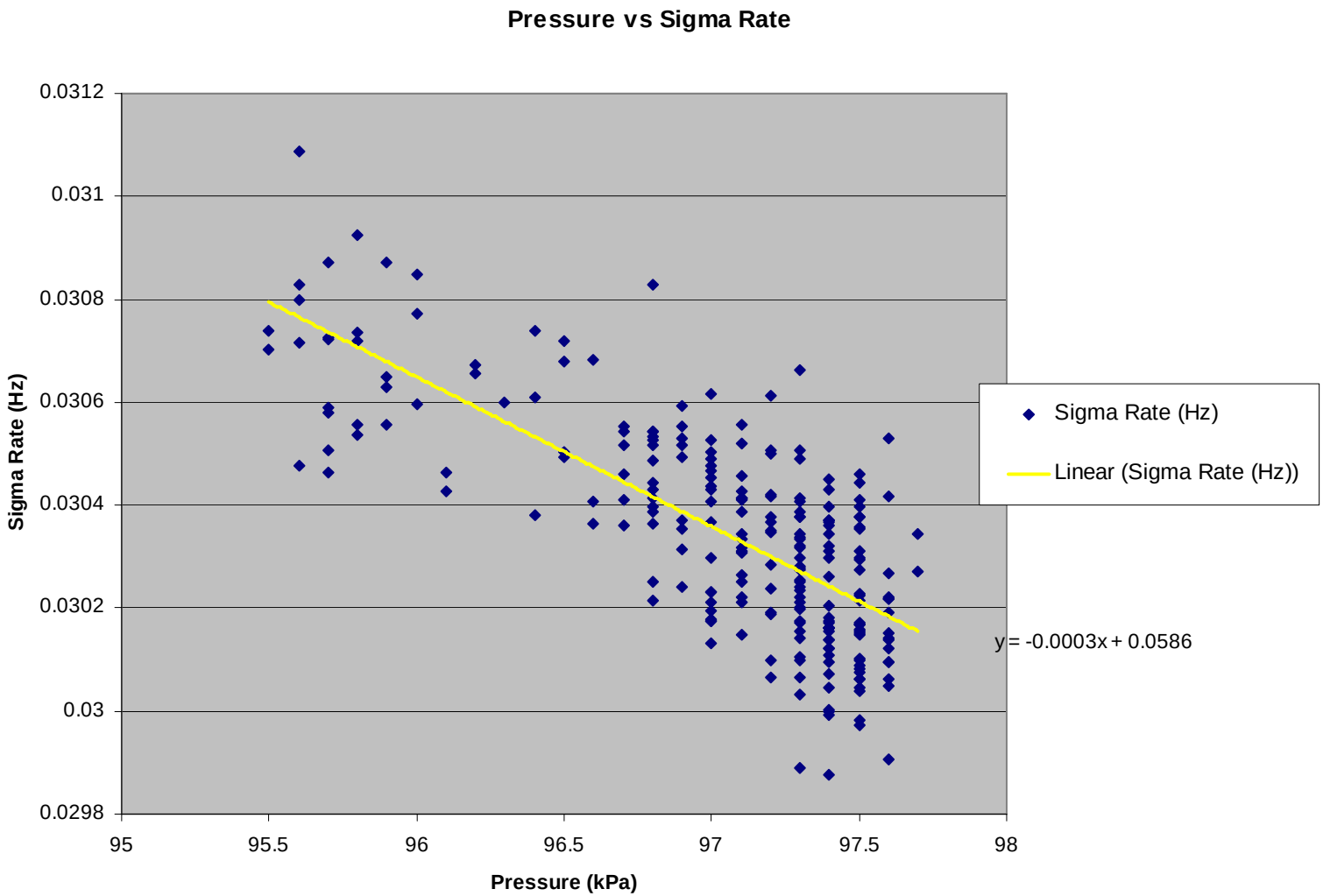
The data from this detector can be found on the internet at the site…

