EEE Data

Preliminary analysis from Savona station

Data from 1-10-2016 to 4-6-2017

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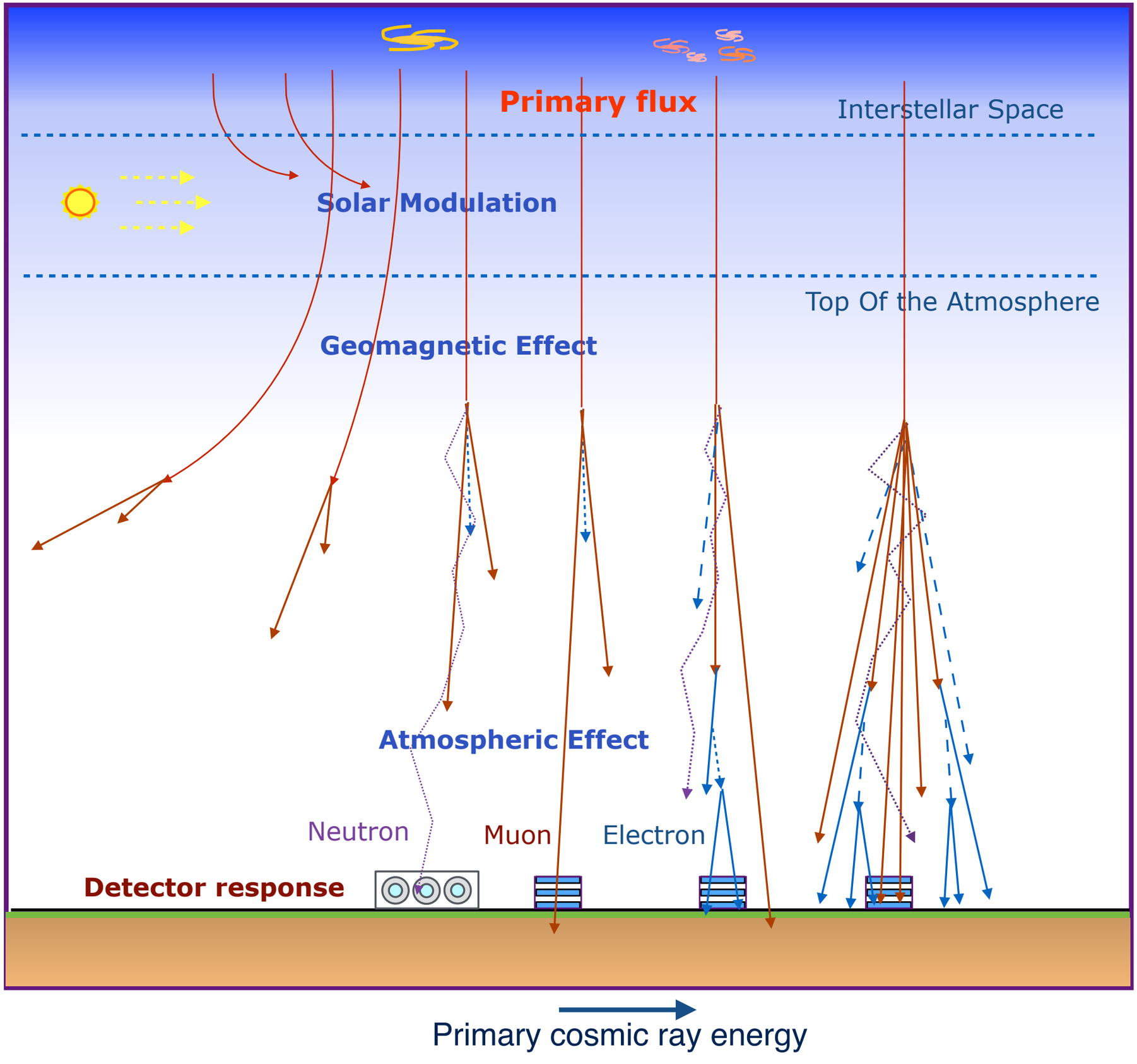
Ago 3rd. 2018 - Univ. Santiago de Compostela

About Cosmic Rays
and the atmospheric effect


Primary flux
Interstellar Space
Solar Modulation
Top Of the Atmosphere
Geomagnetic Effect
Atmospheric Effect
Neutron
Muon
Electron
Detector response
Primary cosmic ray energy

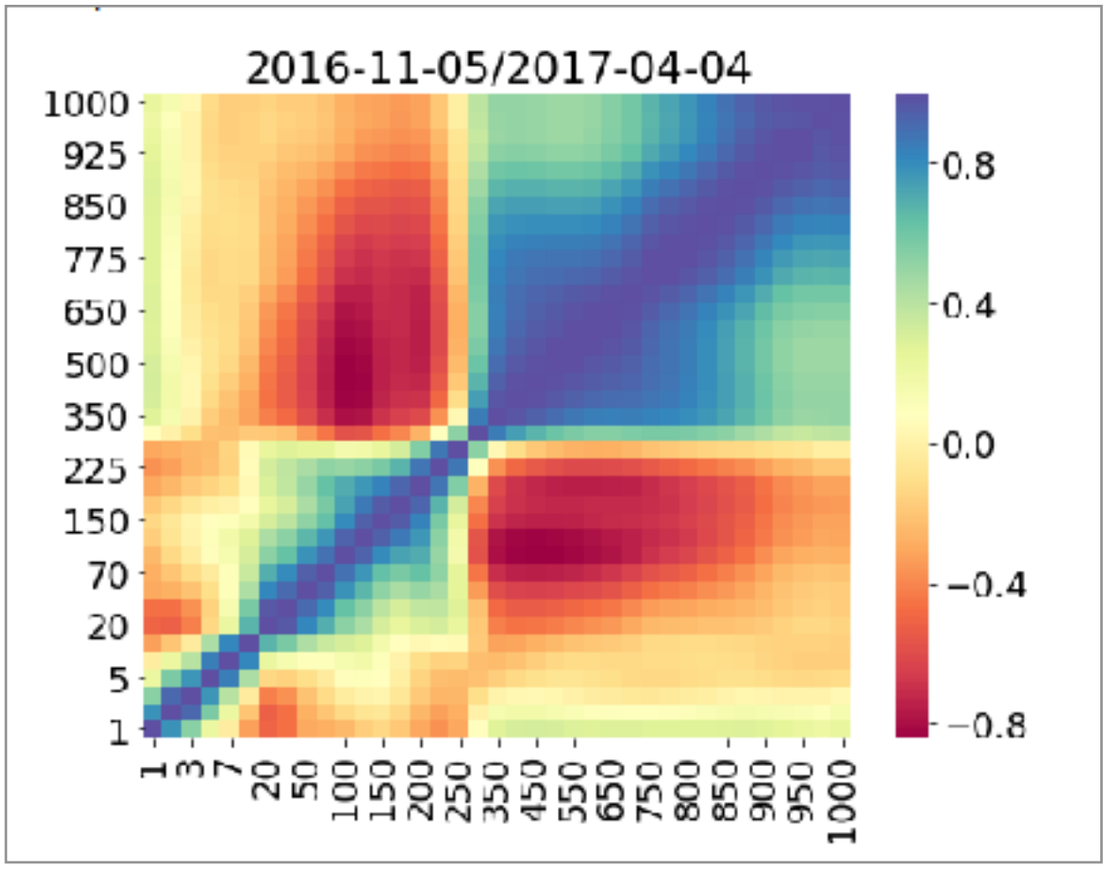
Cosmic rays

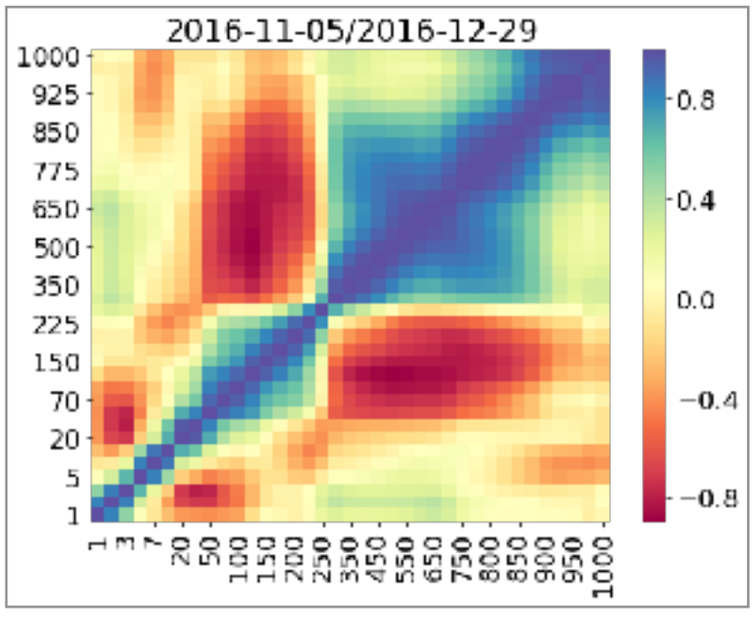
Short summary of properties

Order	Particle	Mass/GeV	Proceso	Mass lenght	Lenght	Prob.	Products
1st.	P	1	Nuclear Col.	~ 70 g.cm^{-2}		1	Nucleons, mesons
	He	4	Nuclear Col.	~ 40 g.cm^{-2}		1	Nucleons, mesons
	C	12	Nuclear Col.	~ 25 g.cm^{-2}		1	Nucleons, mesons
	Fe	56	Nuclear Col.	~ 12 g.cm^{-2}		1	Nucleons, mesons
2nd.	Nucleon	1	Nuclear Col.	110-150 g.cm^{-2}		1	Nucleons, mesons
	Neutron	1	Elastic Col.	150 g.cm^{-2}		1	Neutron
	Kaon	0.490	Nuclear Col.	~ 140 g.cm^{-2}		1	Nucleons, mesons
			Decay		3.7 m	0.6	muon
						0.4	pions
	Pion	0.140	Nuclear Col.	~ 120 g.cm^{-2}		1	Nucleons, mesons
			Decay		7.8 m	1	Muons
3rd.	Muon	0.106	Decay		659 m	1	Electrons
	Electron	0.0005	Mult. Scatt.	~ 37 g.cm^{-2}		1	Electrons & gammas
	Gamma	0	Pair C.	~ 37 g.cm^{-2}		1	Electrons

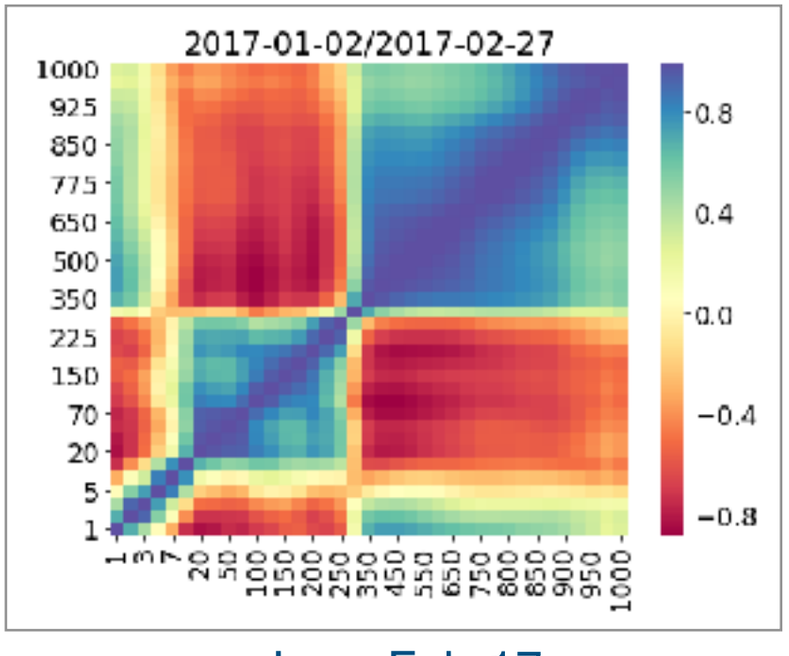
The Atmosphere

Temperature correlation between layers

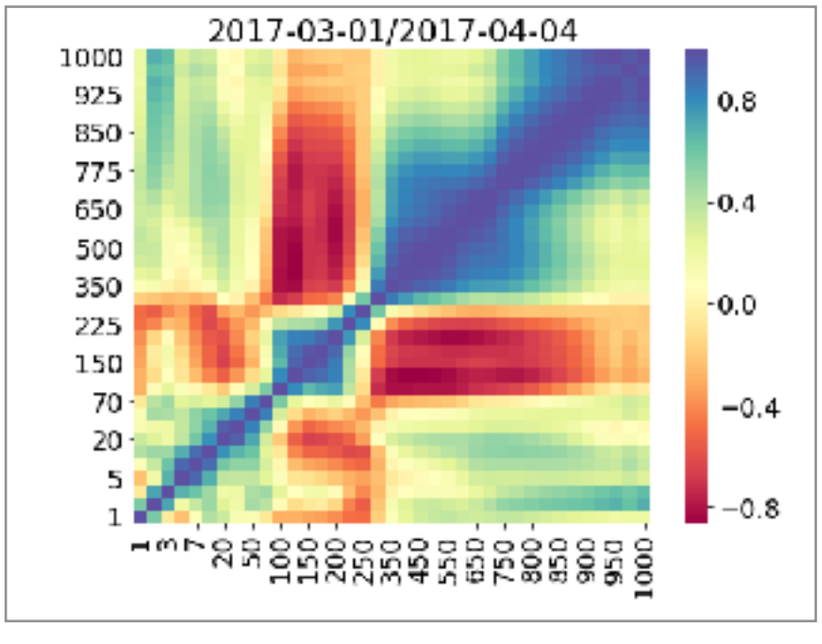




Nov-Dec 16



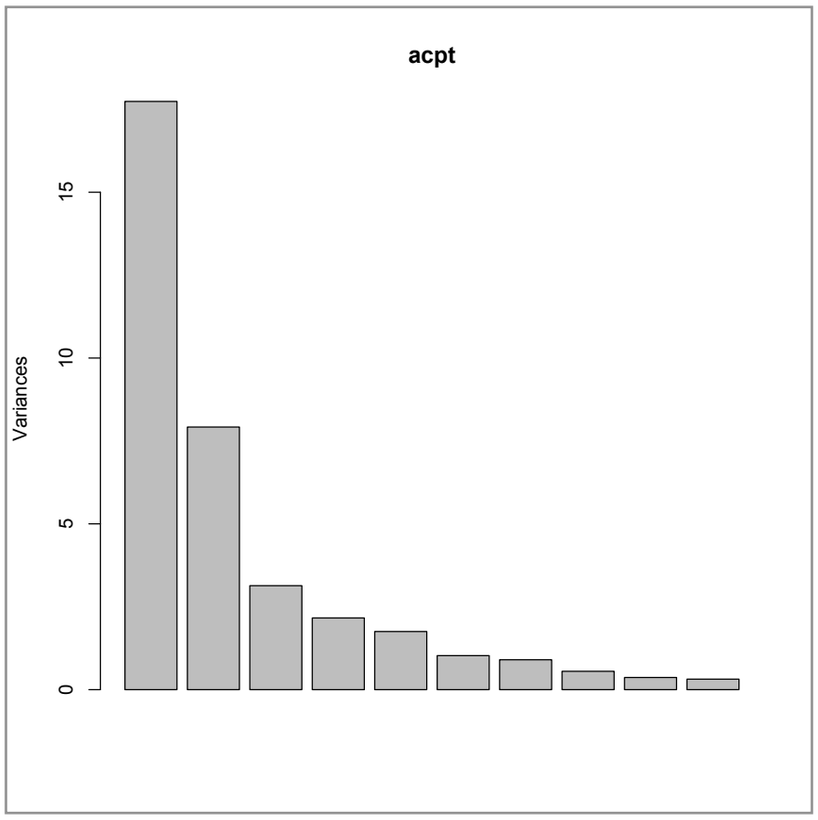
Jan - Feb 17



Mar - Abr 17

Atmosphere temperature PCA analysis

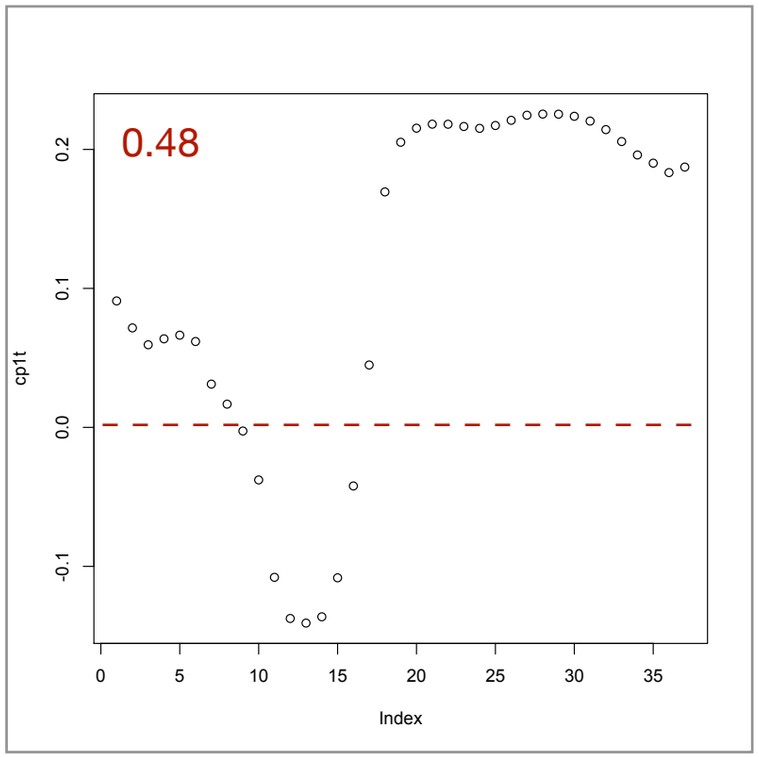
Whole period

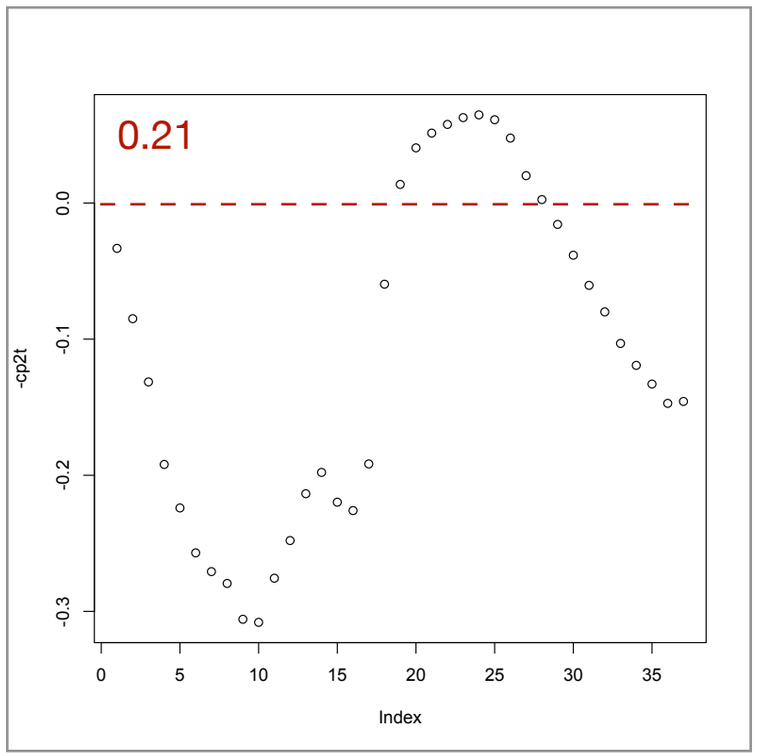


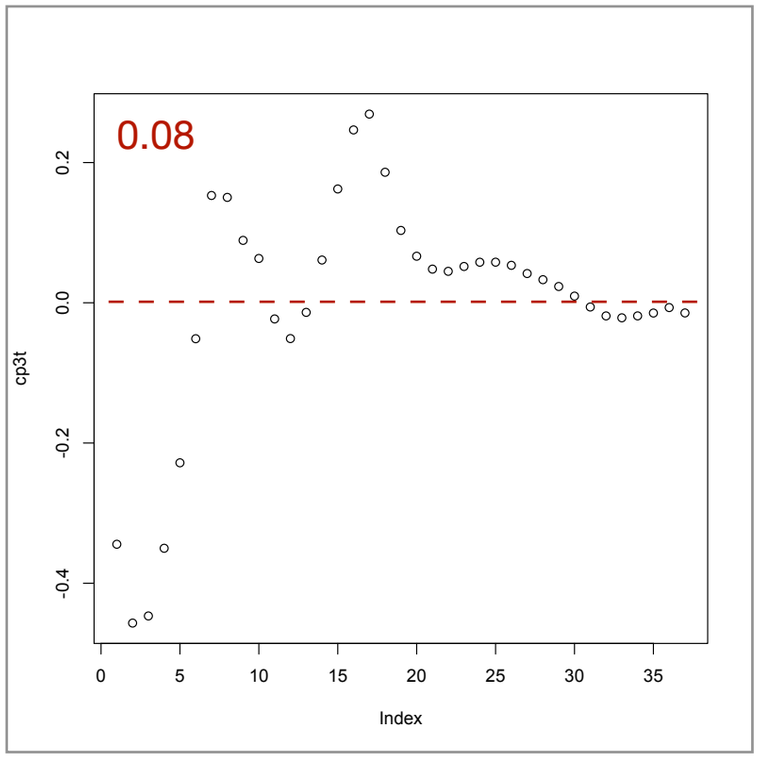

```
> summary(acpt)
Importance of components%s:
                          PC1        PC2        PC3        PC4        PC5
Standard deviation     4.21166375 2.81414942 1.77067988 1.47044368 1.32409562
Proportion of Variance 0.47941000 0.21404000 0.08474000 0.05844000 0.04738000
Cumulative Proportion  0.47941000 0.69345000 0.77819000 0.83662000 0.88401000
                          PC6         PC7        PC8        PC9         PC10
Standard deviation     1.01312291 0.949671052 0.74414904 0.60610791 0.563150749
Proportion of Variance 0.02774000 0.024380000 0.01497000 0.00993000 0.008570000
Cumulative Proportion  0.91175000 0.936120000 0.95109000 0.96102000 0.969590000
                          PC11        PC12        PC13        PC14         PC15
Standard deviation     0.495748244 0.43489487 0.358619244 0.318737306 0.294340373
Proportion of Variance 0.006640000 0.00511000 0.003480000 0.002750000 0.002340000
Cumulative Proportion  0.976230000 0.98134000 0.984820000 0.987570000 0.989910000
                          PC16        PC17         PC18        PC19         PC20
Standard deviation     0.265517046 0.221096847 0.210255828 0.194262391 0.181529955
Proportion of Variance 0.001910000 0.001320000 0.001190000 0.001020000 0.000890000
Cumulative Proportion  0.991810000 0.993130000 0.994330000 0.995350000 0.996240000
```