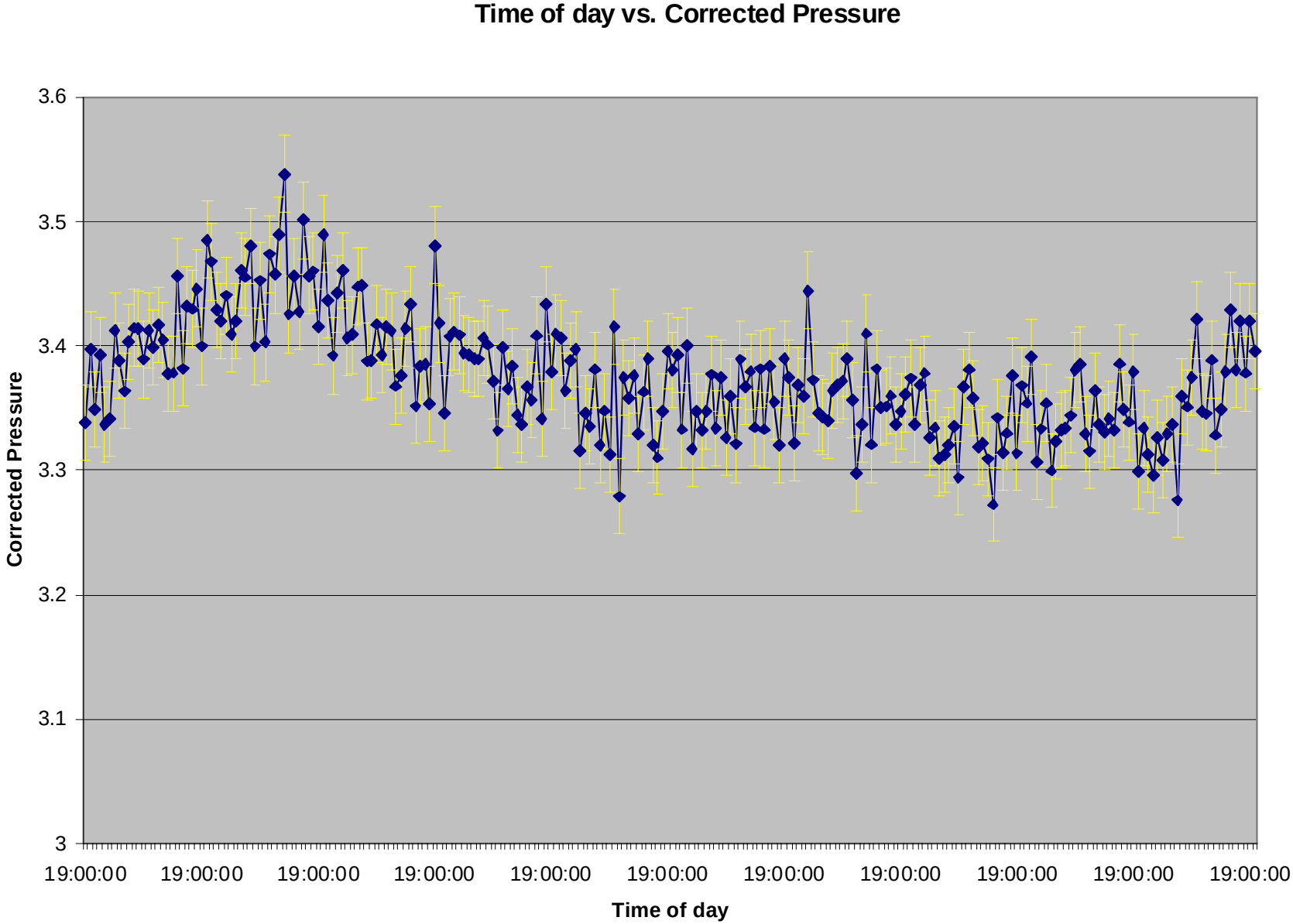
http://web1.pas.rochester.edu/~jmelvil1/logs/

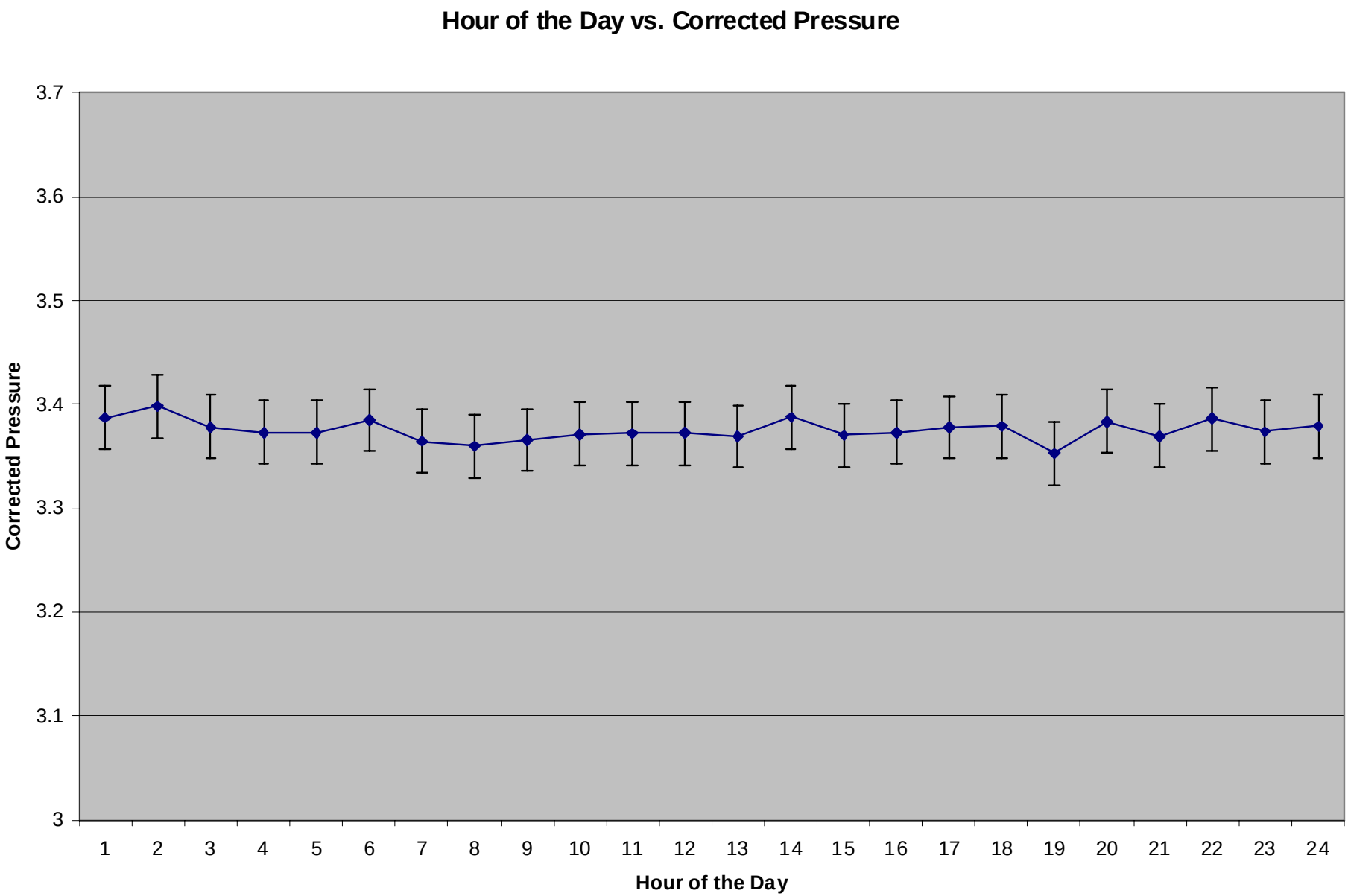
Sample data collected form the U of R web site