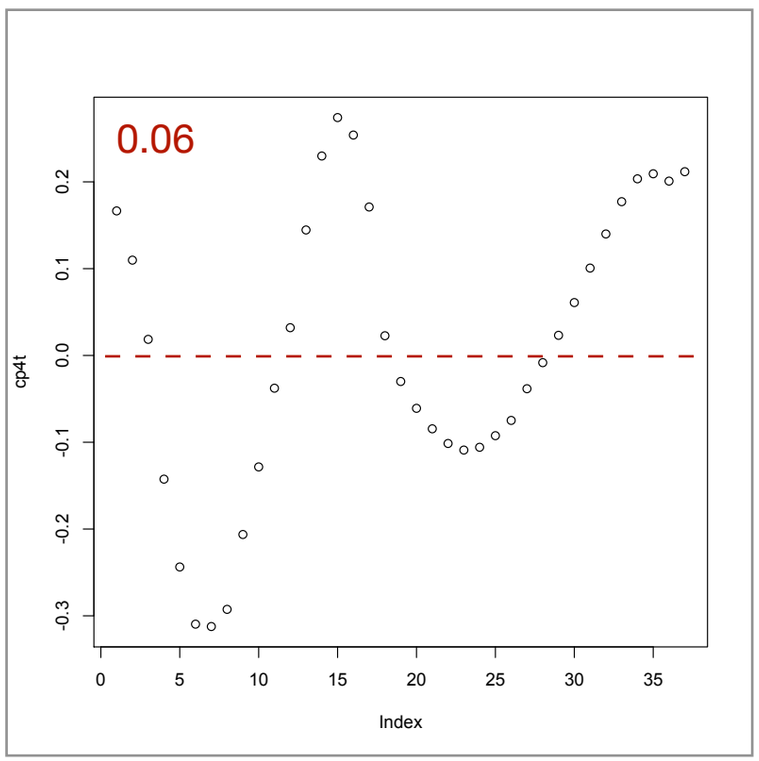
Atmosphere temperature PCA analysis

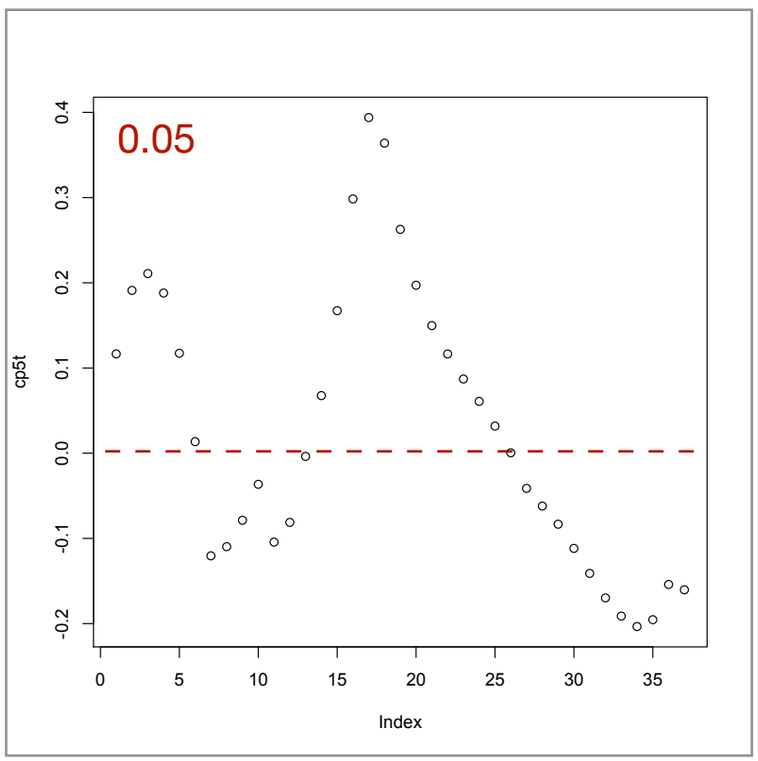
Whole period











Atmosphere temperature PCA analysis

2 month periods

Period 1 : 5.11.16 - 31.12.16

	PC1	PC2	PC3	PC4	PC5
Standard deviation	3.09279444	1.88101592	1.74723233	1.1181279	1.05845648
Proportion of Variance	0.43644000	0.16144000	0.13929000	0.0570400	0.05112000
Cumulative Proportion	0.43644000	0.59788000	0.73717000	0.7942200	0.84533000

	PC6	PC7	PC8	PC9	PC10
Standard deviation	0.97793067	0.747097009	0.65473356	0.576026216	0.499010562
Proportion of Variance	0.04364000	0.025470000	0.01956000	0.015140000	0.011360000
Cumulative Proportion	0.88897000	0.914440000	0.93400000	0.949140000	0.960500000

Period 2 : 1.1.17 - 28.2.17

	PC1	PC2	PC3	PC4	PC5
Standard deviation	4.52446134	2.04198049	1.50967453	1.37169249	1.28837433
Proportion of Variance	0.58375000	0.11890000	0.06499000	0.05365000	0.04733000
Cumulative Proportion	0.58375000	0.70266000	0.76765000	0.82130000	0.86864000

	PC6	PC7	PC8	PC9	PC10
Standard deviation	1.08985855	1.03635611	0.67948785	0.639323552	0.589523761
Proportion of Variance	0.03387000	0.03063000	0.01317000	0.011660000	0.009910000
Cumulative Proportion	0.90251000	0.93314000	0.94630000	0.957960000	0.967870000

Period 3 : 1.3.17 - 1.5.17

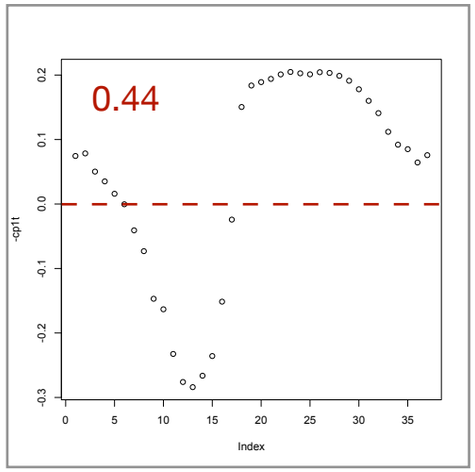
	PC1	PC2	PC3	PC4	PC5
Standard deviation	3.04794032	1.59810567	1.52594939	1.11498664	0.884580991
Proportion of Variance	0.49267000	0.13544000	0.12349000	0.06593000	0.041500000
Cumulative Proportion	0.49267000	0.62812000	0.75161000	0.81754000	0.859040000

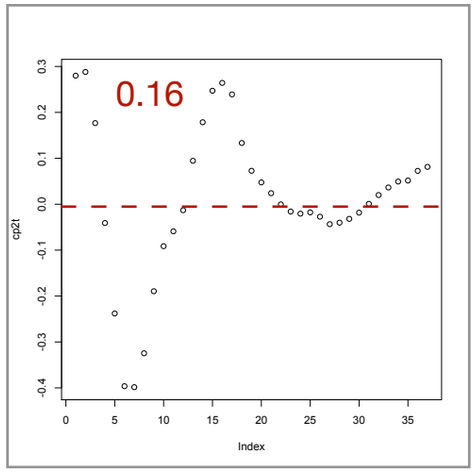
	PC6	PC7	PC8	PC9	PC10
Standard deviation	0.78777949	0.668979392	0.617795716	0.516589447	0.442461898
Proportion of Variance	0.03291000	0.023730000	0.020240000	0.014150000	0.010380000
Cumulative Proportion	0.89195000	0.915680000	0.935920000	0.950080000	0.960460000

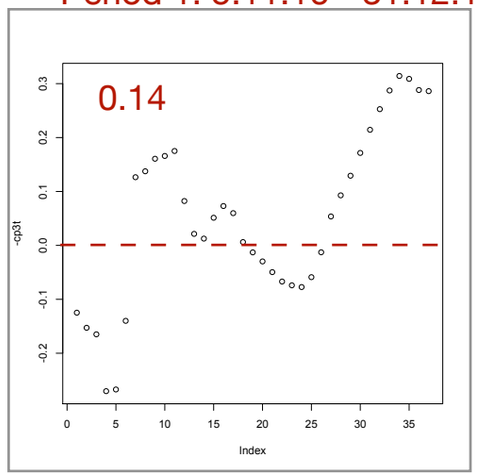
Atmosphere temperature PCA analysis

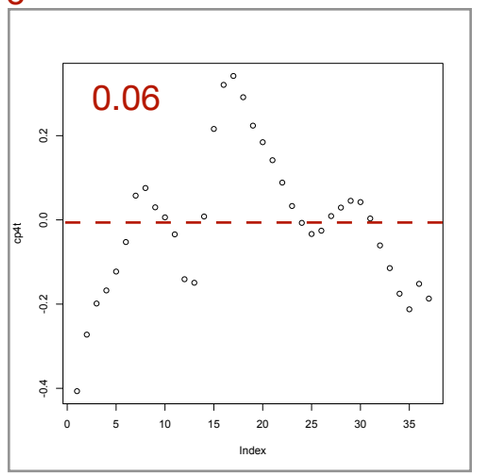
2 month periods

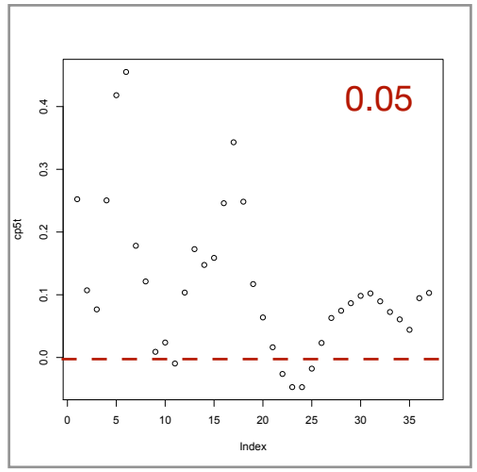
Period 1: 5.11.16 - 31.12.16



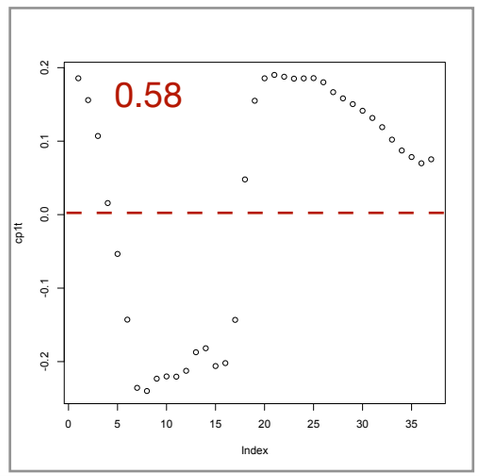


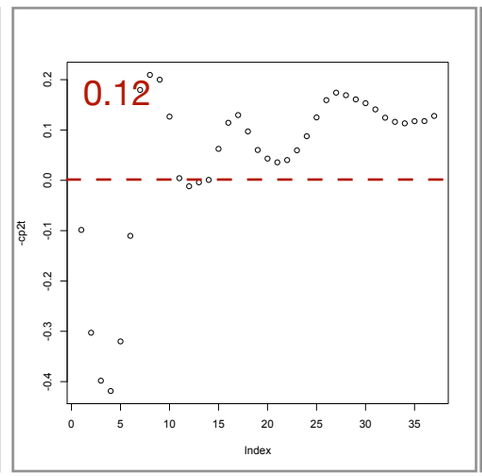


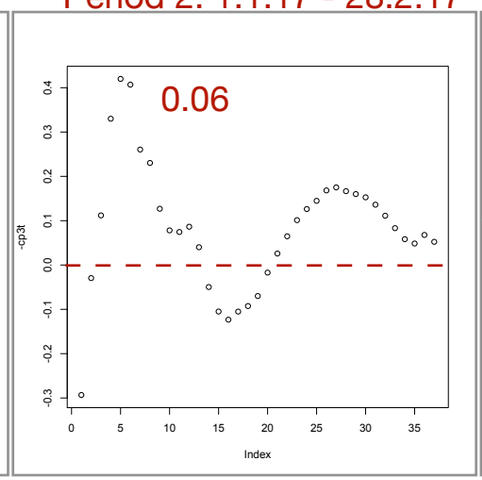


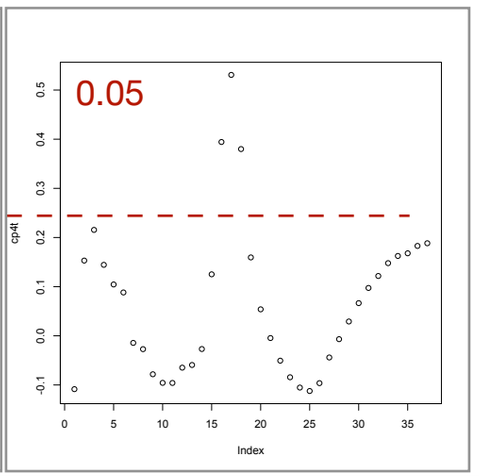


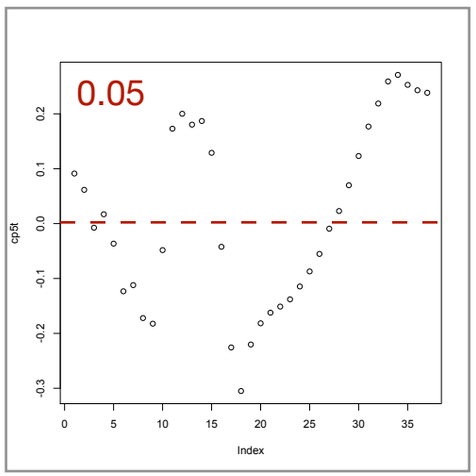
Period 2: 1.1.17 - 28.2.17



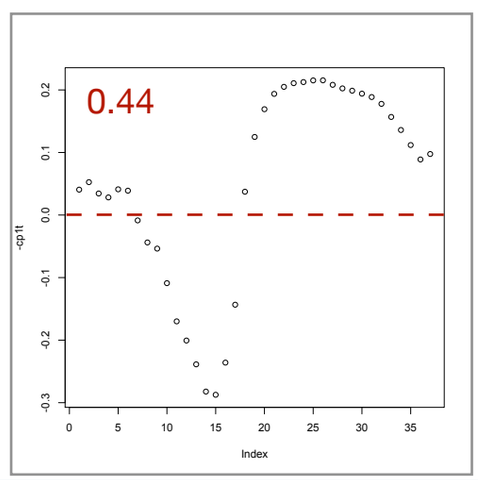


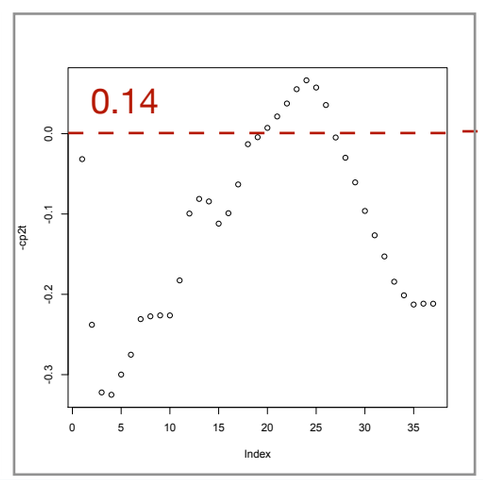


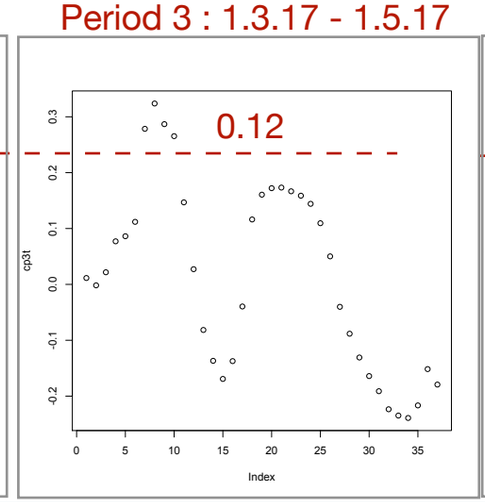


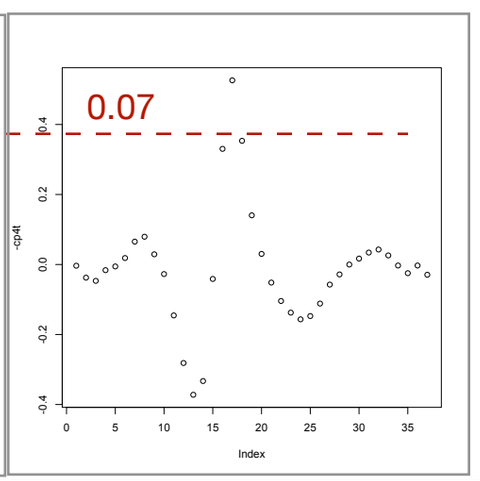


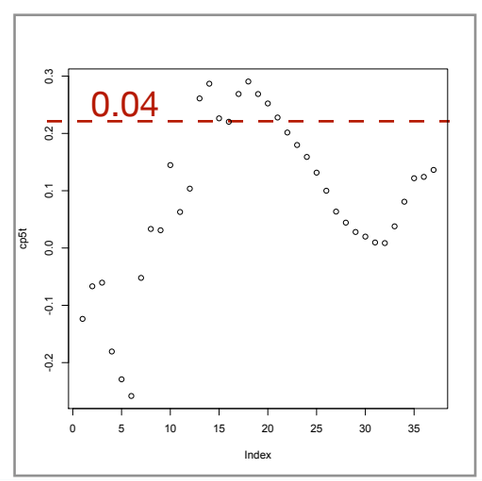
Period 3 : 1.3.17 - 1.5.17











Atmosphere height PCA analysis
Whole period

```
> summary(acph)
Importance of components%s:
                                PC1        PC2        PC3         PC4         PC5
Standard deviation     4.71323569 3.16220104 1.79261851 0.927507458 0.597228246
Proportion of Variance 0.60039000 0.27026000 0.08685000 0.023250000 0.009640000
Cumulative Proportion  0.60039000 0.87065000 0.95750000 0.980750000 0.990390000
                                PC6         PC7         PC8         PC9        PC10
Standard deviation     0.398465386 0.286935787 0.228069699 0.14527217 0.114014123
Proportion of Variance 0.004290000 0.002230000 0.001410000 0.00057000 0.000350000
Cumulative Proportion  0.994680000 0.996910000 0.998320000 0.99889000 0.999240000
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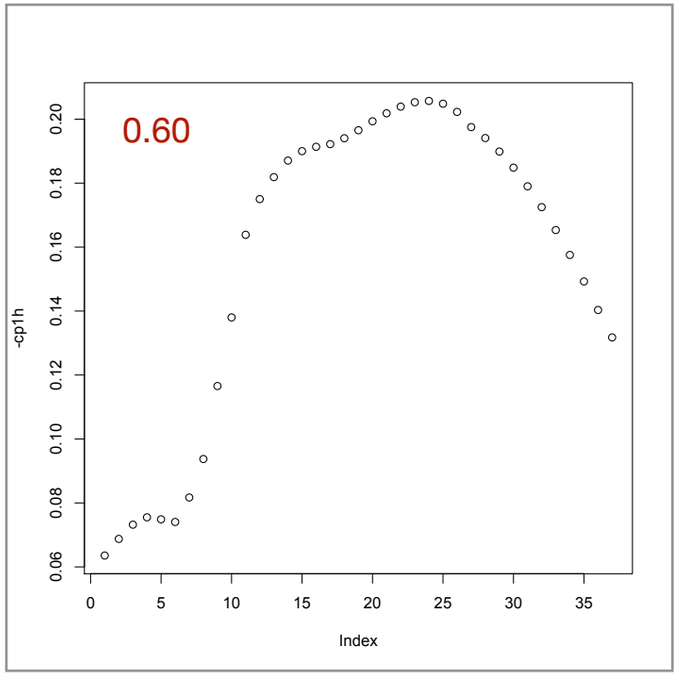
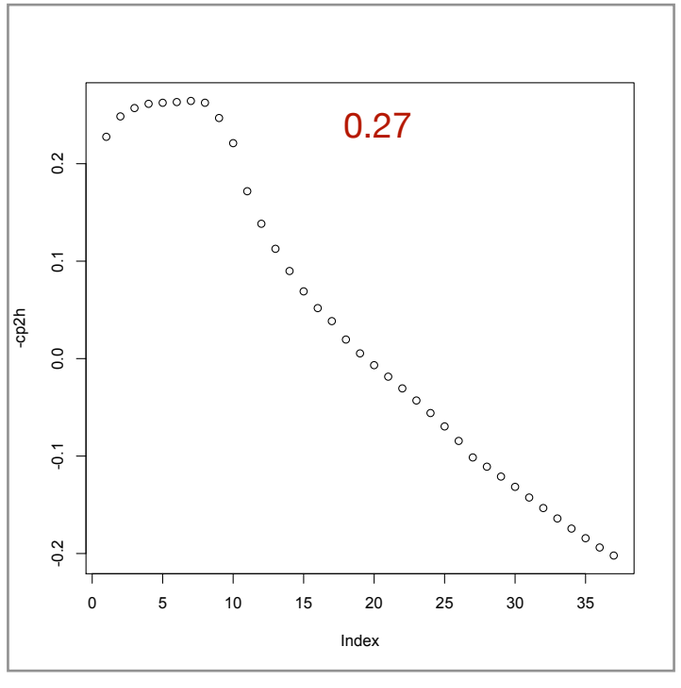
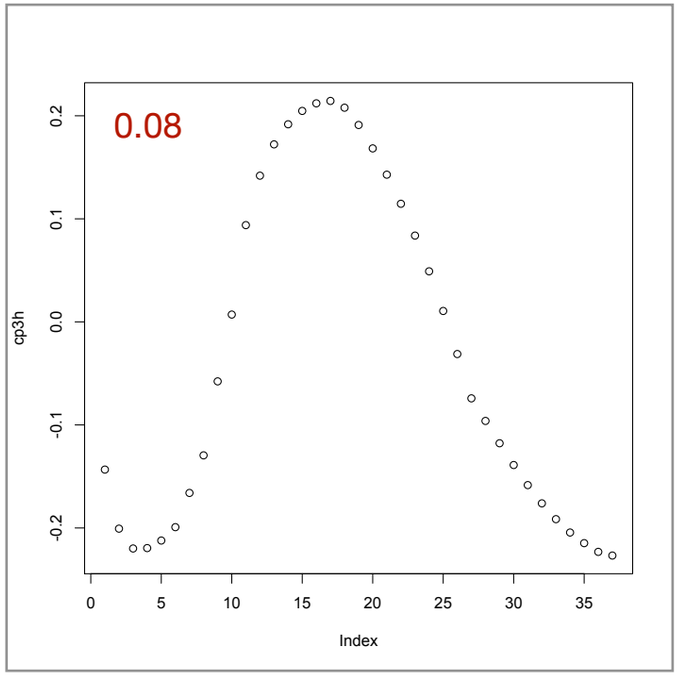






Atmosphere height PCA analysis
2-month periods

Period 1 : 5.11.16 - 31.12.16