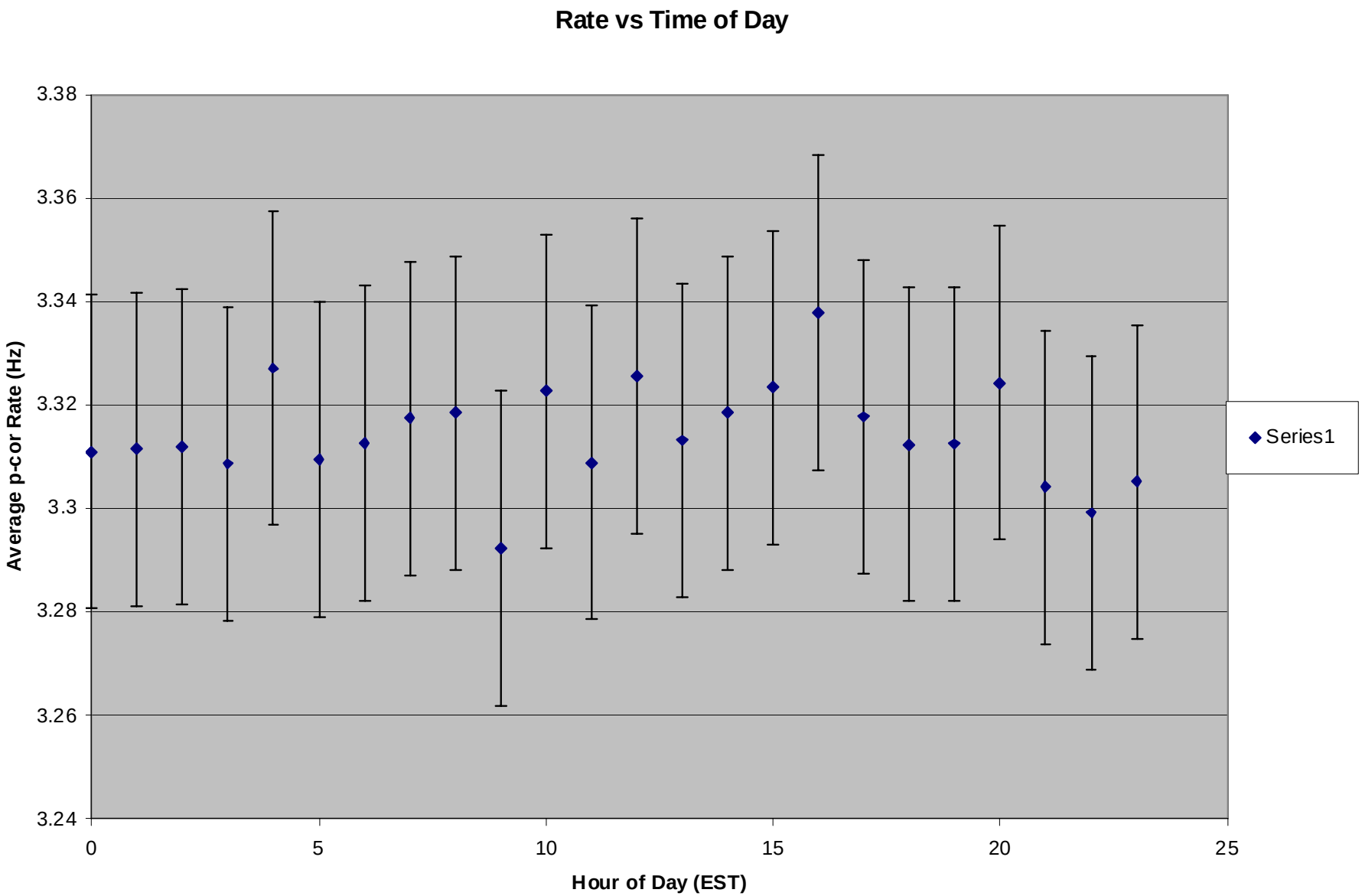
Date	Time(UTC)	Pressure(hPa)	Detector Temp(C)	Counts	Rate(Hz)	Sigma(Hz)
20060413	19:00:00	1022.2	25.2	113253	377.51	1.122	283	8	28	246
20060413	19:05:00	1023.1	25.1	112664	375.547	1.119	331	4	29	298
20060413	19:10:00	1022.4	25.3	111846	372.82	1.115	292	8	32	250
20060413	19:15:00	1023.6	25.3	112540	375.133	1.118	291	1	27	262
20060413	19:20:00	1023.5	25.2	112651	375.503	1.119	289	4	28	257
20060413	19:25:00	1022.6	25.2	112679	375.597	1.119	269	5	17	246
20060413	19:30:00	1023.1	25.3	112525	375.083	1.118	258	6	21	231
20060413	19:35:00	1022.0	25.3	112511	375.037	1.118	283	9	23	250
20060413	19:40:00	1022.8	25.2	112615	375.383	1.119	278	2	23	252
20060413	19:45:00	1022.9	25.2	113163	377.21	1.121	283	9	20	253
20060413	19:50:00	1021.6	25.1	112963	376.543	1.12	256	6	17	233
20060413	19:55:00	1022.0	25.2	113296	377.653	1.122	334	6	31	297