```
> summary(acph)
Importance of components%s:
                            PC1       PC2       PC3         PC4         PC5
Standard deviation     4.89794857 1.5951578 1.1416108 0.754003519 0.574448429
Proportion of Variance 0.82776000 0.0878000 0.0449700 0.019620000 0.011390000
Cumulative Proportion  0.82776000 0.9155500 0.9605200 0.980140000 0.991520000
                             PC6         PC7         PC8         PC9         PC10
Standard deviation     0.306945052 0.23086674 0.181971449 0.157173984 0.119440367
Proportion of Variance 0.003250000 0.00184000 0.001140000 0.000850000 0.000490000
Cumulative Proportion  0.994770000 0.99661000 0.997760000 0.998610000 0.999100000
```

Period 2 : 1.1.17 - 28.2.17

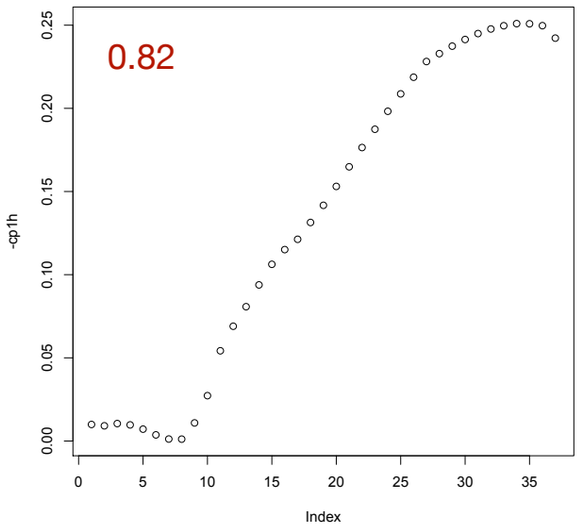
```
> summary(acph)
Importance of components%s:
                            PC1       PC2       PC3         PC4         PC5
Standard deviation     4.11425037 2.52134688 1.49740088 0.903093215 0.565258359
Proportion of Variance 0.62765000 0.23572000 0.08314000 0.030240000 0.011850000
Cumulative Proportion  0.62765000 0.86338000 0.94652000 0.976760000 0.988610000
                             PC6         PC7         PC8         PC9         PC10
Standard deviation     0.314622469 0.239926419 0.253215932 0.120304719 0.108784831
Proportion of Variance 0.003670000 0.003340000 0.002380000 0.000540000 0.000440000
Cumulative Proportion  0.992280000 0.995620000 0.997990000 0.998530000 0.998970000
```

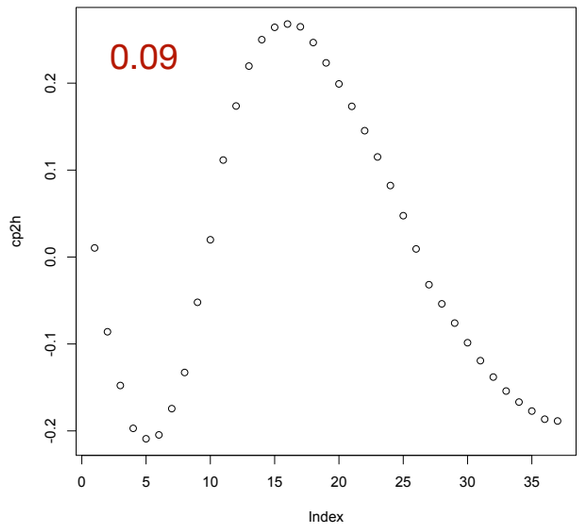
Period 3 : 1.3.17 - 1.5.17

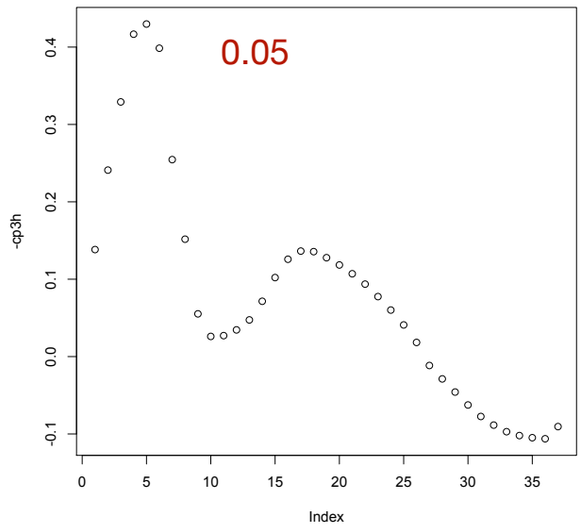
```
> summary(acph)
Importance of components%s:
                            PC1       PC2       PC3         PC4         PC5
Standard deviation     3.6120286 1.65547021 1.28141534 0.703422177 0.410821967
Proportion of Variance 0.7126300 0.14969000 0.08969000 0.027030000 0.009220000
Cumulative Proportion  0.7126300 0.86232000 0.95201000 0.979030000 0.988250000
                             PC6         PC7         PC8         PC9         PC10
Standard deviation     0.317945084 0.21970112 0.164603228 0.118618996 0.0973412378