Graphs from our paddle

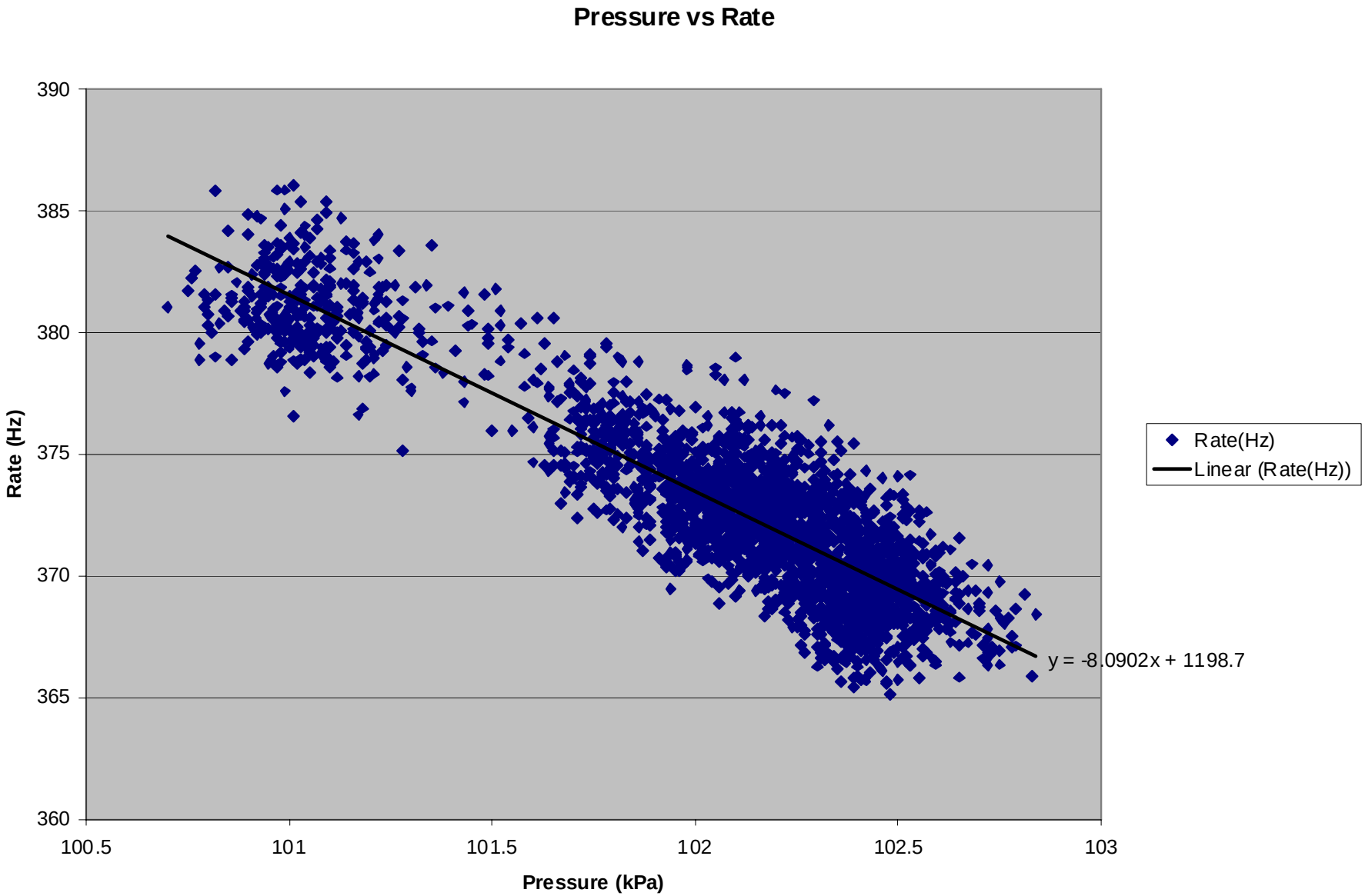


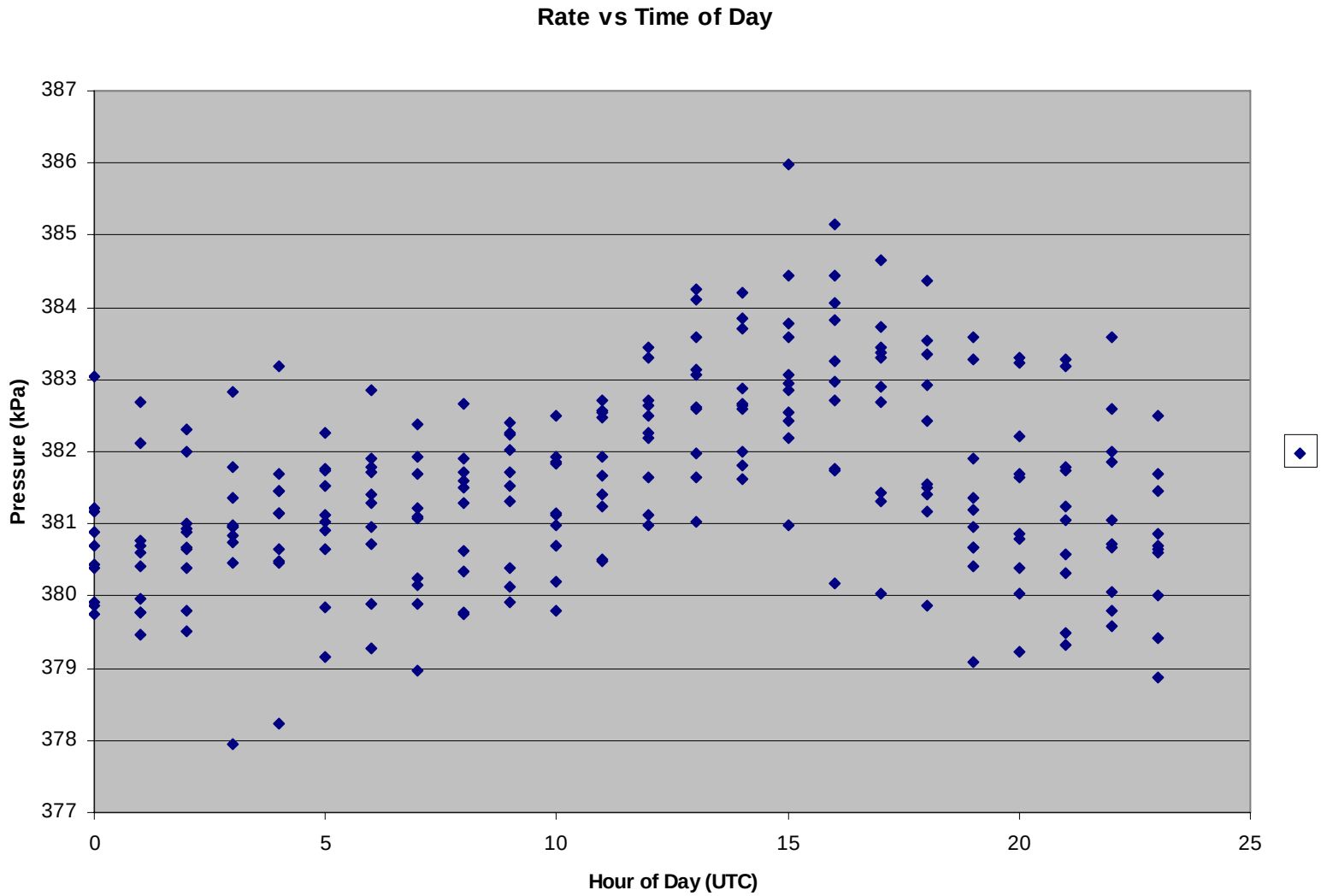

Time of day vs. Corrected Pressure
Corrected Pressure
3.6
3.5
3.4
3.3
3.2
3.1
3
19:00:00
19:00:00
19:00:00
19:00:00
19:00:00
19:00:00
19:00:00
19:00:00
19:00:00
19:00:00
19:00:00
Time of day

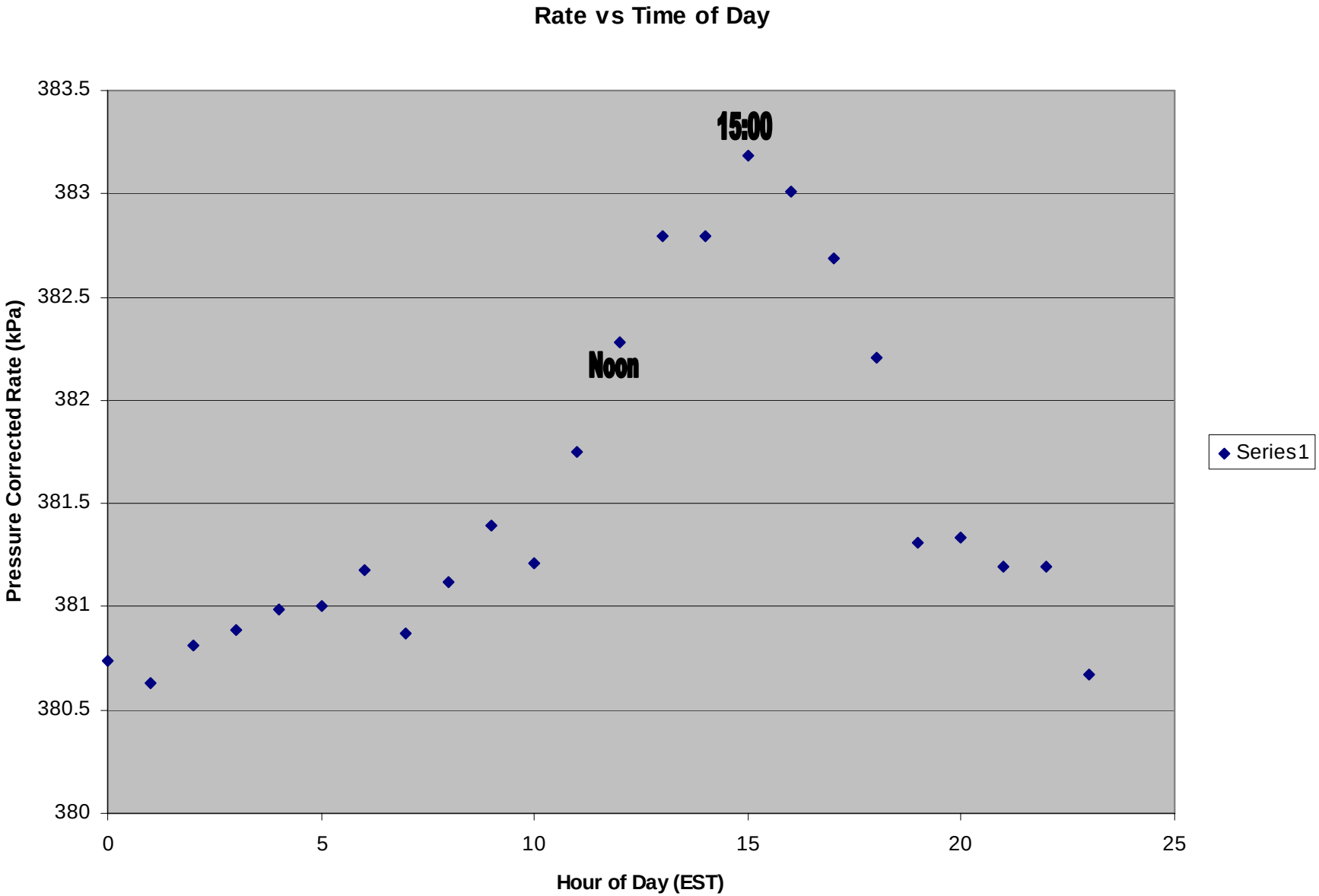

Hour of the Day vs. Corrected Pressure
Corrected Pressure
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Hour of the Day


Rate vs Time of Day
Average p-cor Rate (Hz)
3.38
3.36
3.34
3.32
3.3
3.28
3.26
3.24
0
5
10
15
20
25
Hour of Day (EST)
Series1

Graphs of UR data


Pressure vs Rate
390
385
380
375
370
365
360
Rate (Hz)
100.5
101
101.5
102
102.5
103
Pressure (kPa)
Rate(Hz)
Linear (Rate(Hz))
y = -8.0902x + 1198.7


Rate vs Time of Day
Pressure (kPa)
387
386
385
384
383
382
381
380
379
378
377
0
5
10
15
20
25
Hour of Day (UTC)


Rate vs Time of Day
383.5
383
382.5
382
381.5
381
380.5
380
15:00
Noon
Pressure Corrected Rate (kPa)
0
5
10
15
20
25
Hour of Day (EST)
Series1

Data Comparison

- The data from our research in Canandaigua shows that the time of day seems to play some role in the muon rate.
- Our data from the University of Rochester further strengthens this conclusion
- In each case, the muon rate was greatest at 15:00 EST, and lowest around the beginning and end of each day.

Conclusions

- The data we have collected from our own muon detector in Canandaigua and the data collected at the University of Rochester yields similar information.

- Each detector indicates that the muon rate is greatest near the height of the day, around 15:00 EST. This leads us to believe that the time of day plays a role in the number of muons reaching the earth's surface throughout the day.