Proportion of Variance 0.005520000 0.00264000 0.001480000 0.000770000 0.0005200000
Cumulative Proportion  0.993770000 0.99641000 0.997890000 0.998660000 0.9991800000
```

Atmosphere height PCA analysis
2-month periods

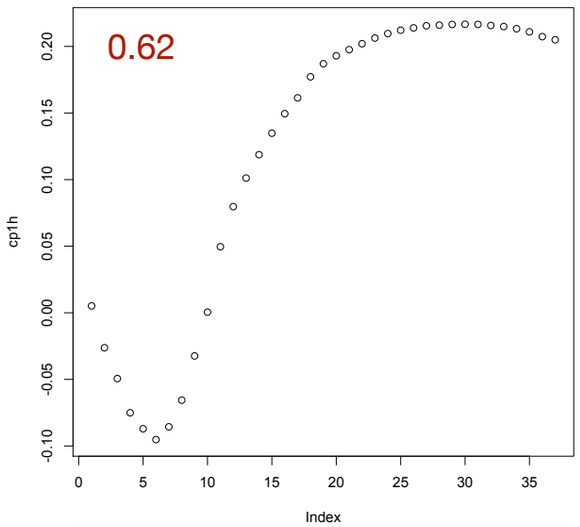
Period 1: 5.11.16 - 31.12.16

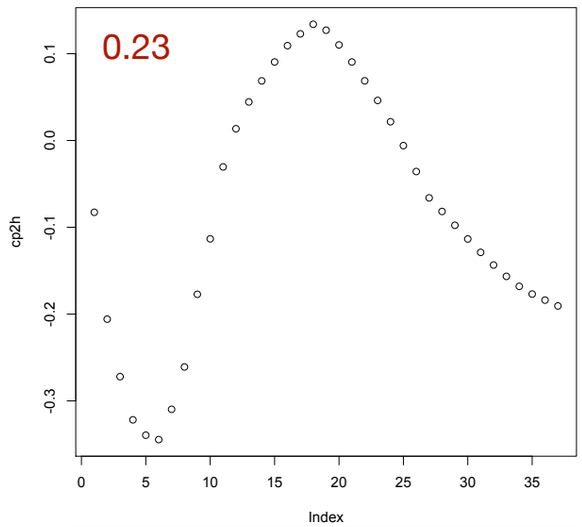


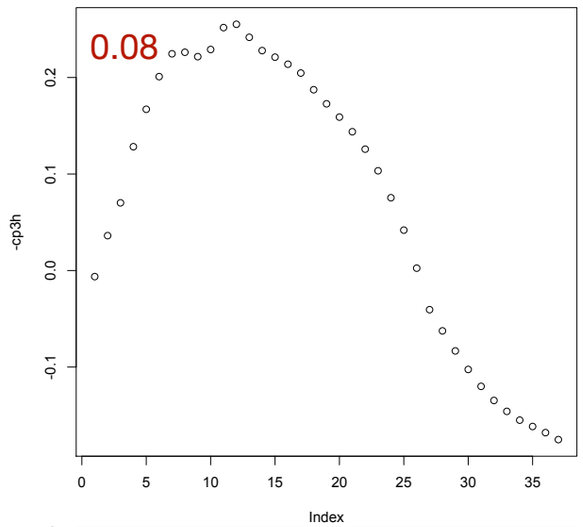




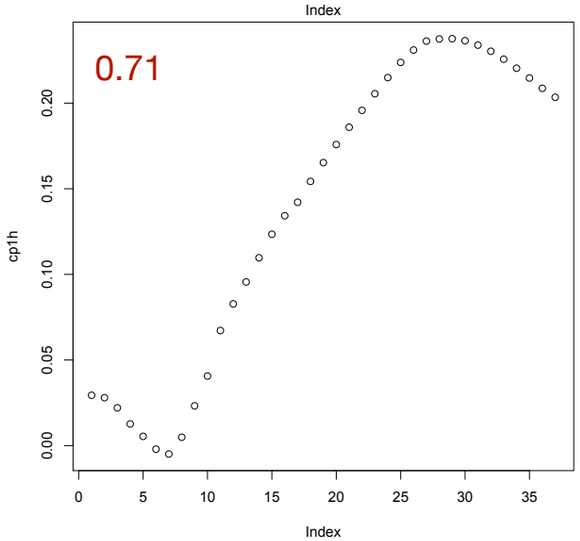
Period 2: 1.1.17 - 28.2.17

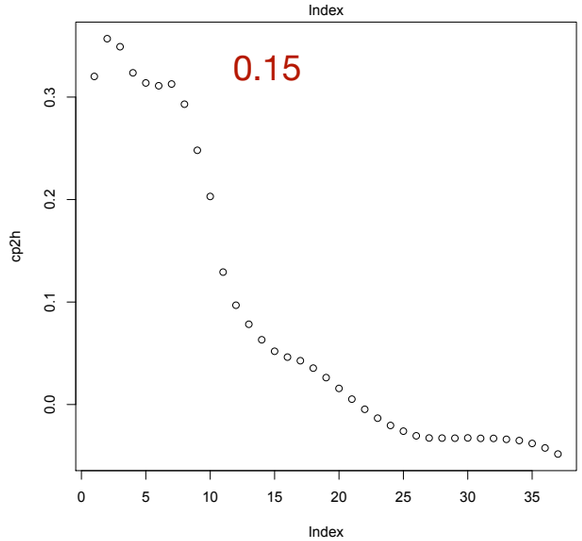


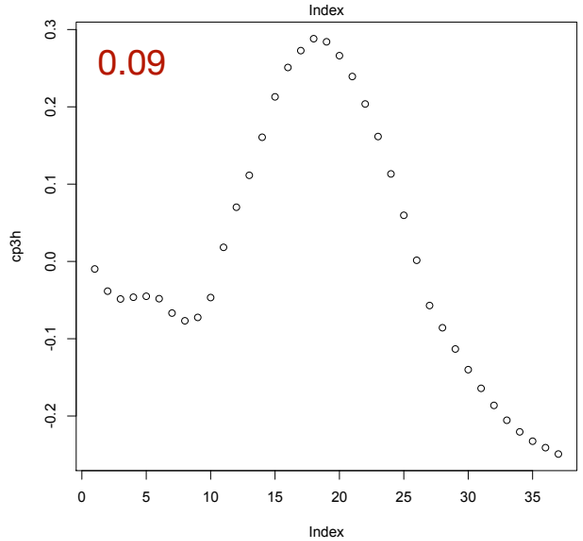




Period 3: 1.3.17 - 1.5.17

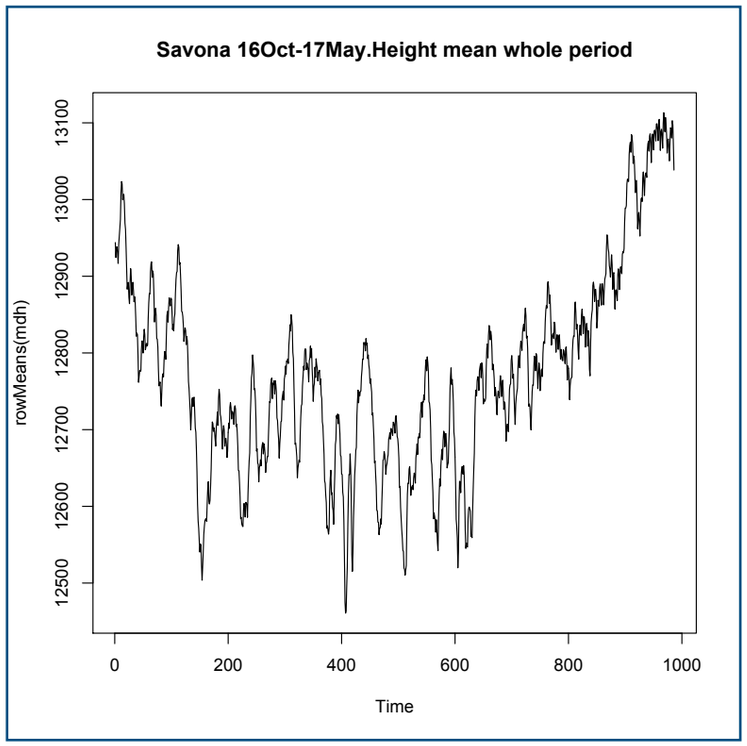


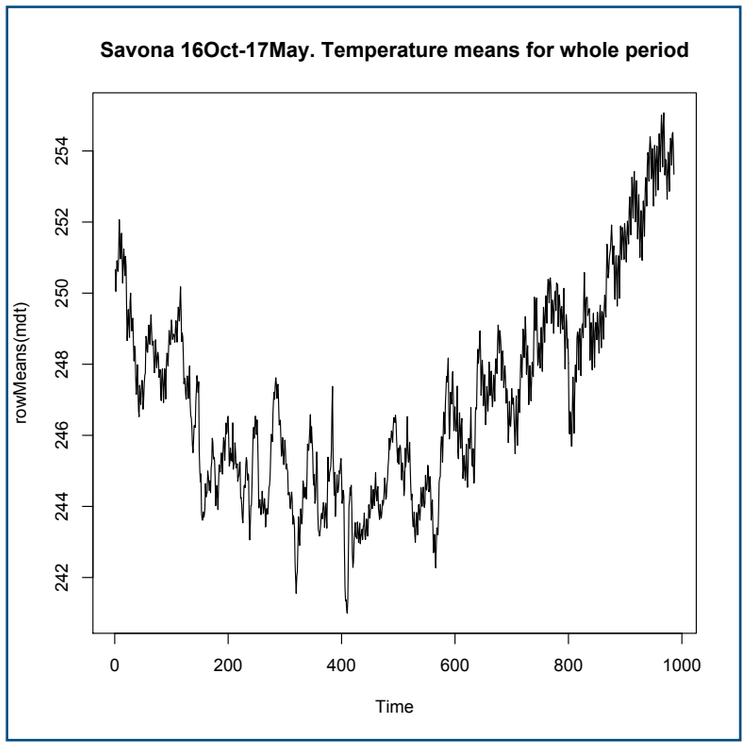


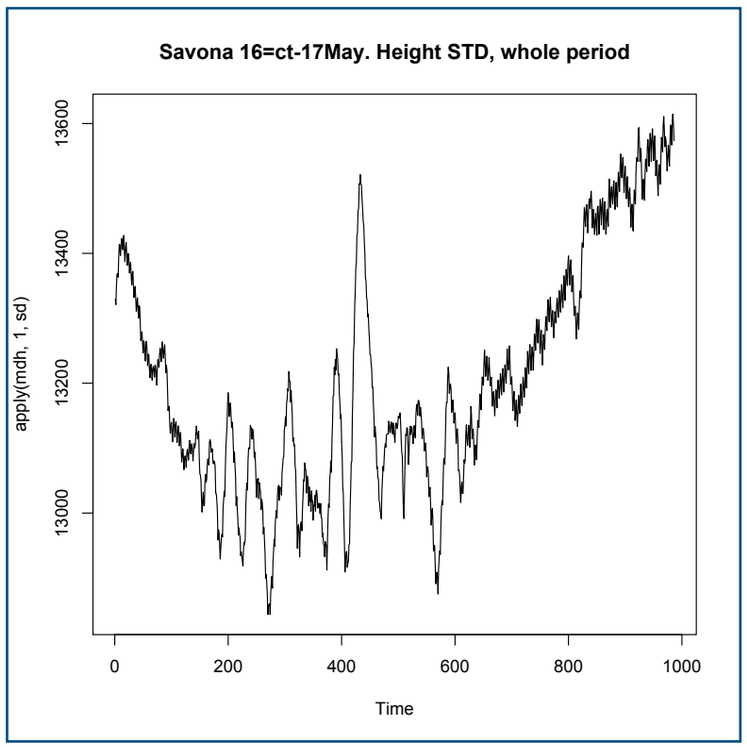


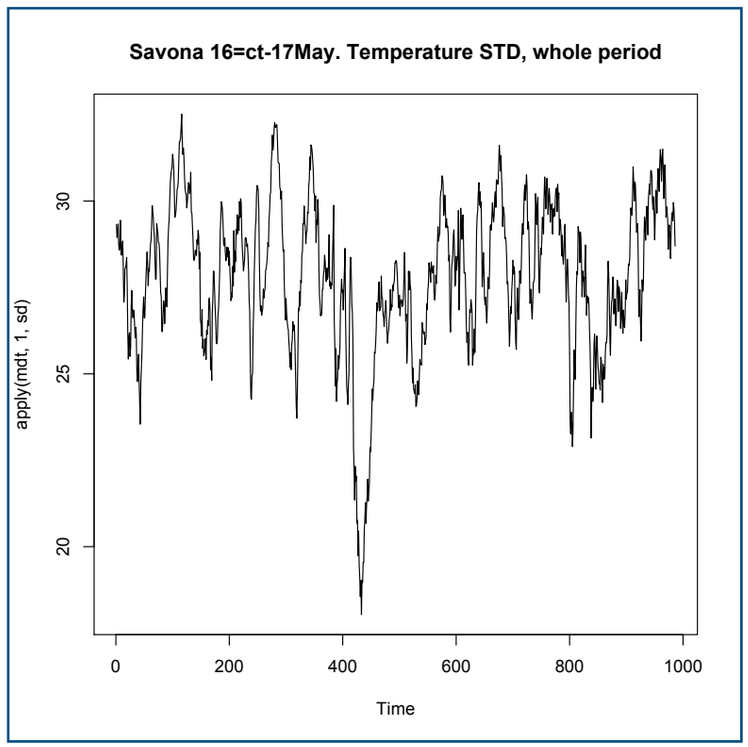
Atmosphere layer temperature and height analysis

Seasonal behavior



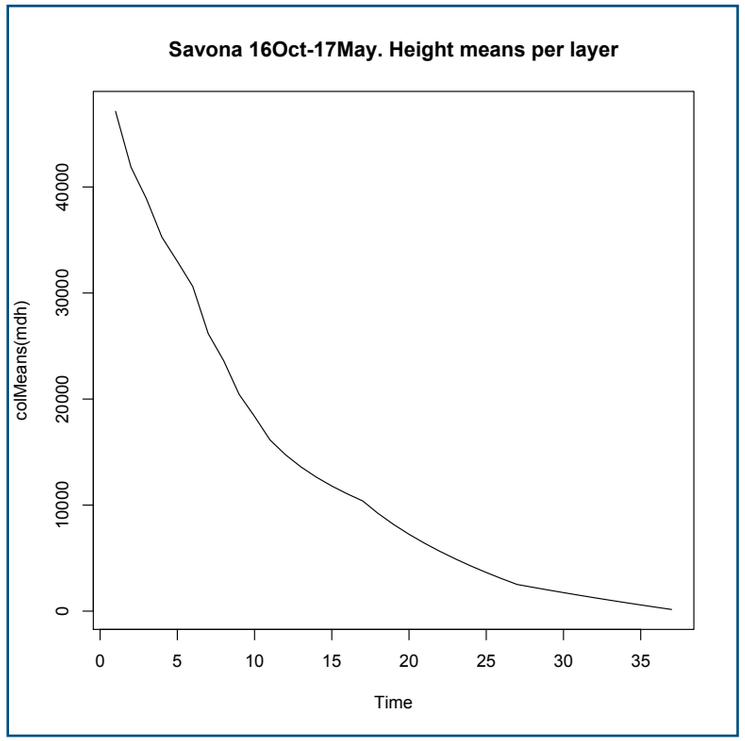


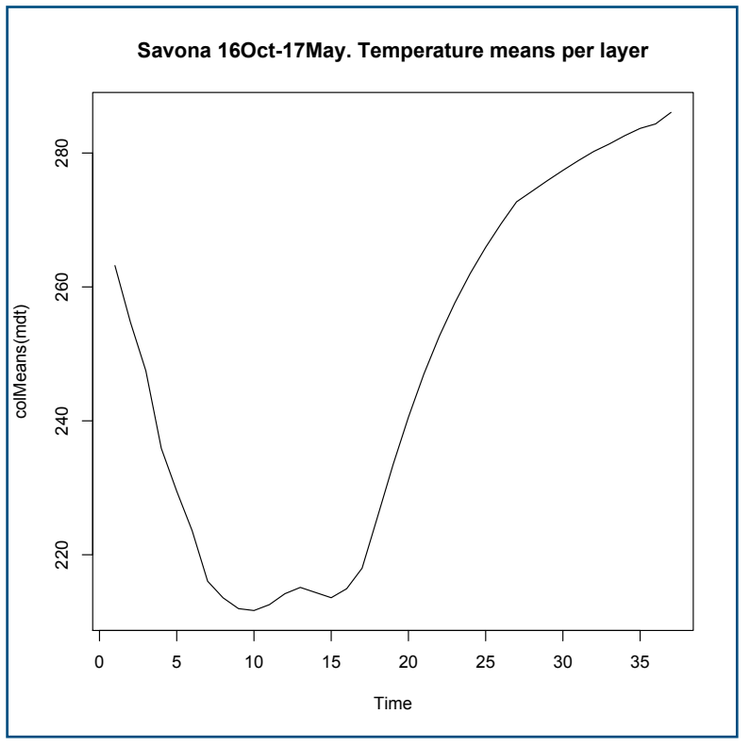


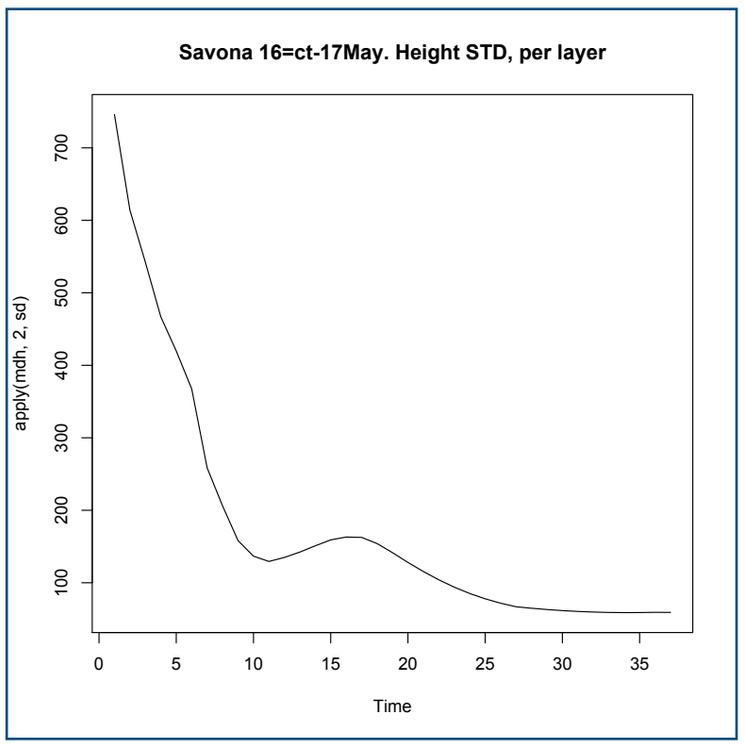


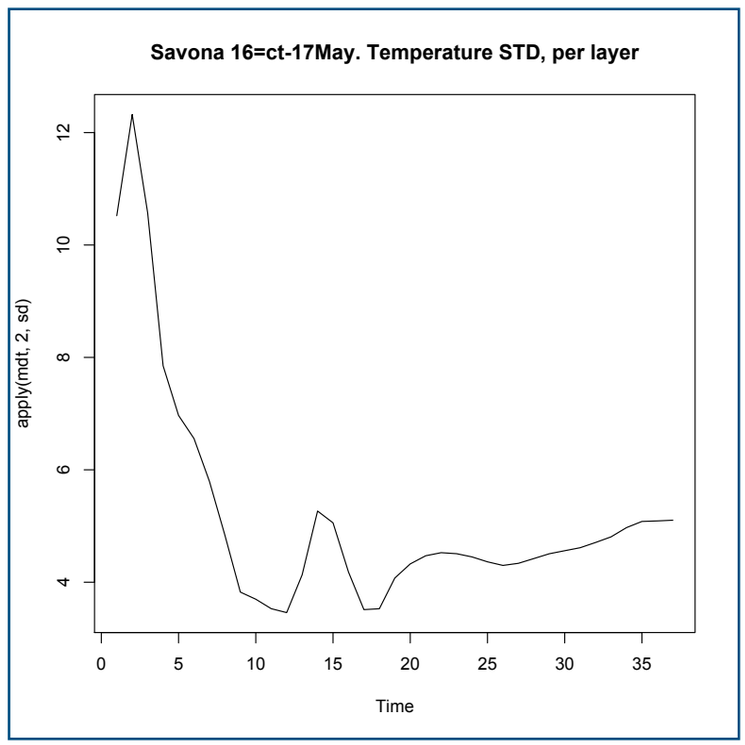
Atmosphere layer temperature and height analysis

Layer behavior





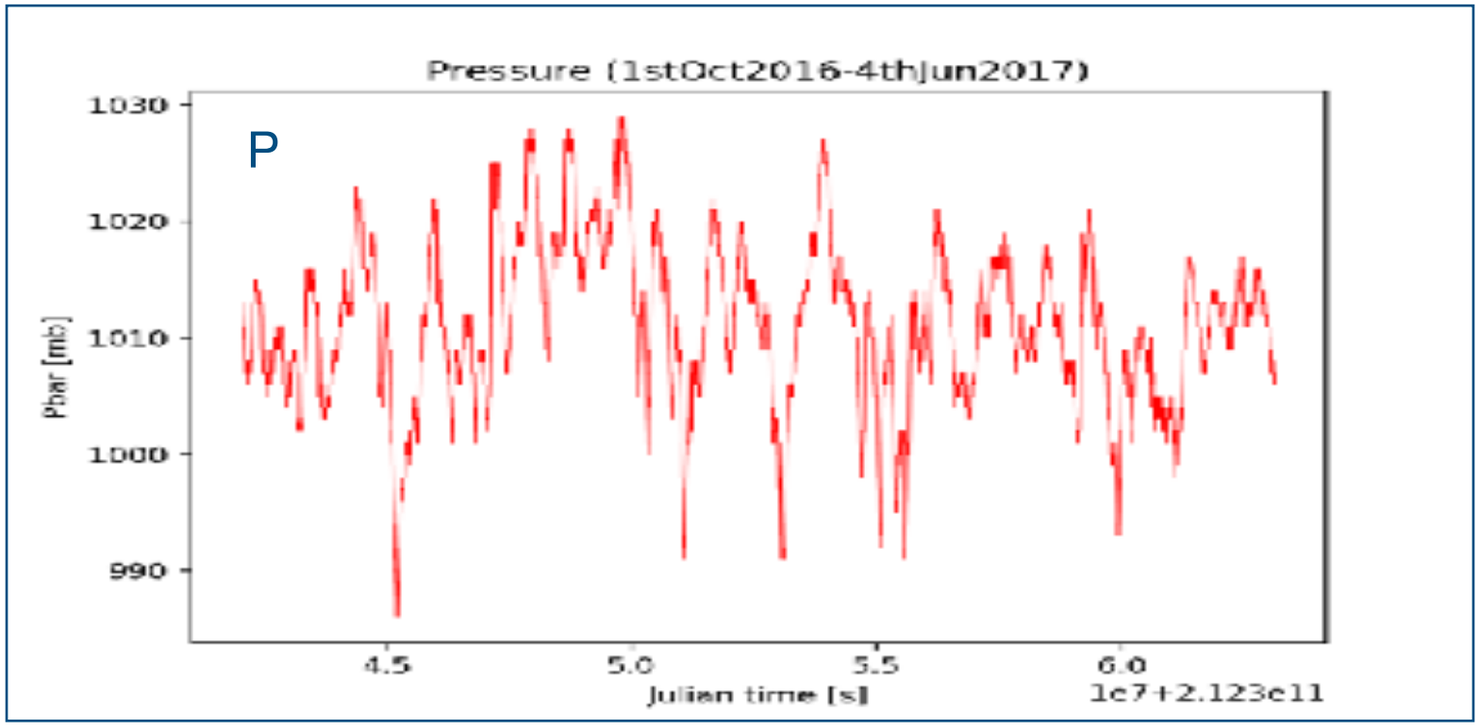




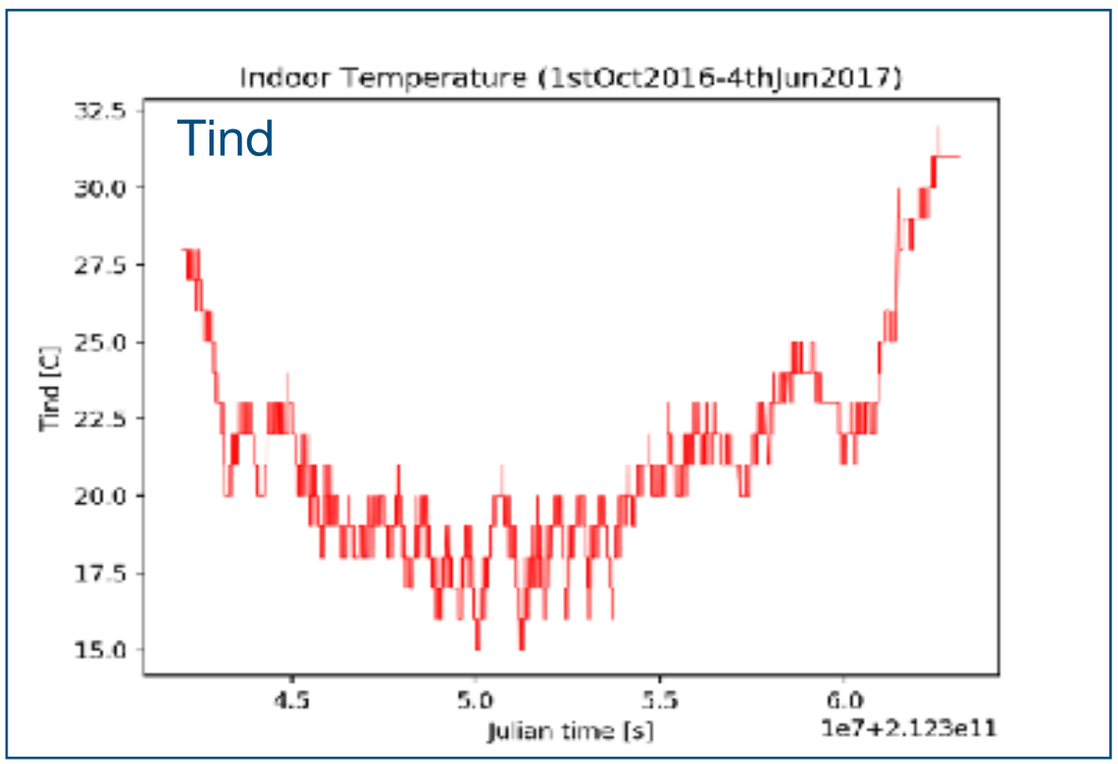
The data correction

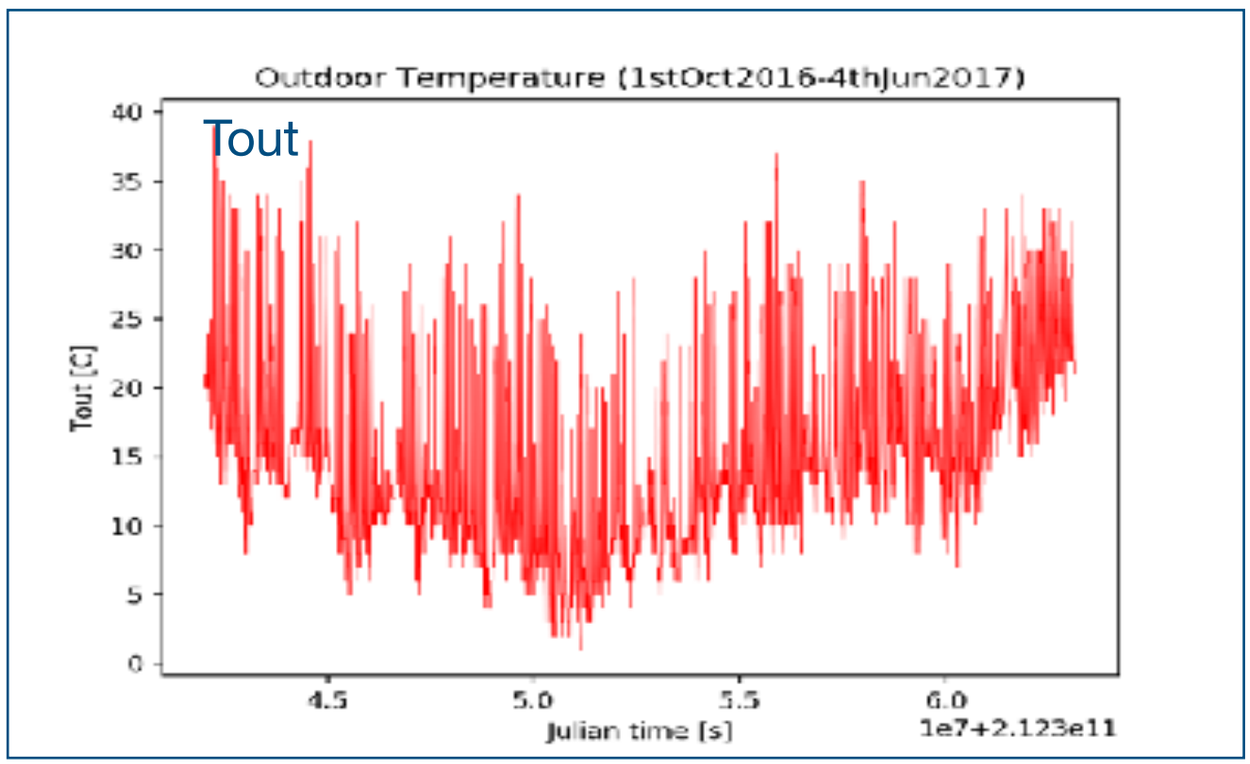
Full period: 2016Oct10-2017June04

Pressure & temperature behaviors



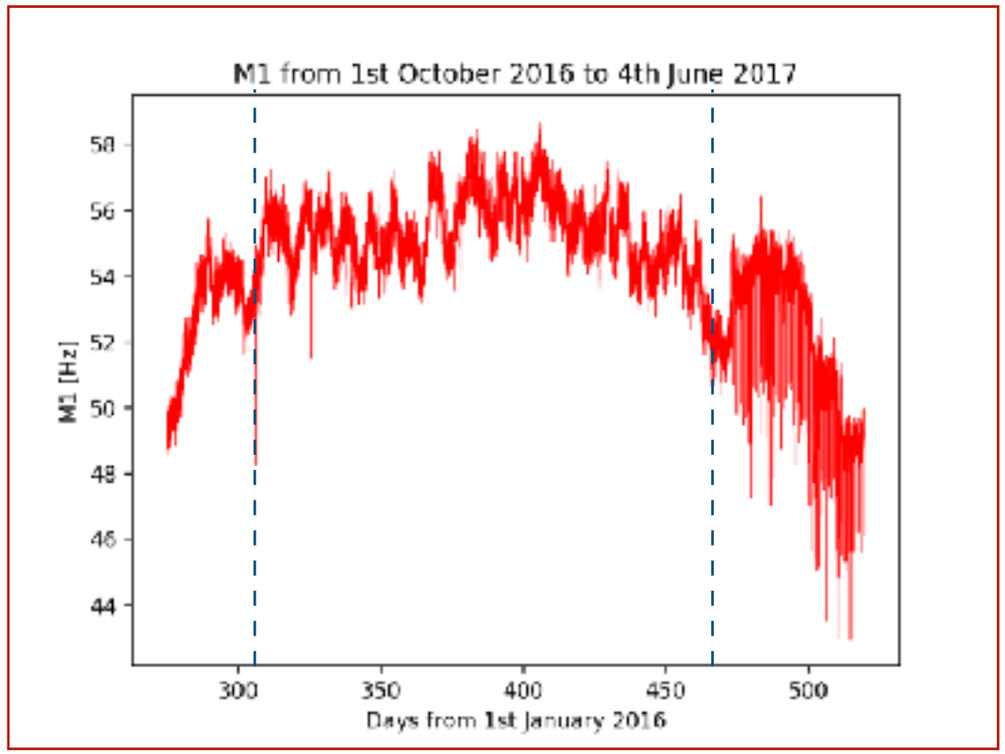
dt = 15 min

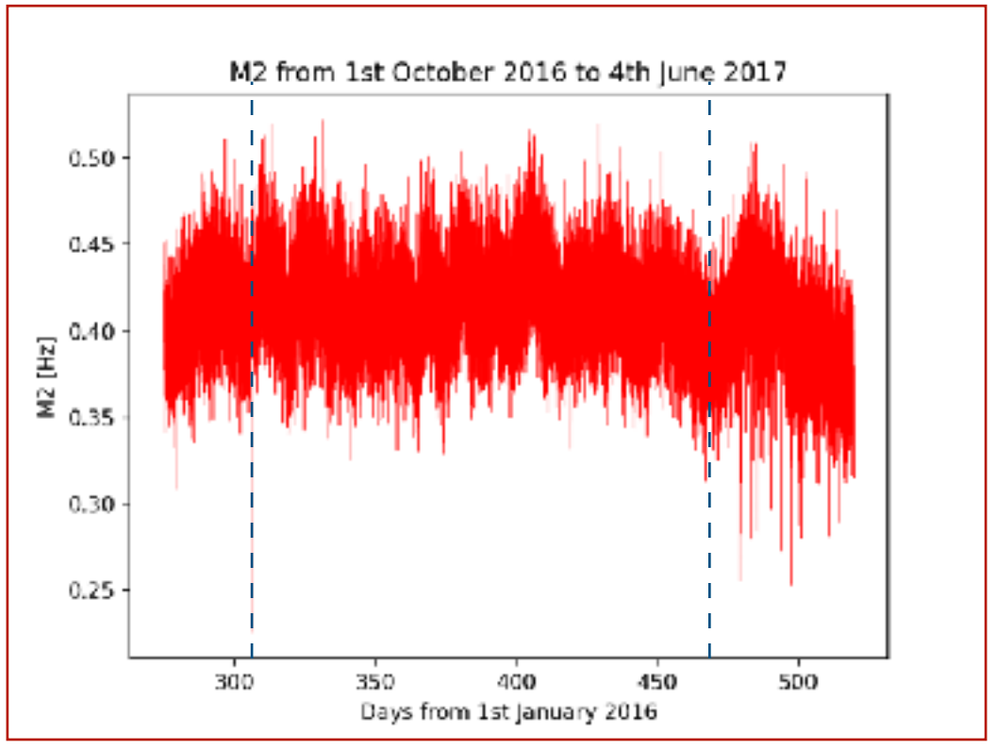


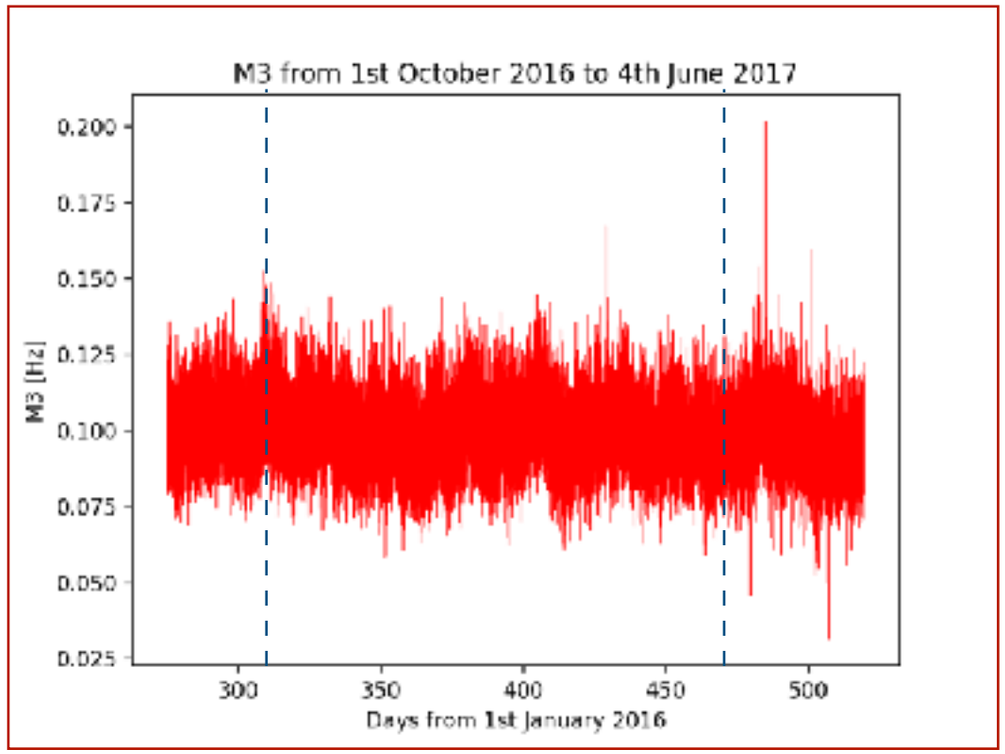


Full period: 2016Oct10-2017June04

M1, M2 & Mn Rates (dt = 15 min)



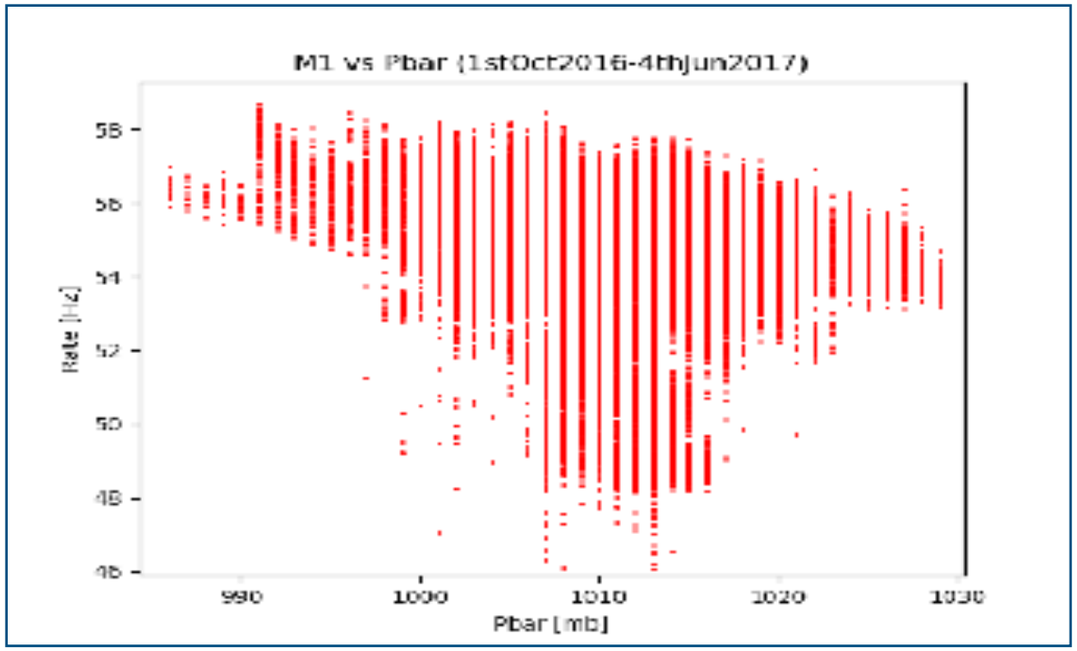




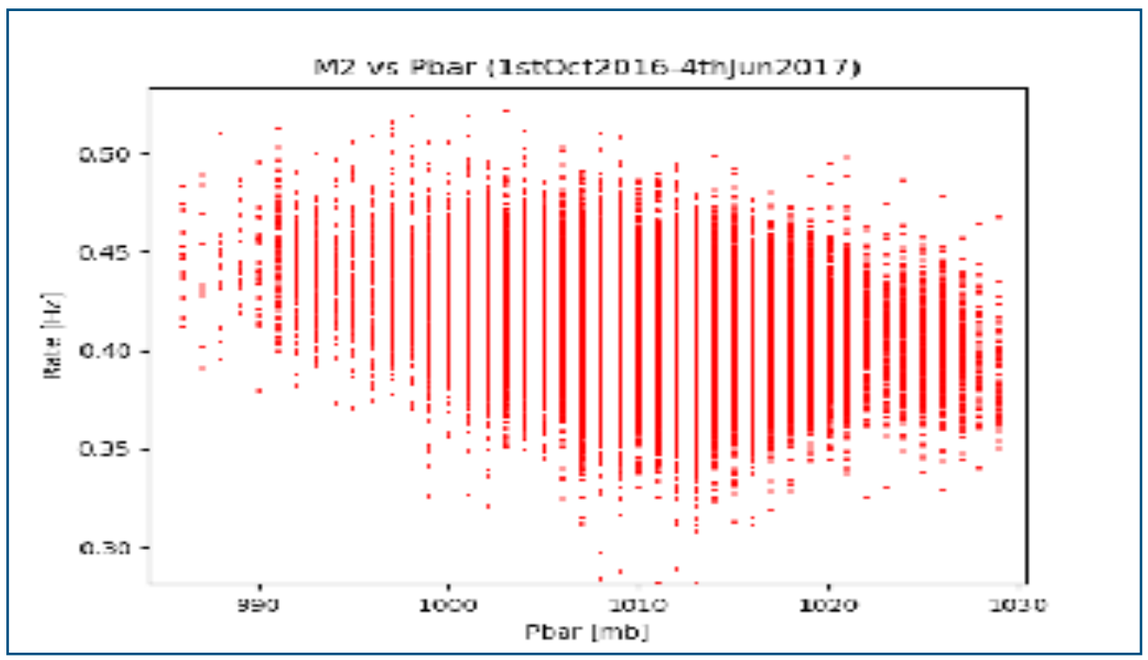
dt = 15 min

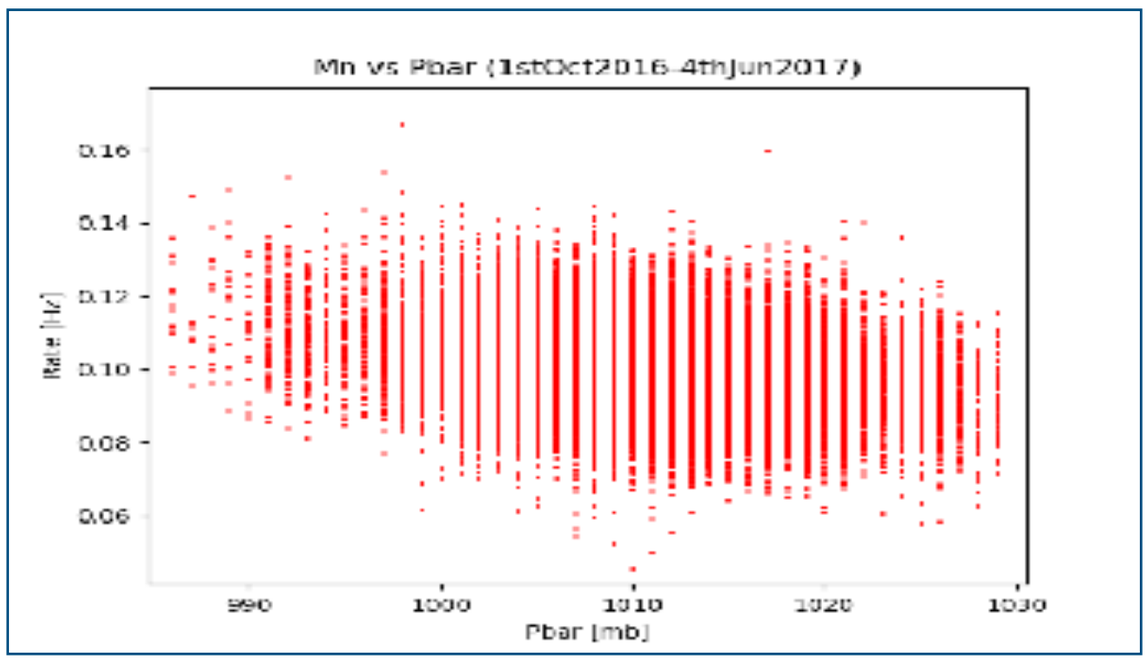
Full period: 2016Oct10-2017June04

Multiplicity vs. pressure (dt = 15min)



dt = 15 min

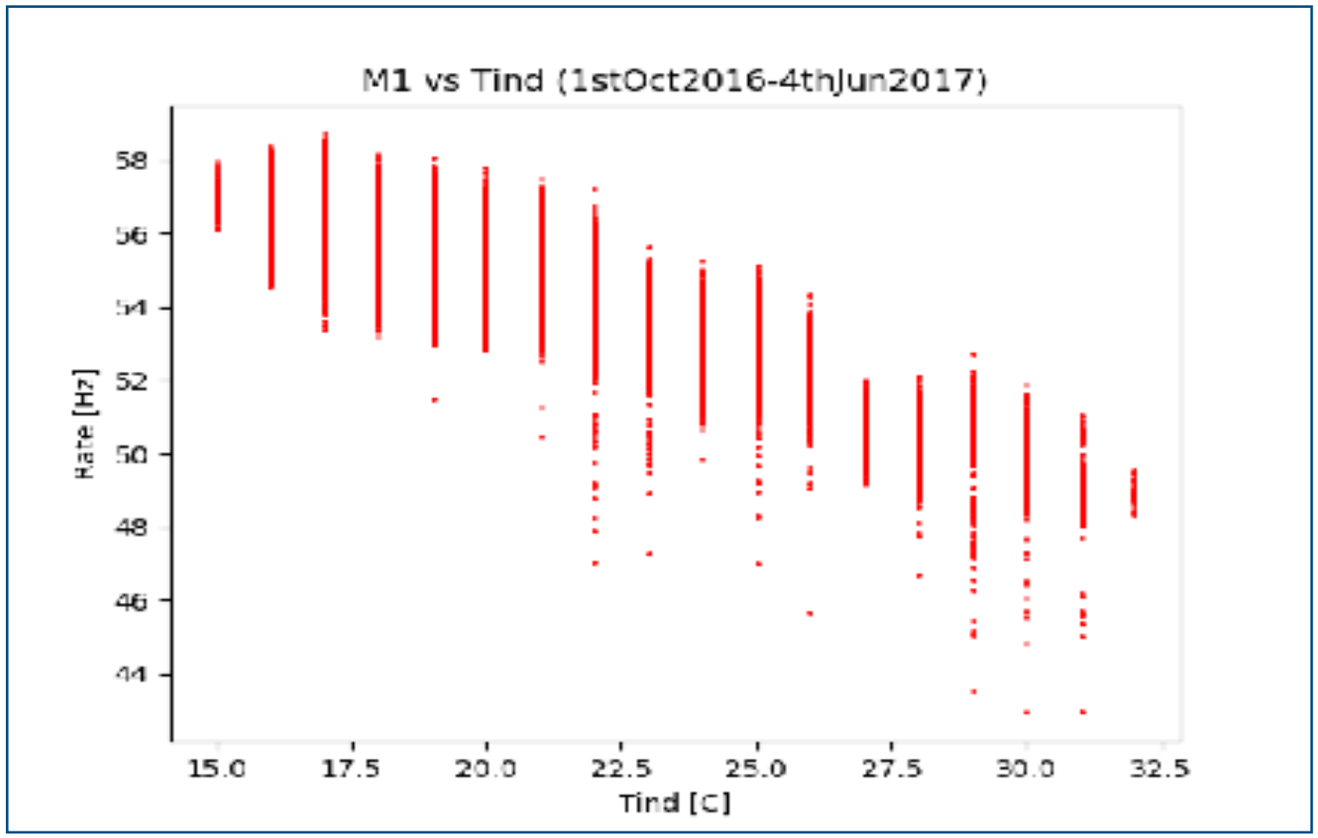




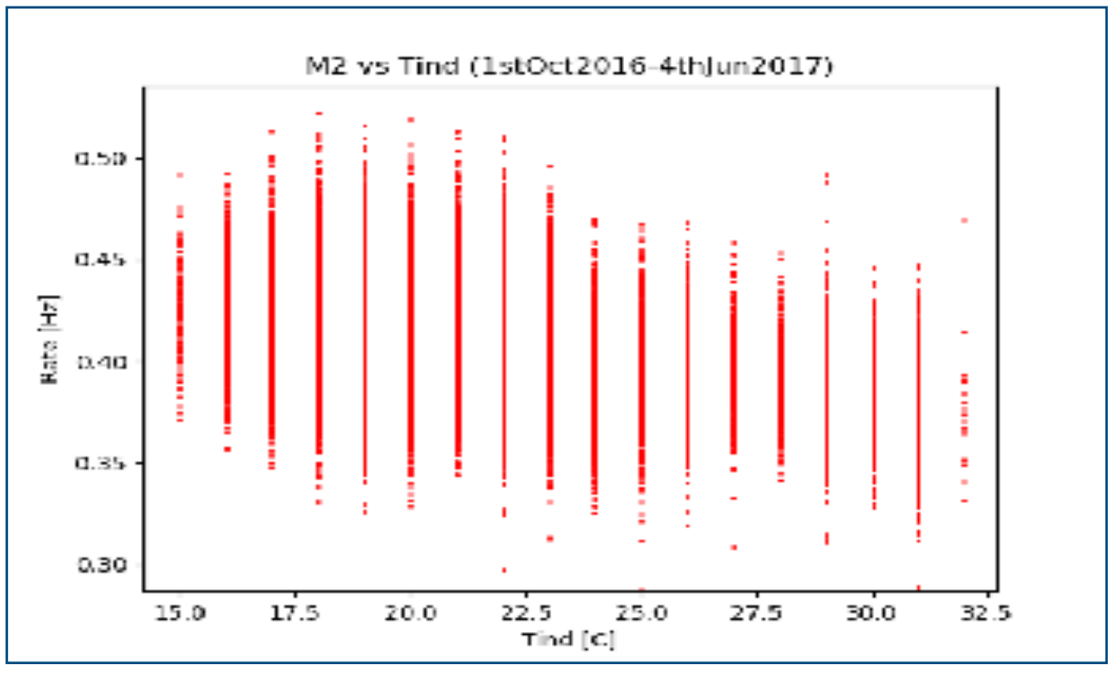
dt = 15 min

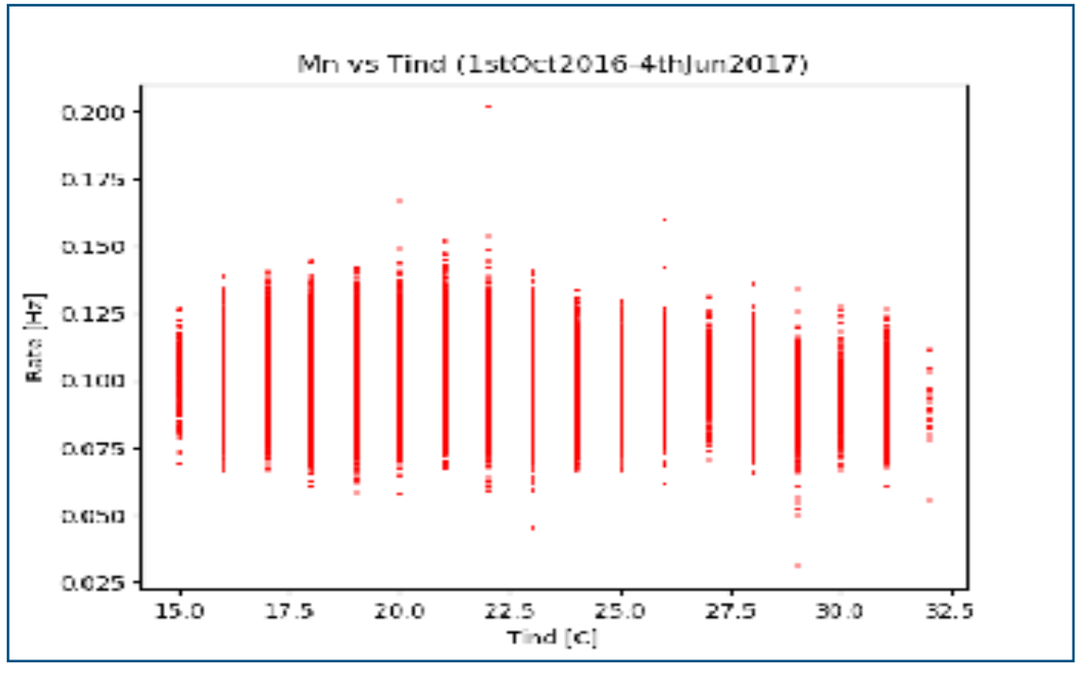
Full period: 2016Oct10-2017June04

Multiplicity vs. temperature indoors (dt = 15min)



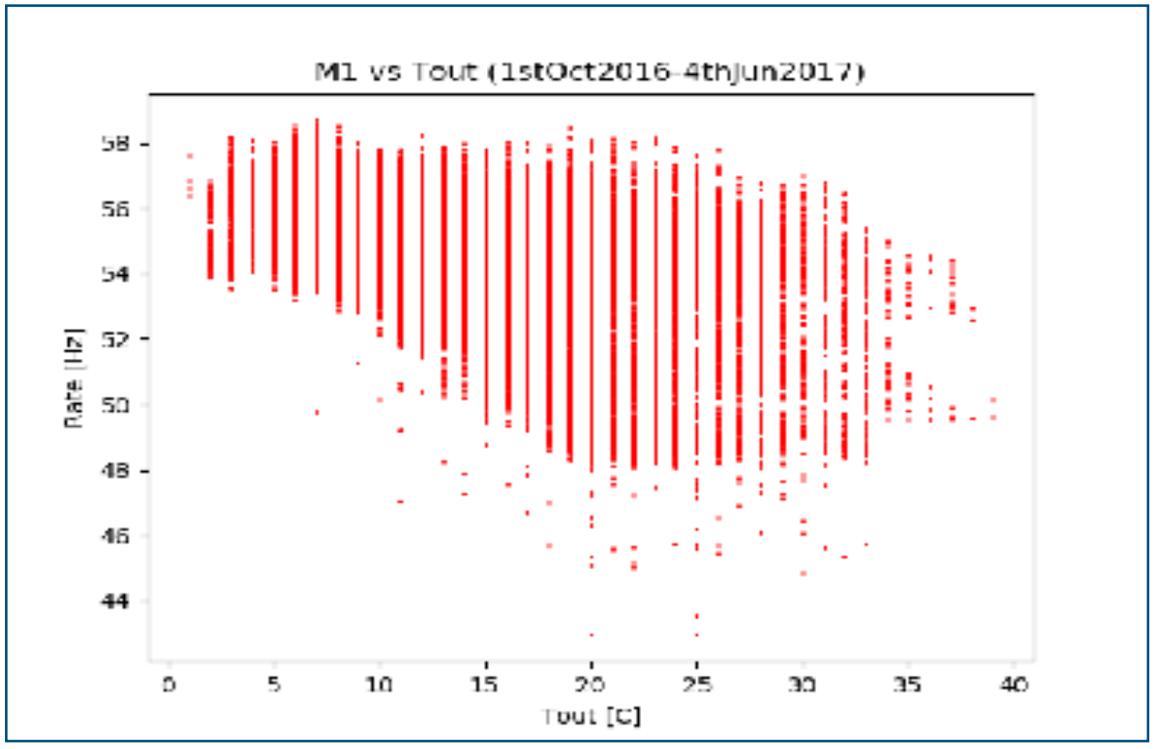
dt = 15 min



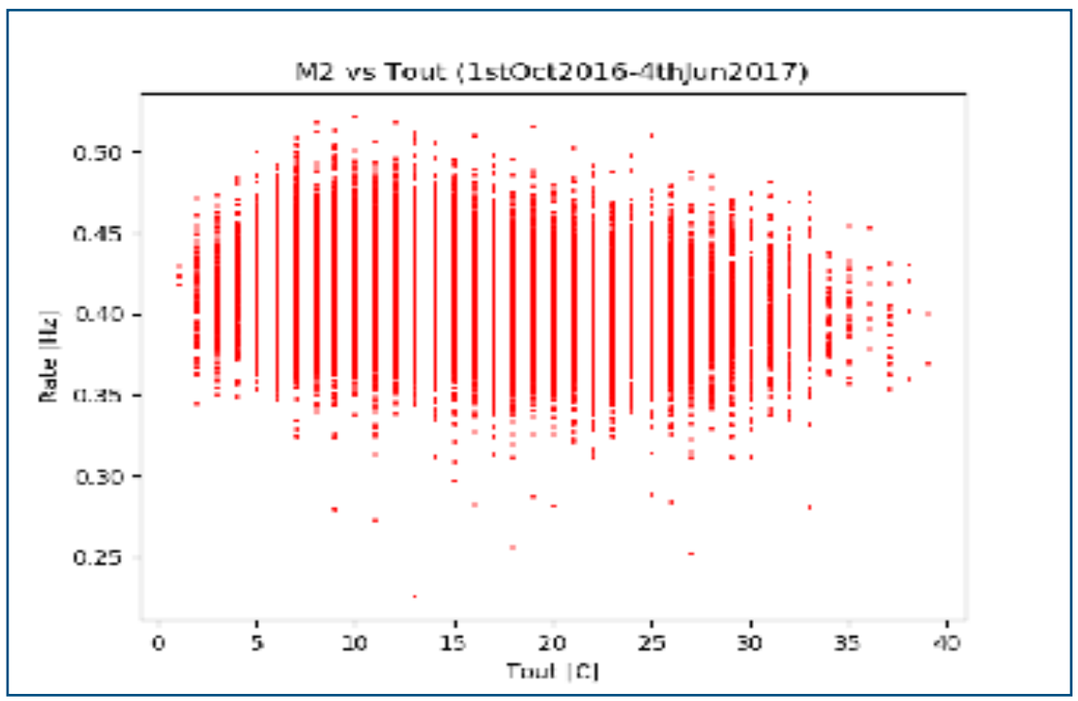


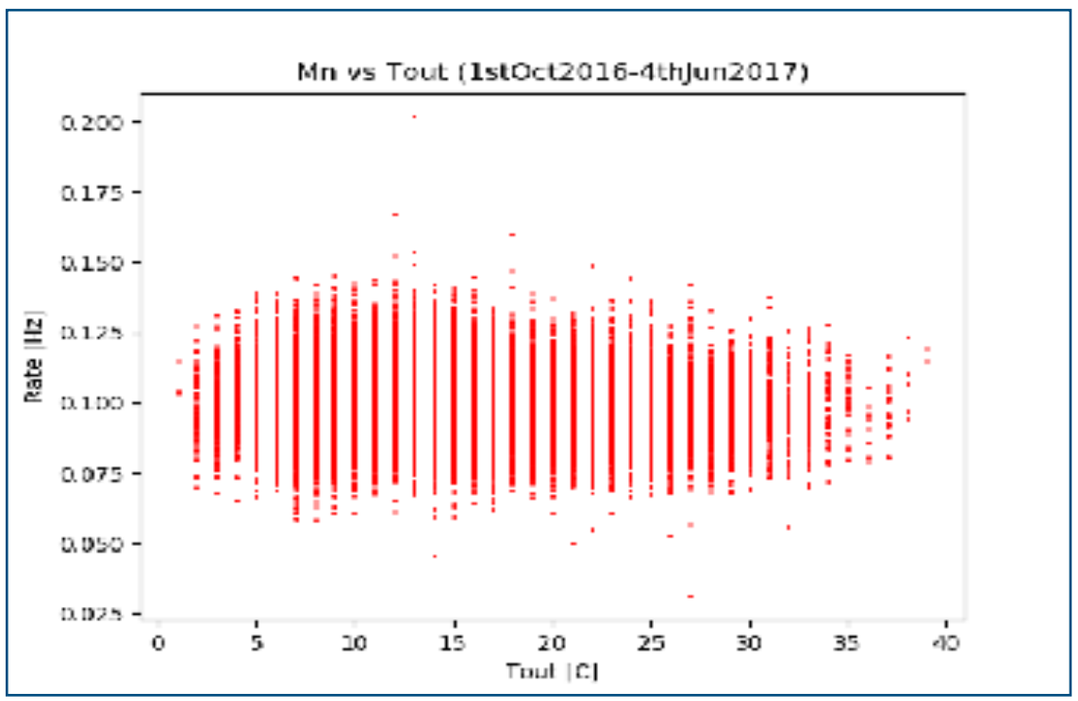
Full period: 2016Oct10-2017June04

Multiplicity vs. temperature outdoors (dt = 15min)



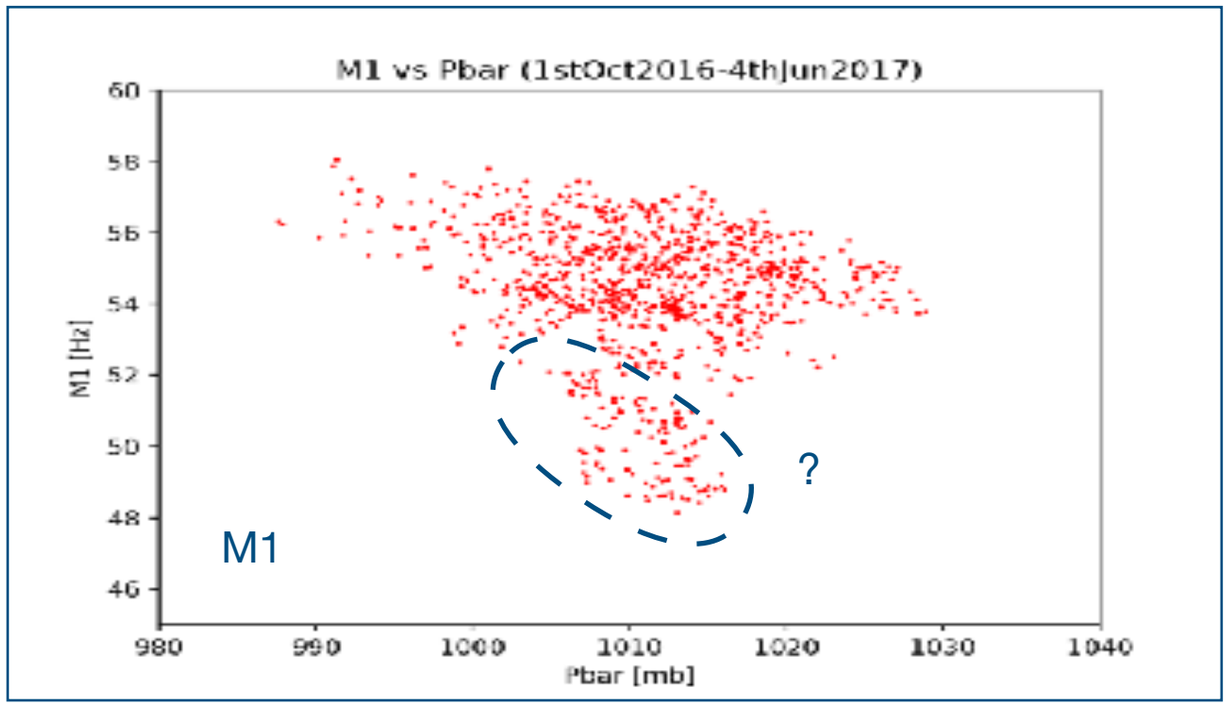
dt = 15 min



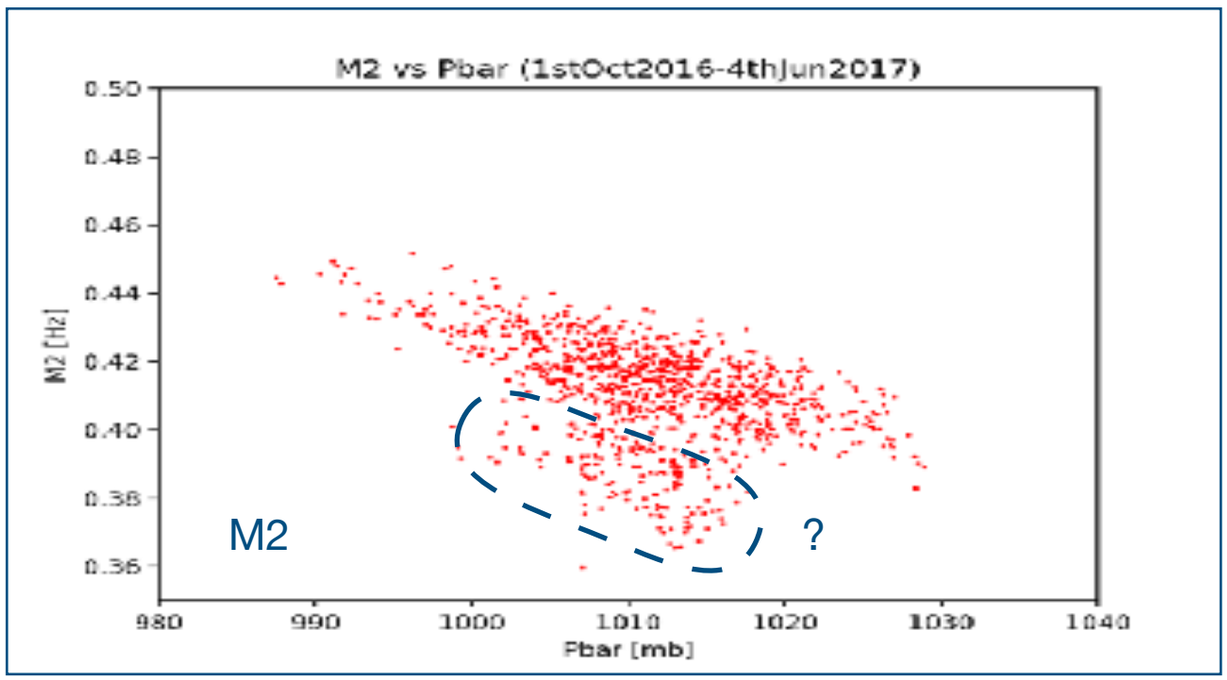


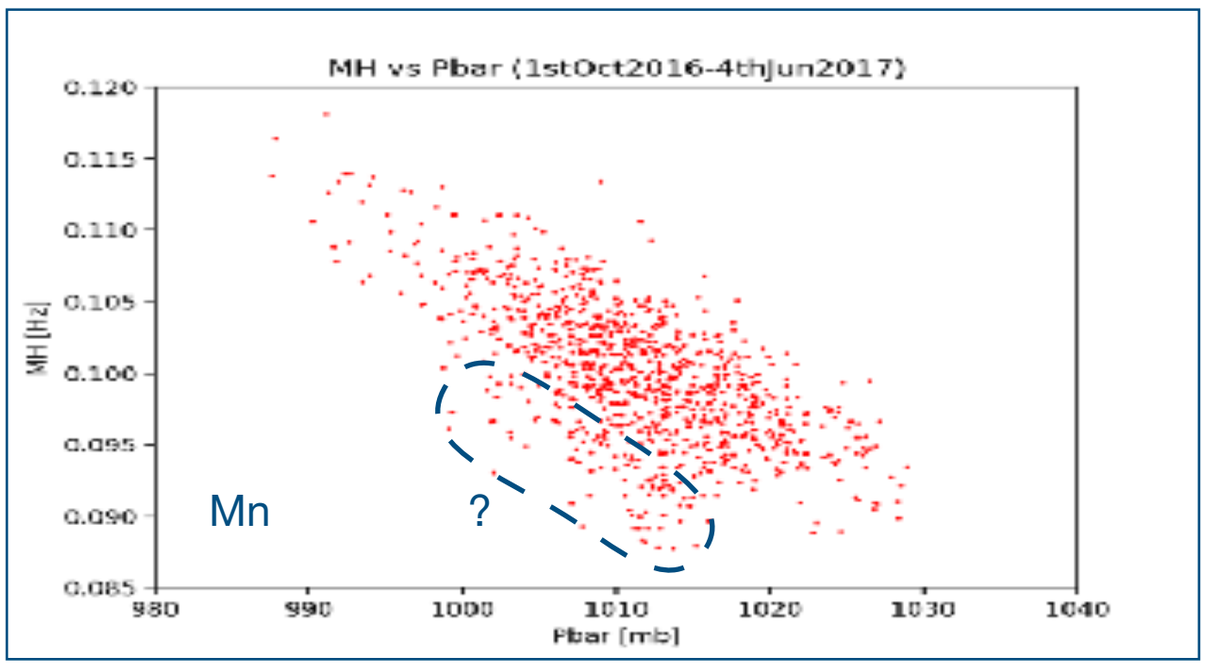
Full period: 2016Oct10-2017June04

Multiplicity vs. pressure (dt = 6h)



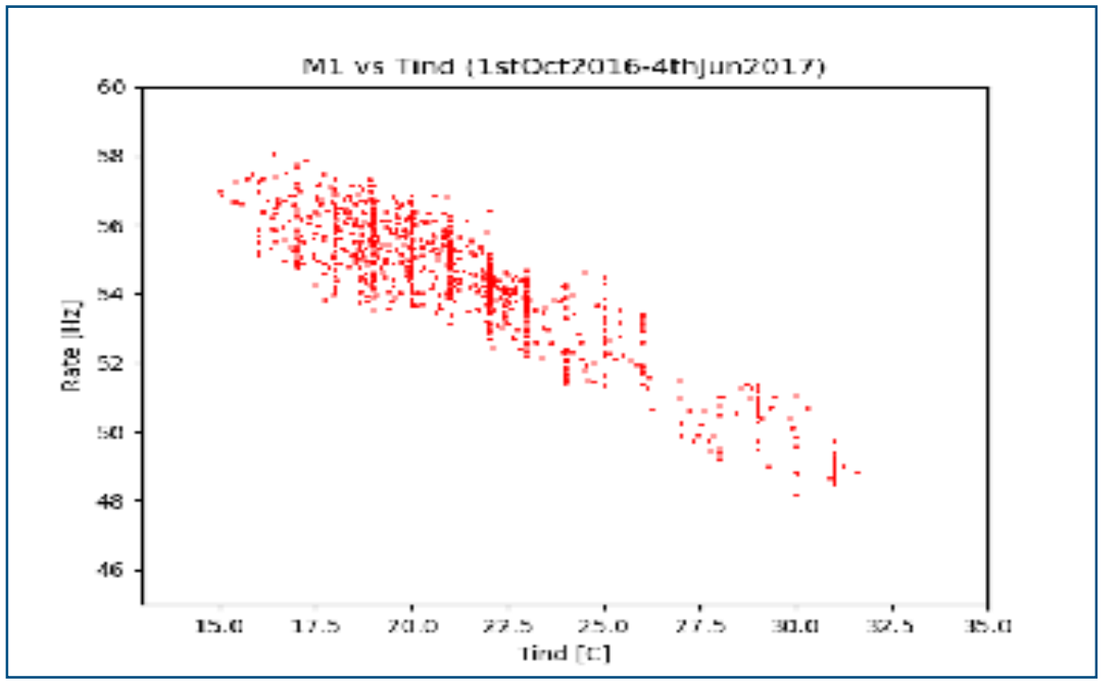
dt = 6 h



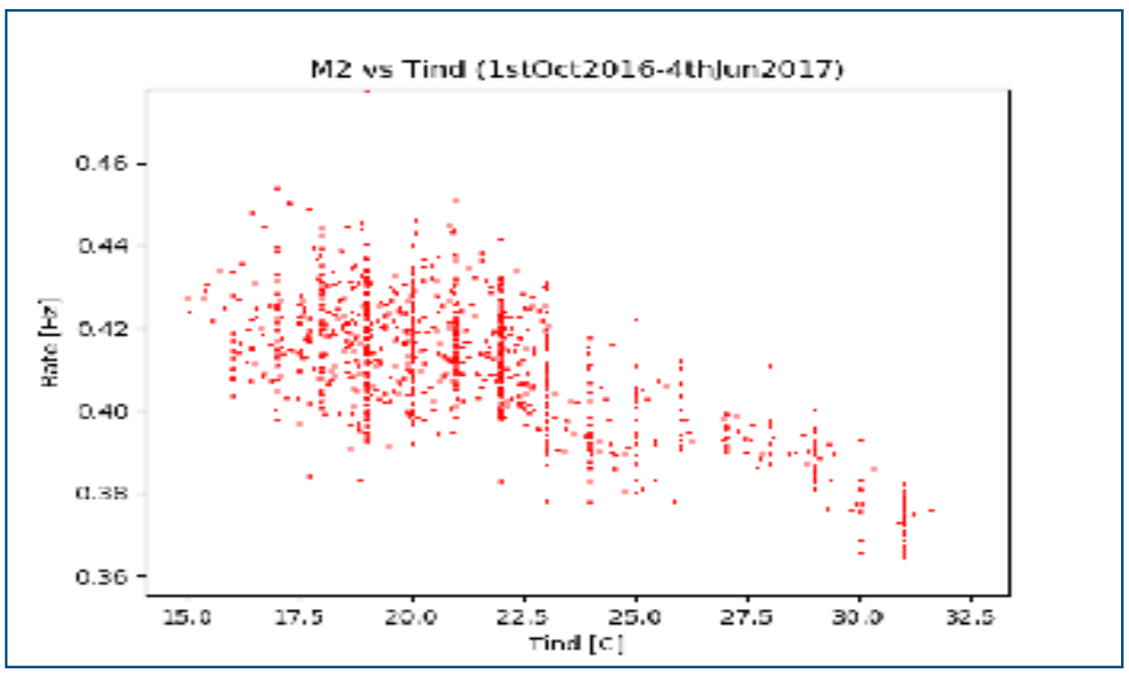


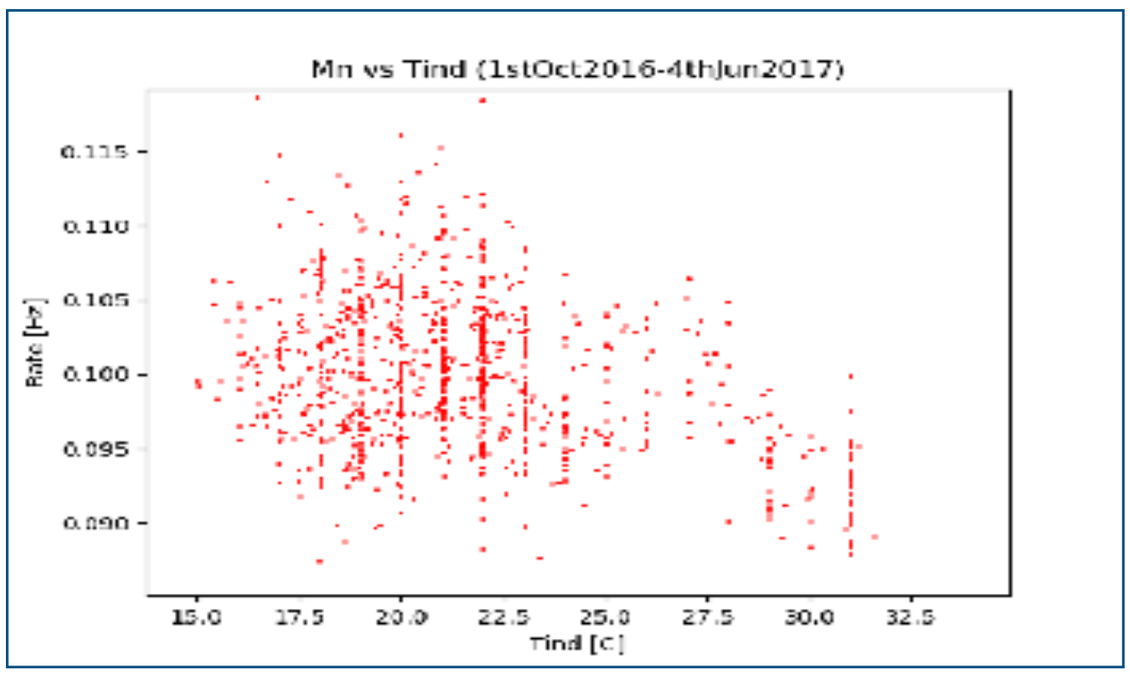
Full period: 2016Oct10-2017June04

Multiplicity vs. t_indoors (dt = 6h)



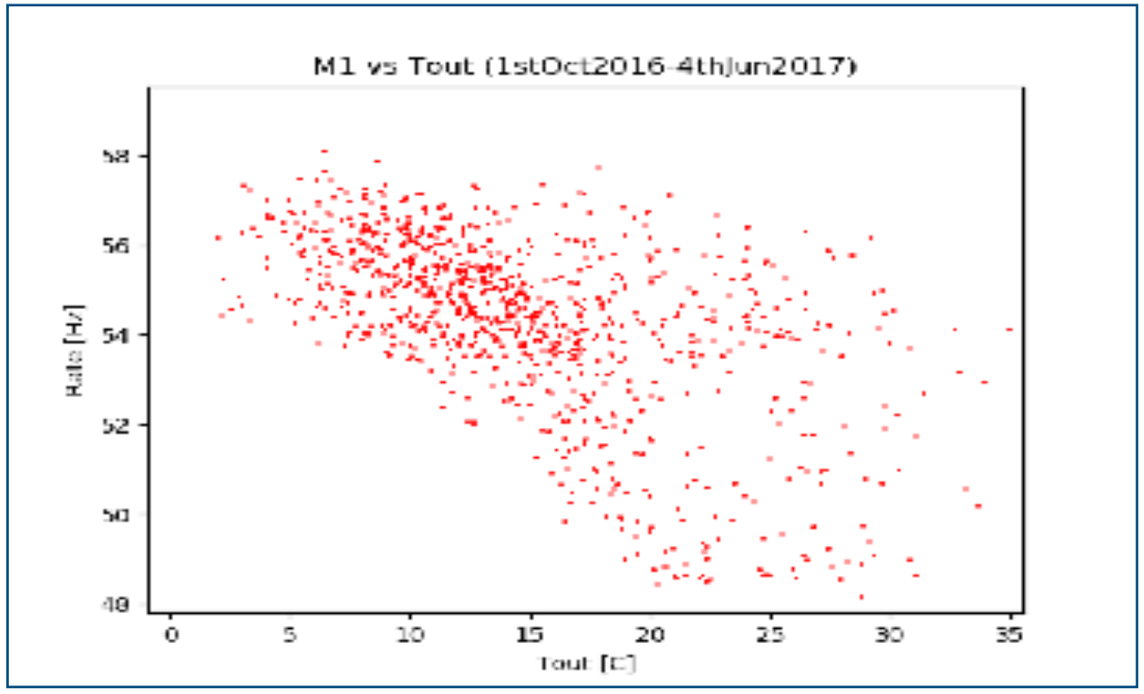
dt = 6 h



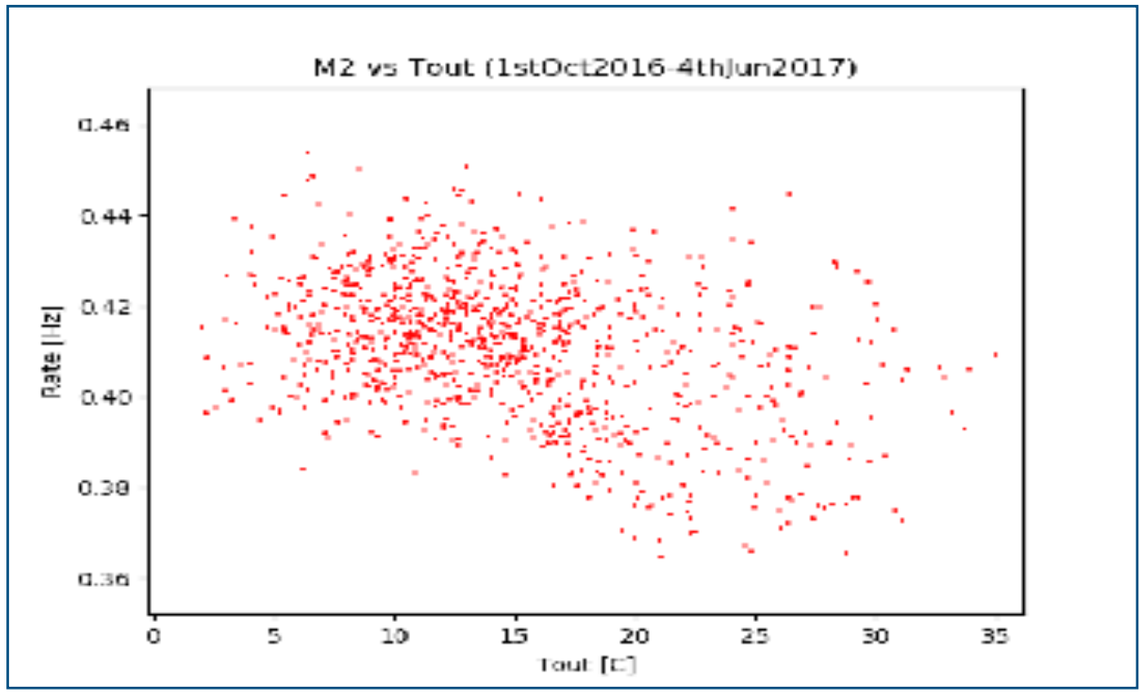


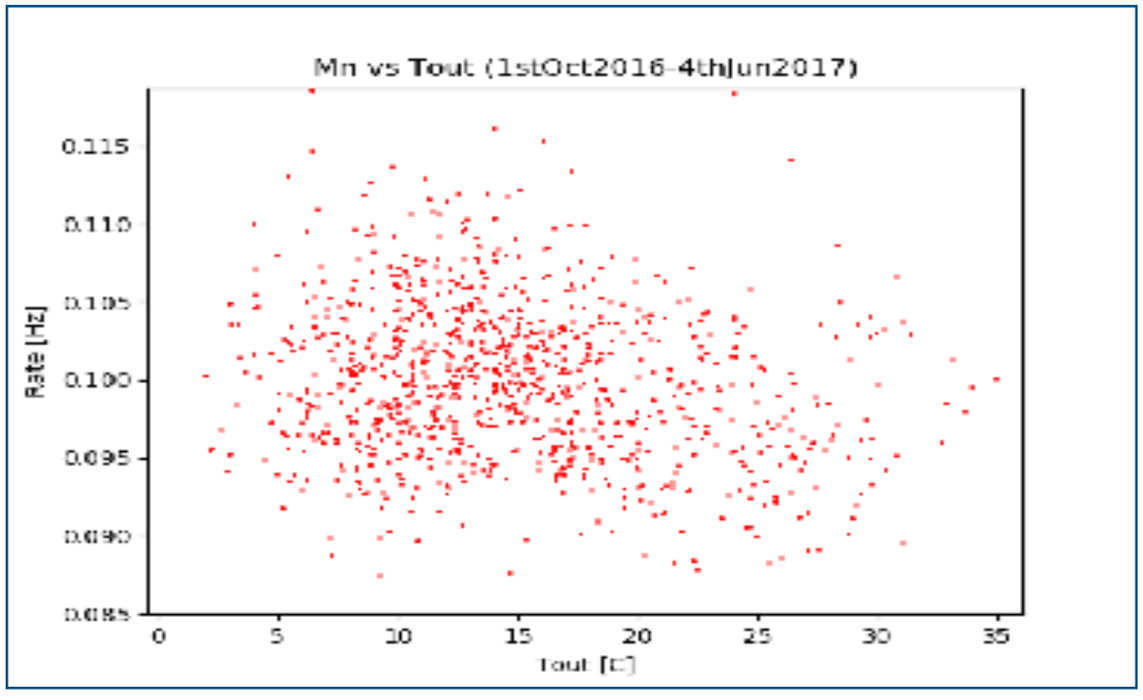
Full period: 2016Oct10-2017June04

Multiplicity vs. t_indoors (dt = 6h)



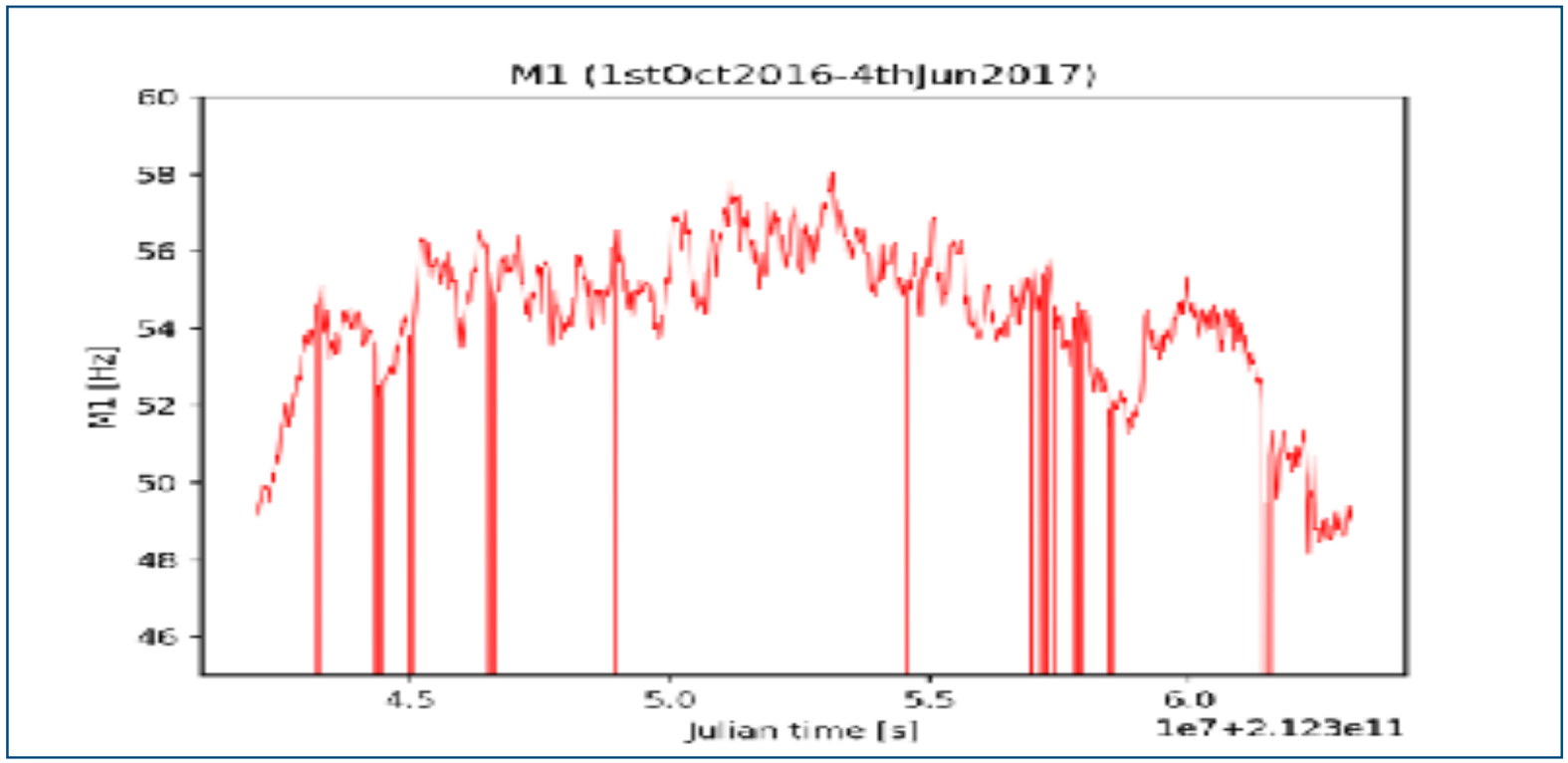
dt = 6 h



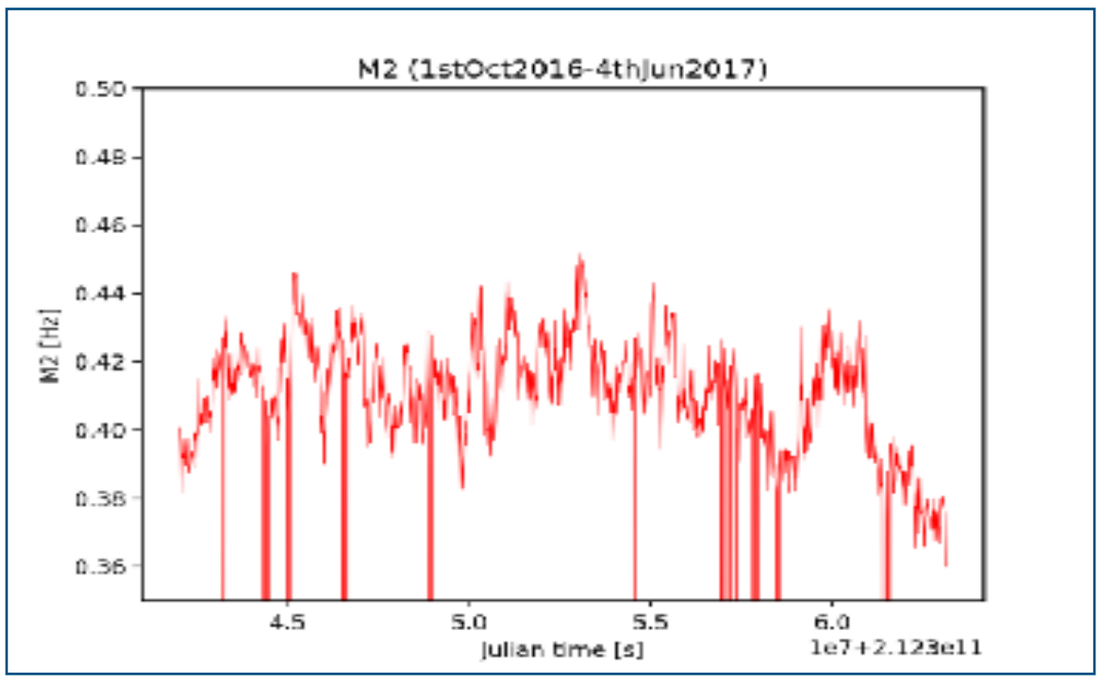


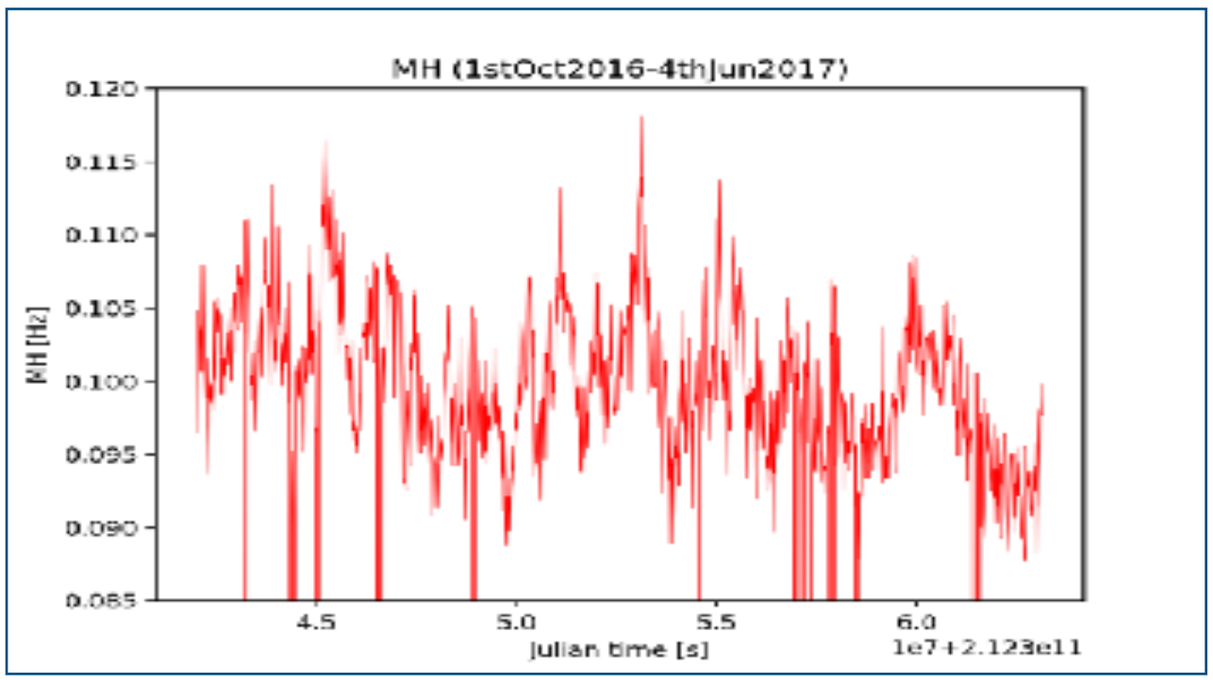
Full period: 2016Oct10-2017June04

M1, M2 & Mn Rates (dt = 6h)



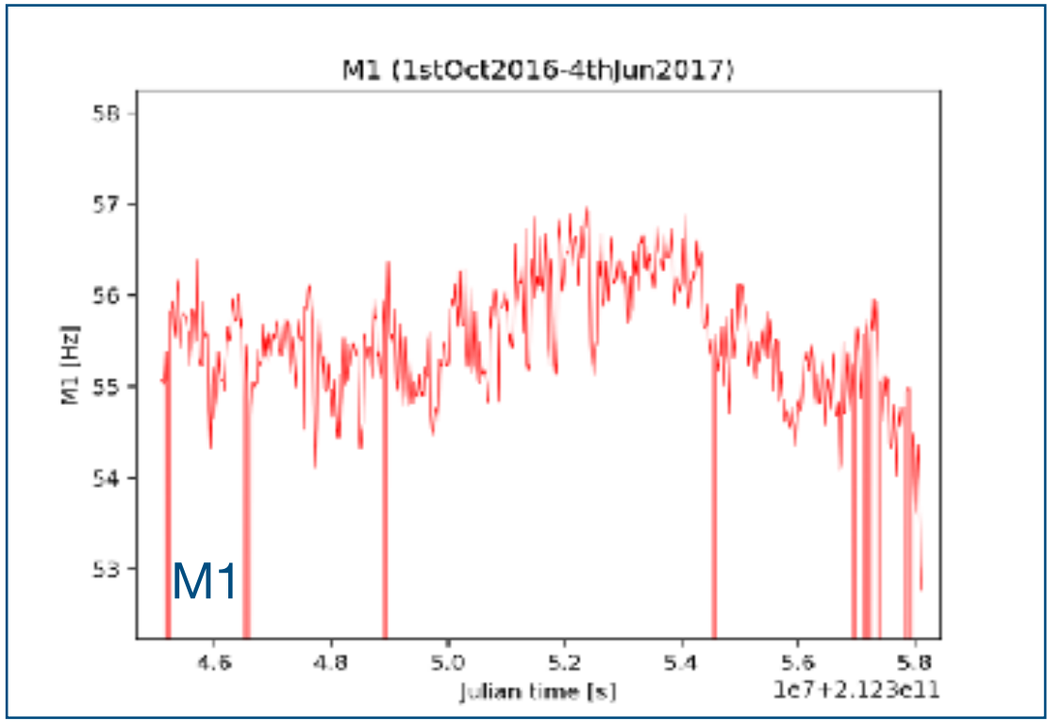
dt = 6 h

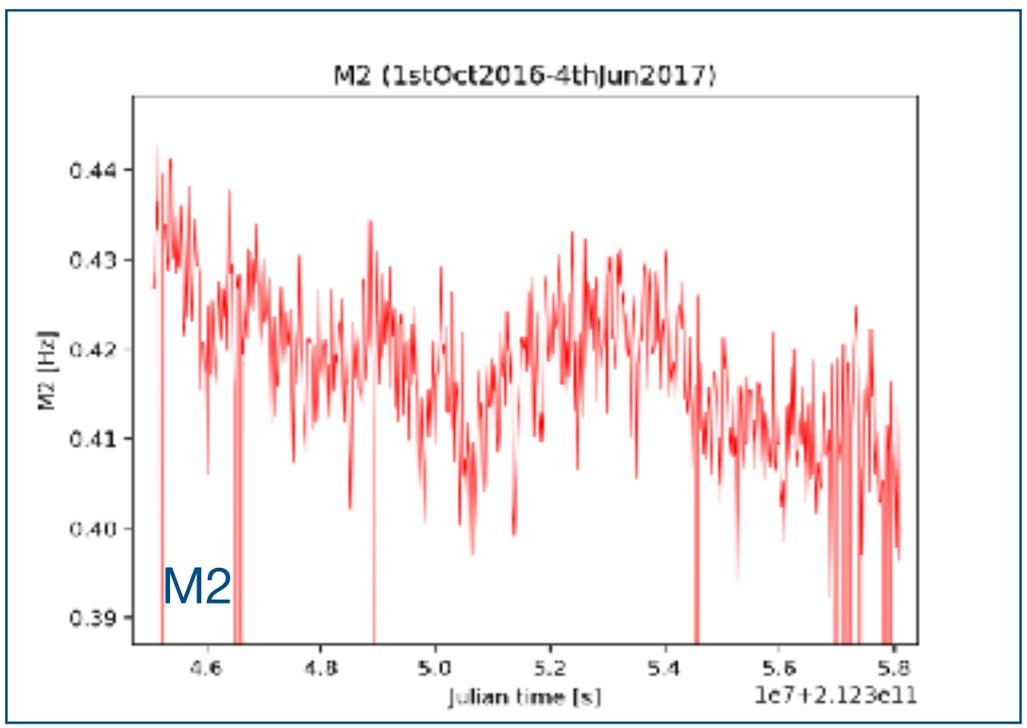


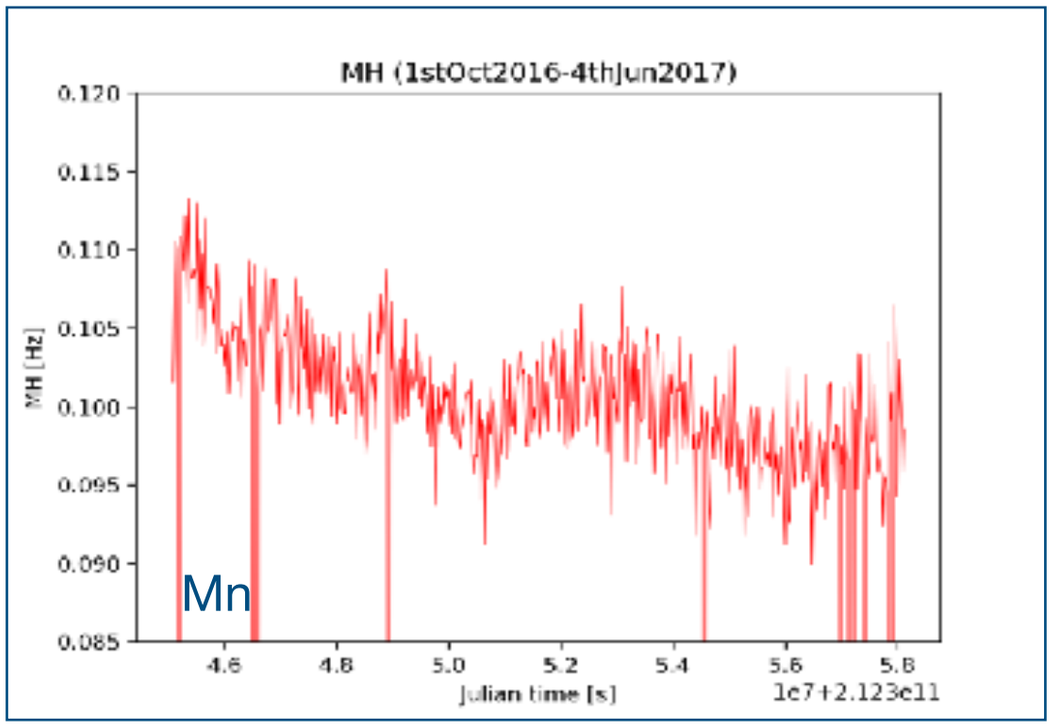


Full period: 2016Oct10-2017Jun04

P&T corrected rates vs Time



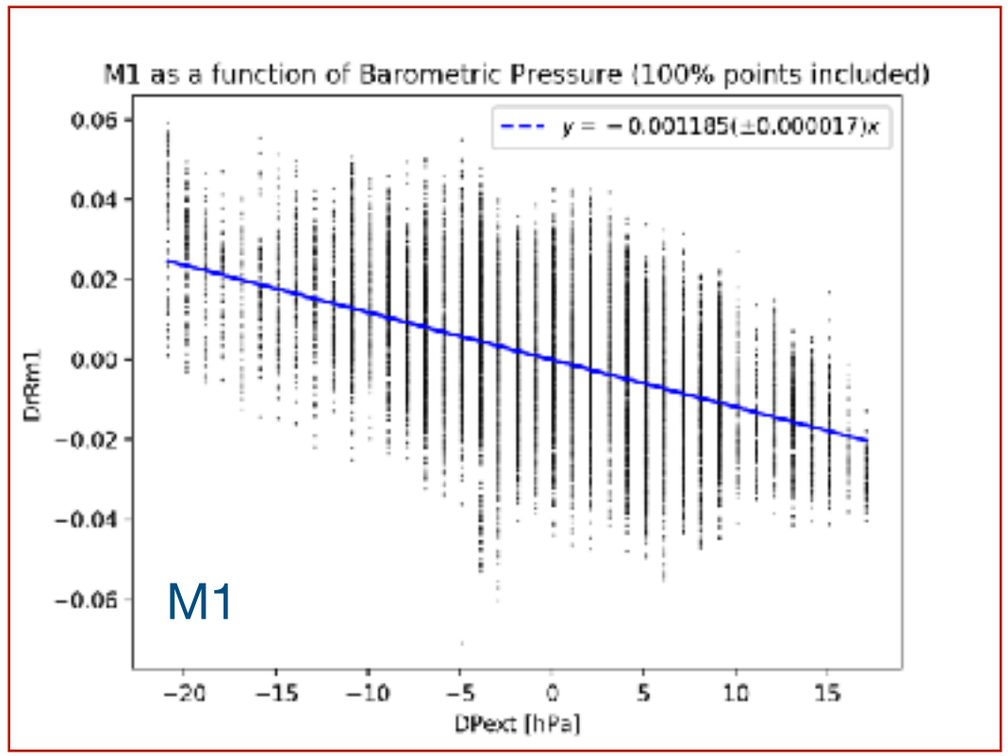


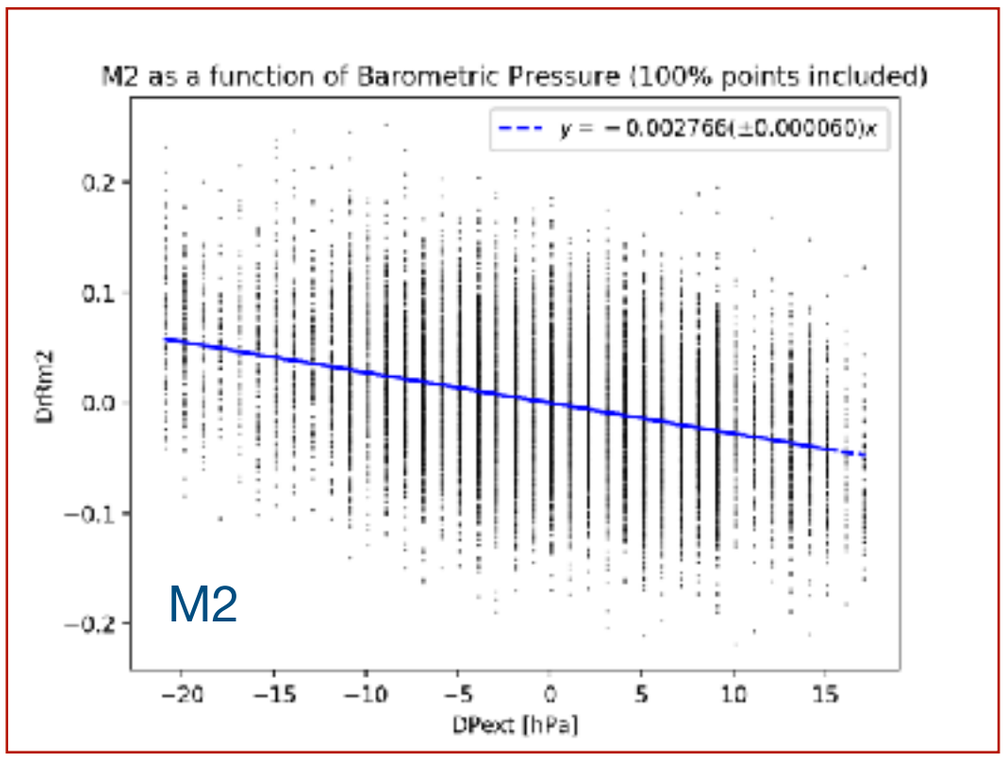


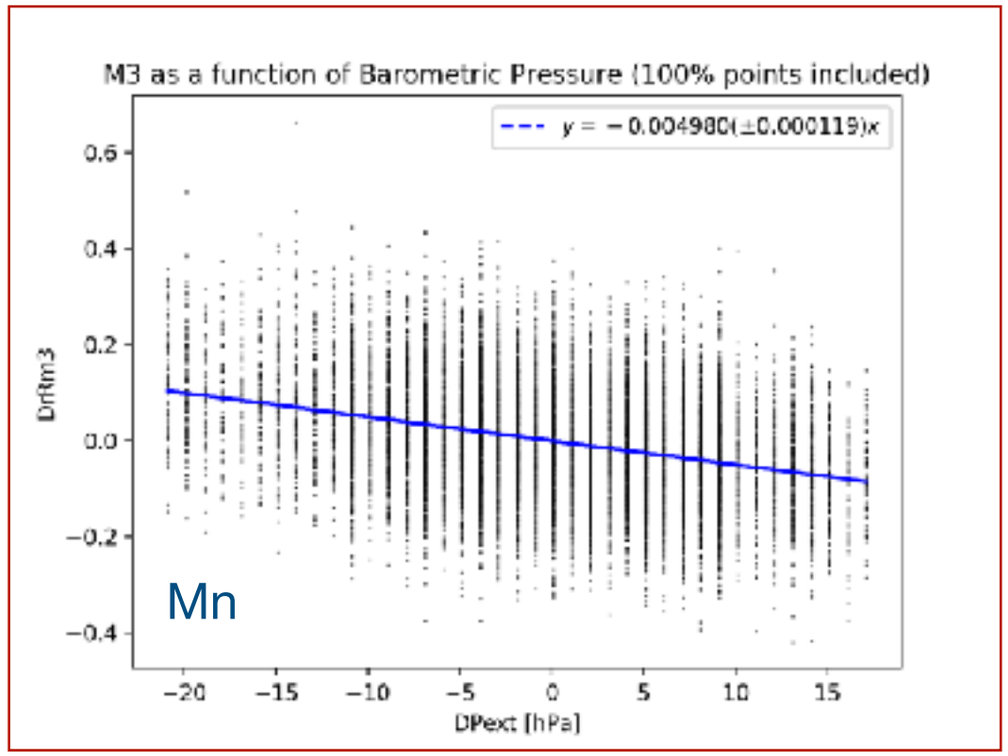
M1, M2 & Mn Rates vs Pbar

$$\Delta R = R - R_{mean}$$

$$\Delta P = P - P_{mean}$$





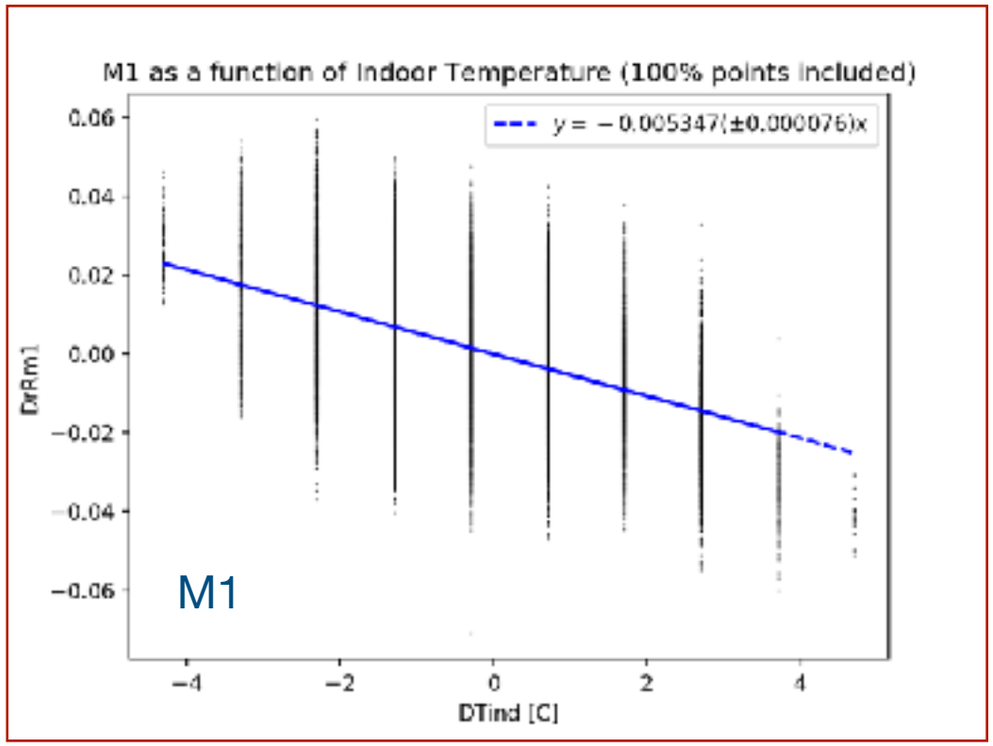


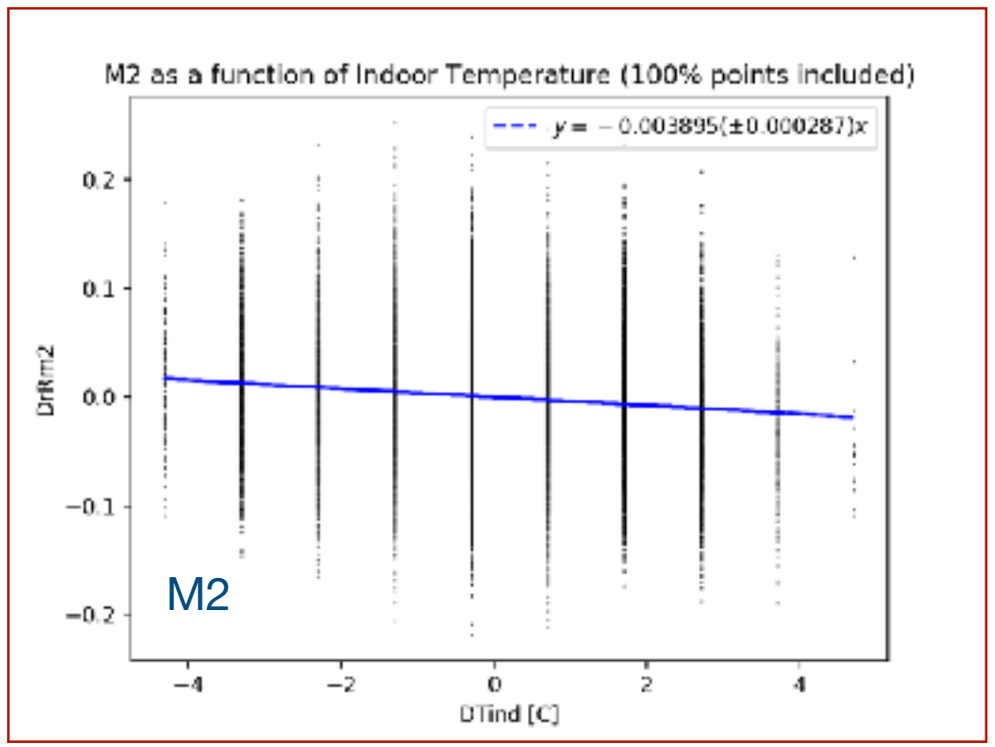
Short period: 2016Nov05-2017Apr05

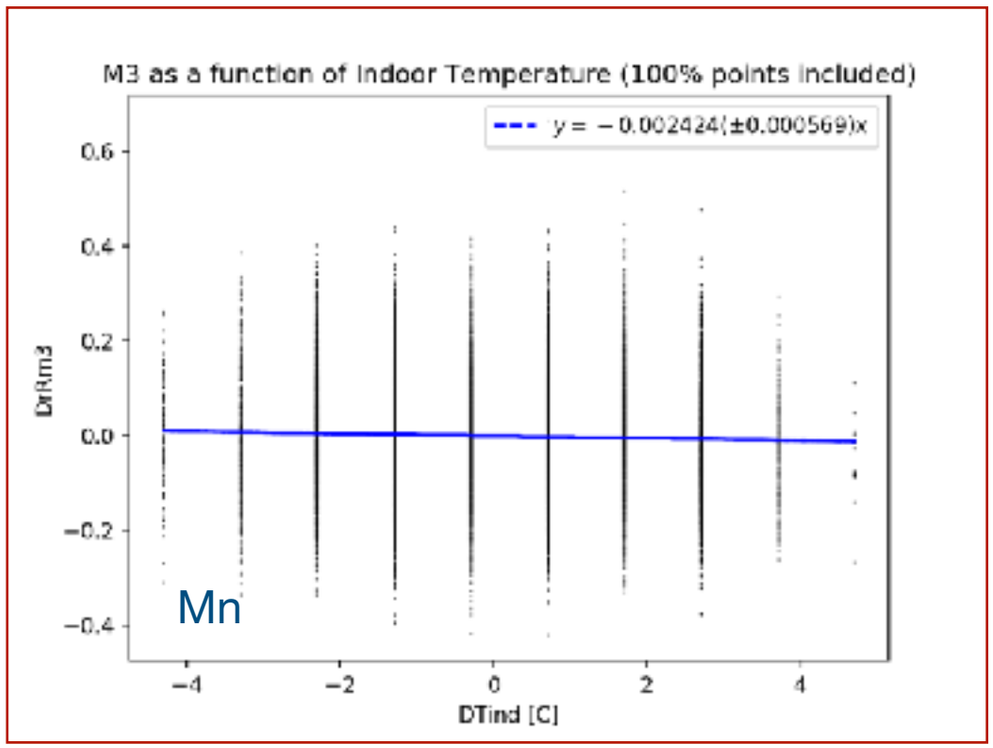
M1, M2 & Mn Rates vs T_indoors

$$\Delta R = R - R_{mean}$$

$$\Delta Ti = Tind - Tind_{mean}$$

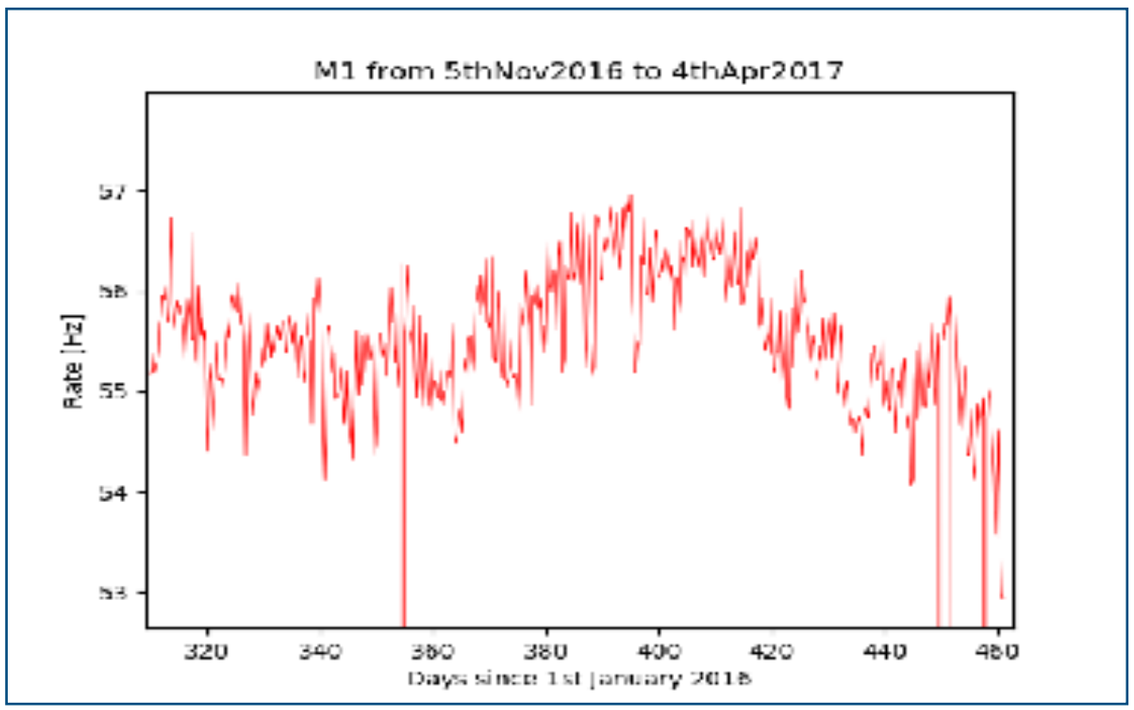


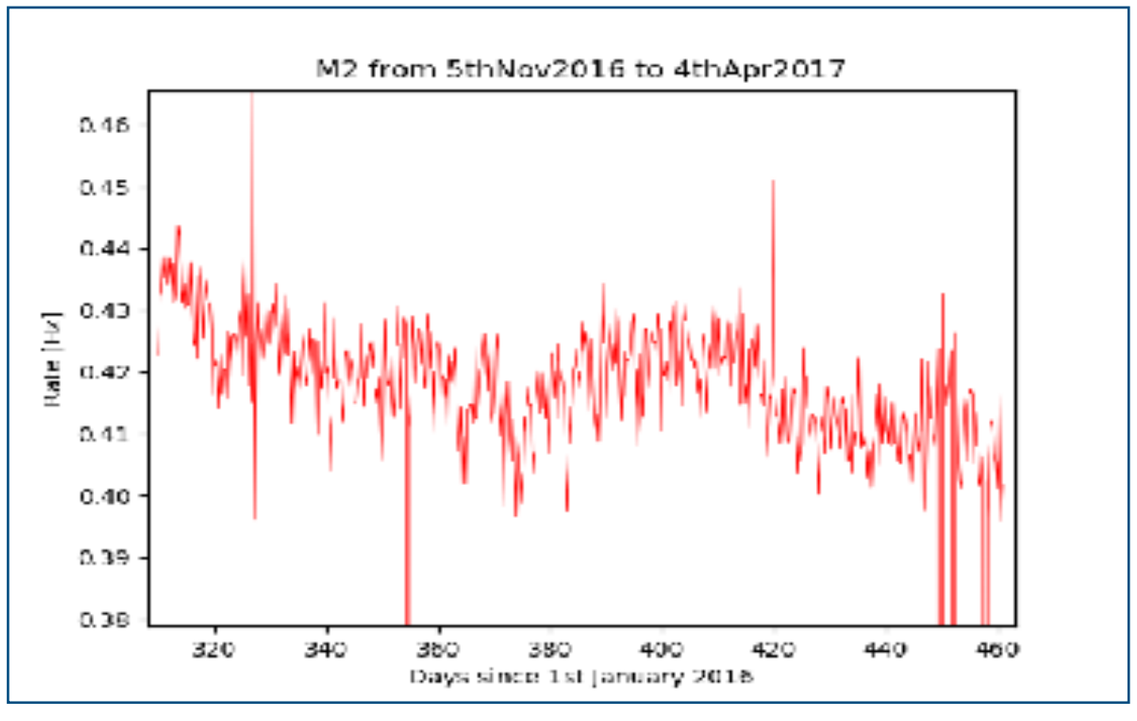


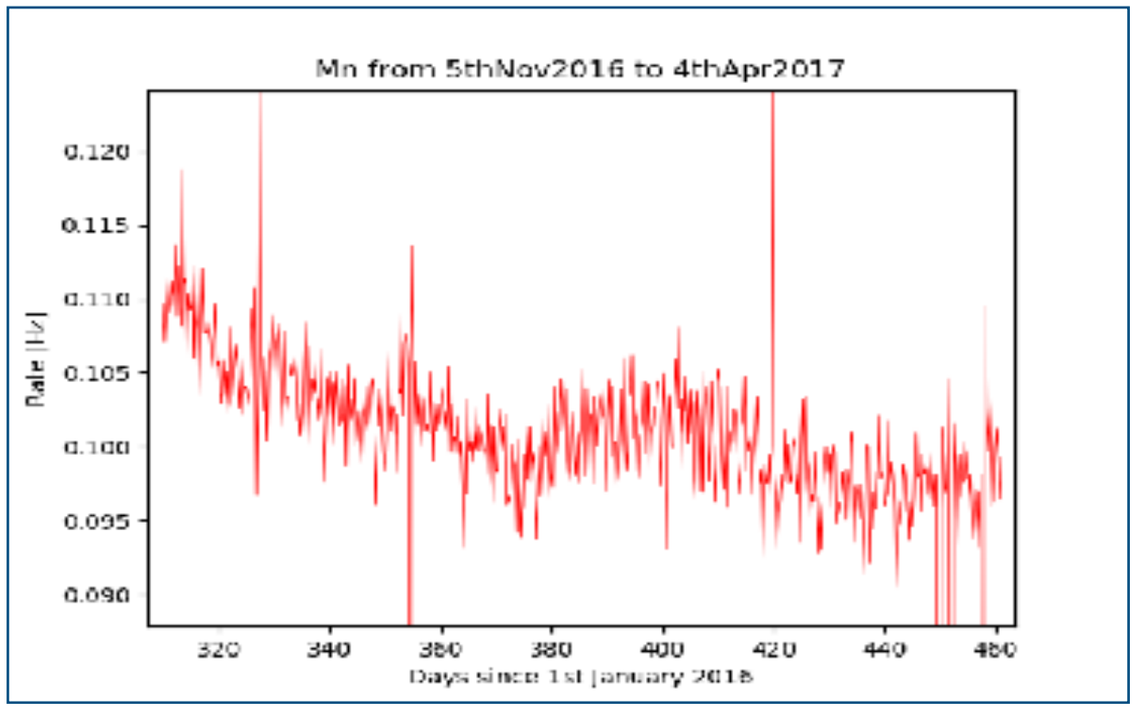


Short period: 2016Nov05-2017Apr05

P&T corrected rates vs Time

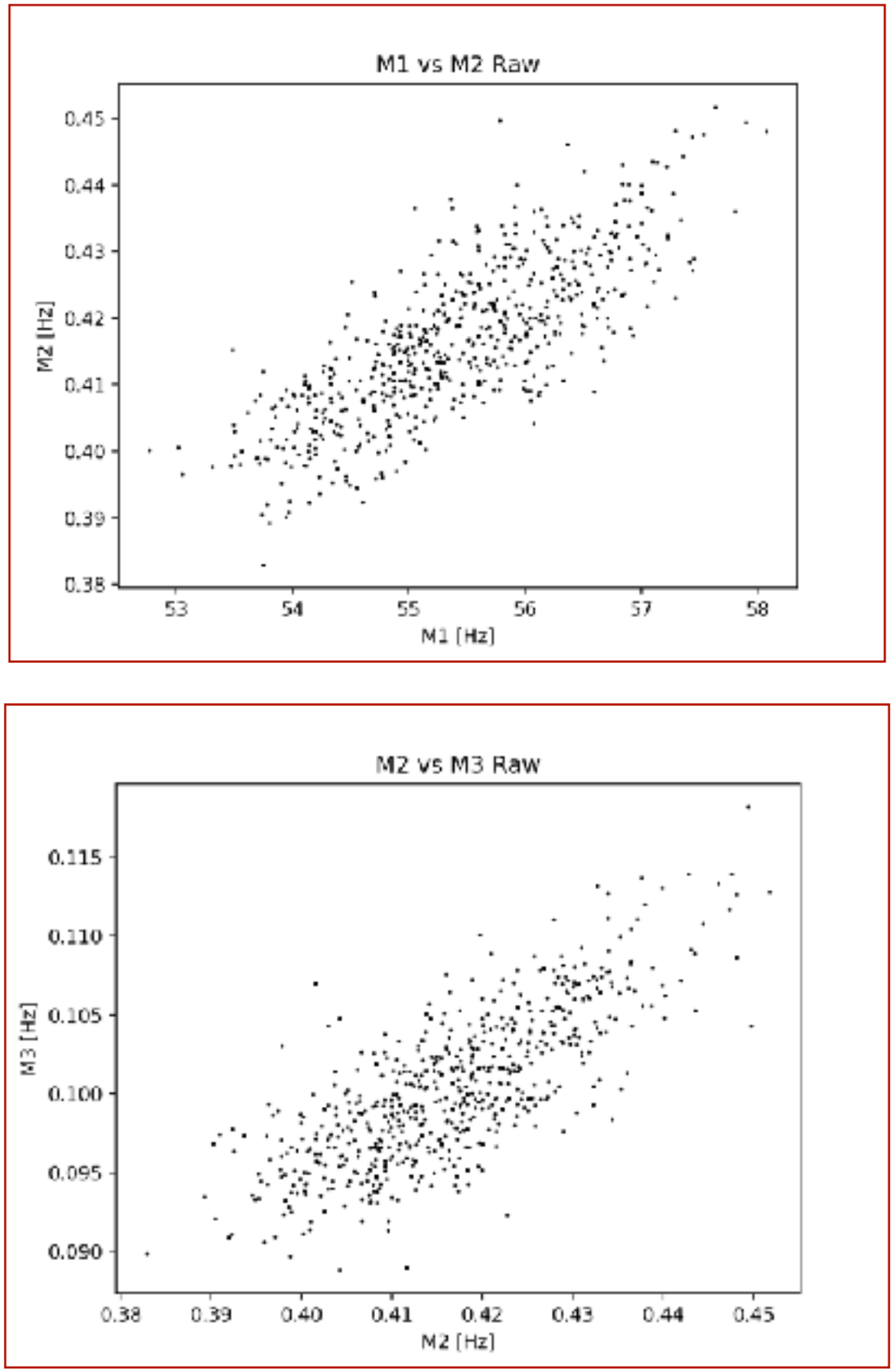


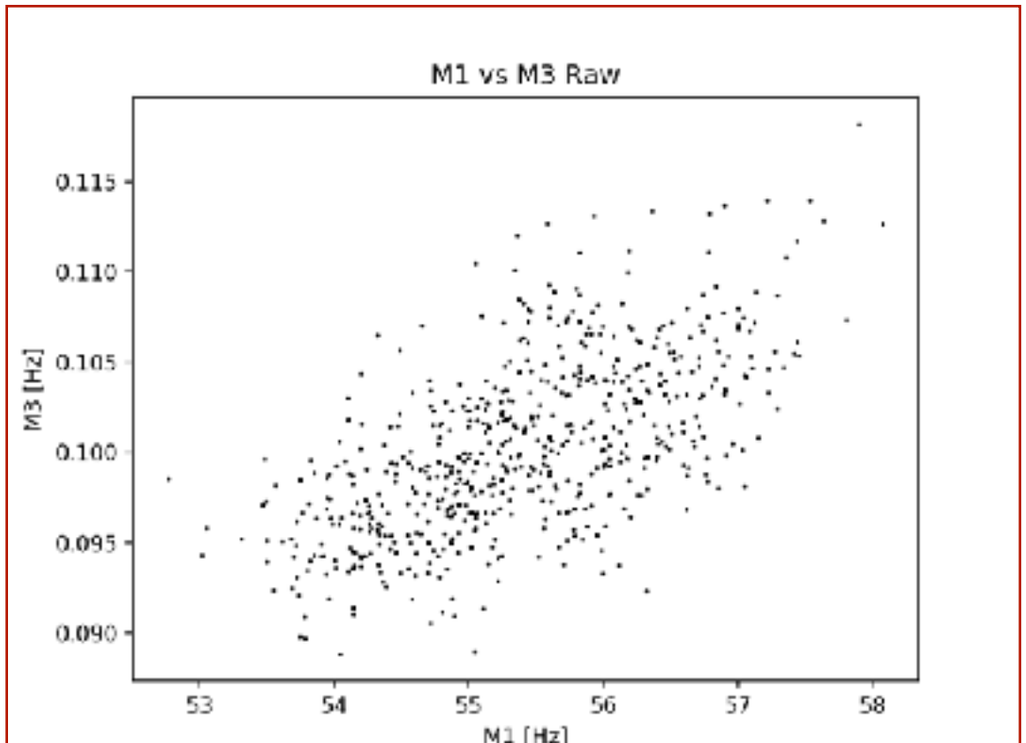




Short period: 2016Nov05-2017Apr05

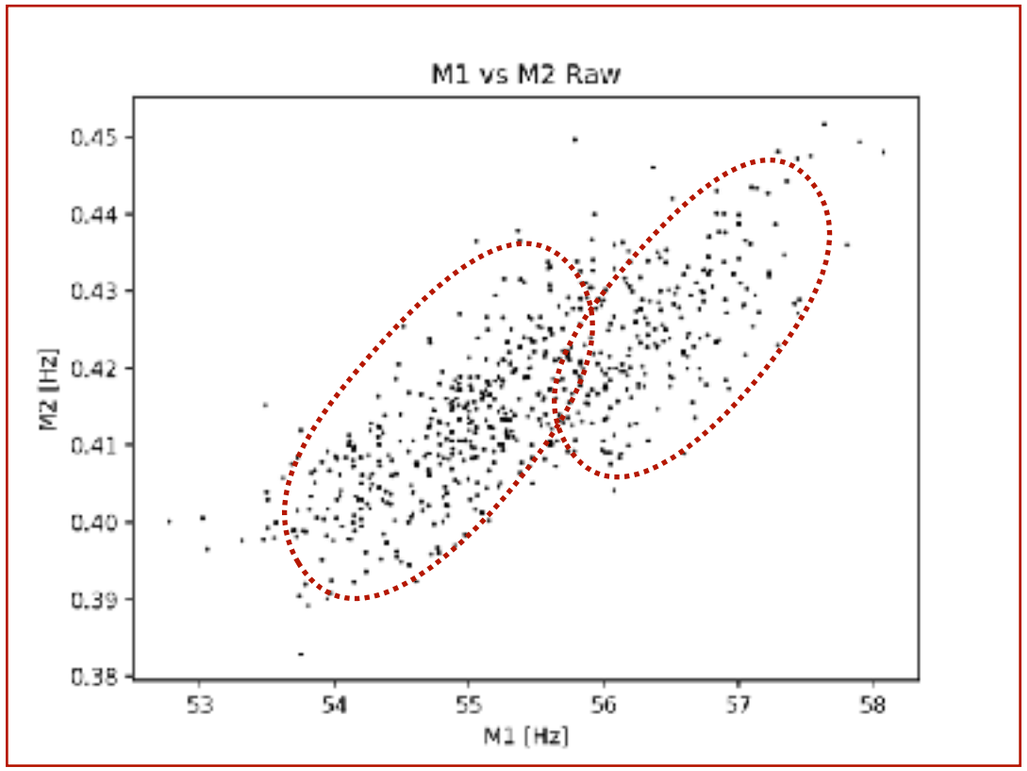
Correlation between multiplicities: uncorrected data

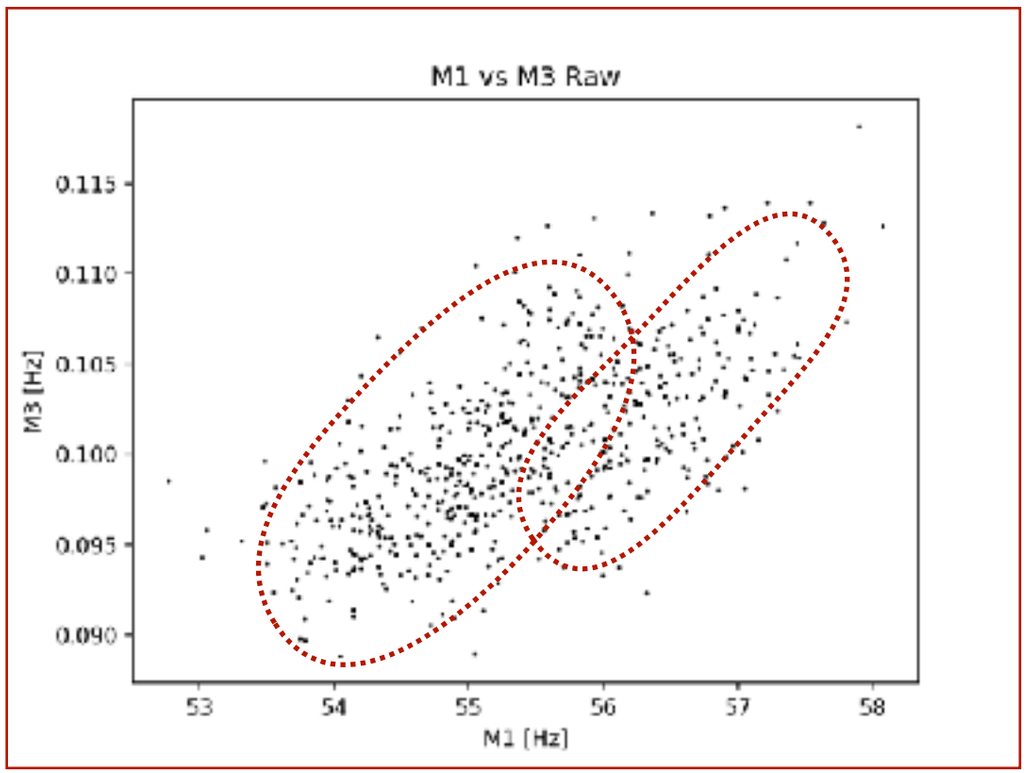


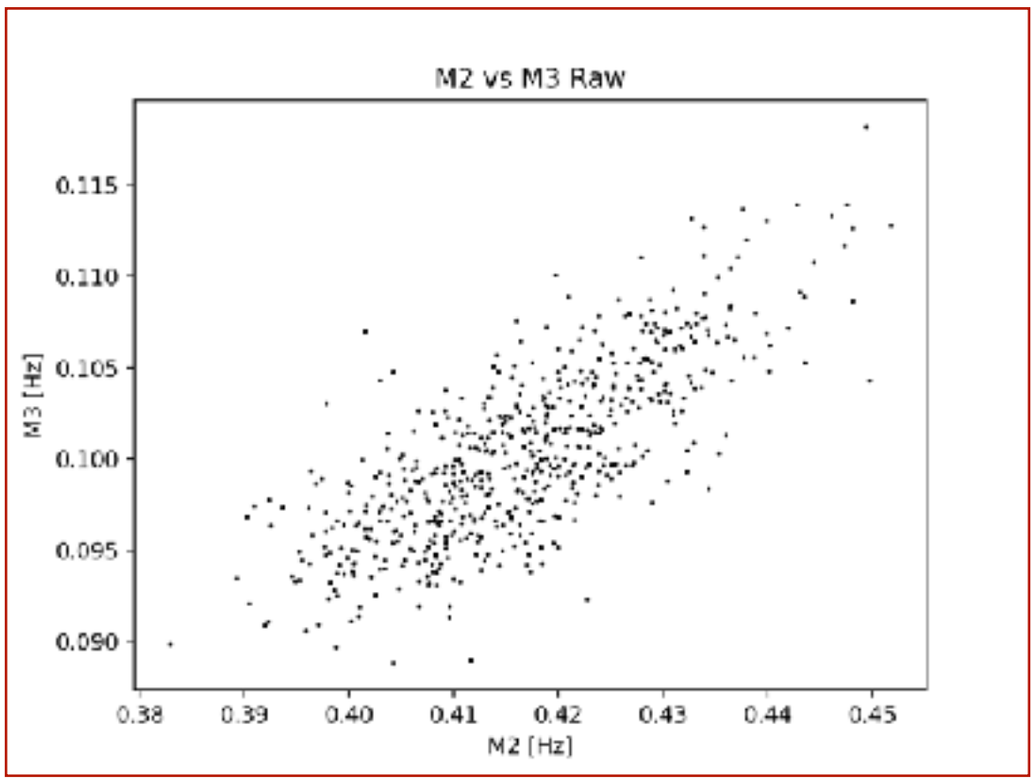


Short period: 2016Nov05-2017Apr05

Correlation between multiplicities: uncorrected data

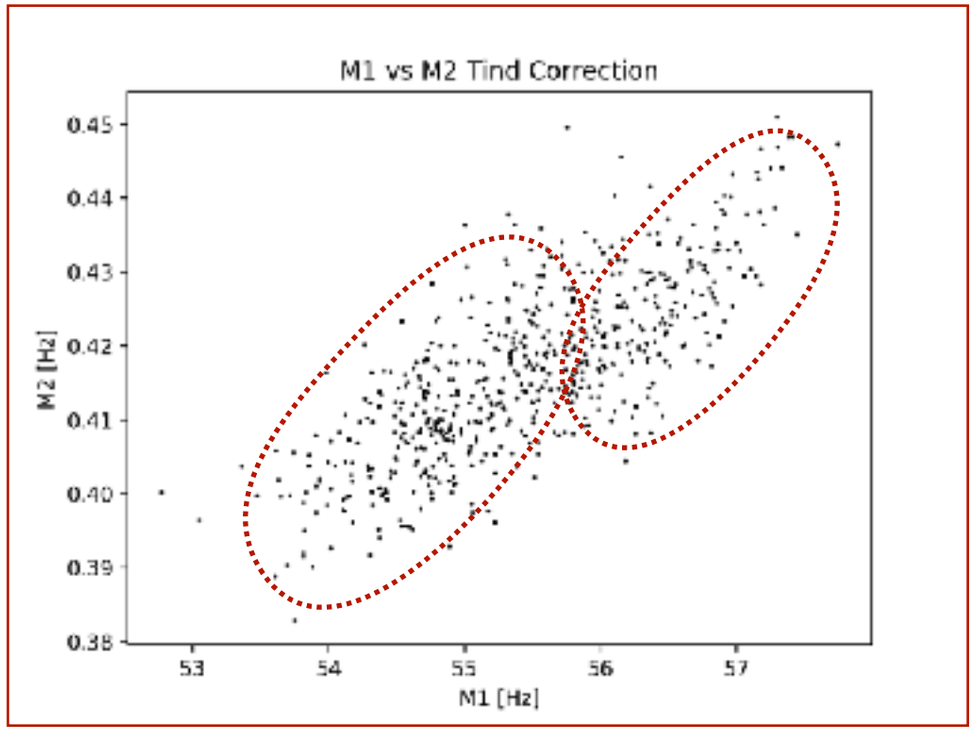


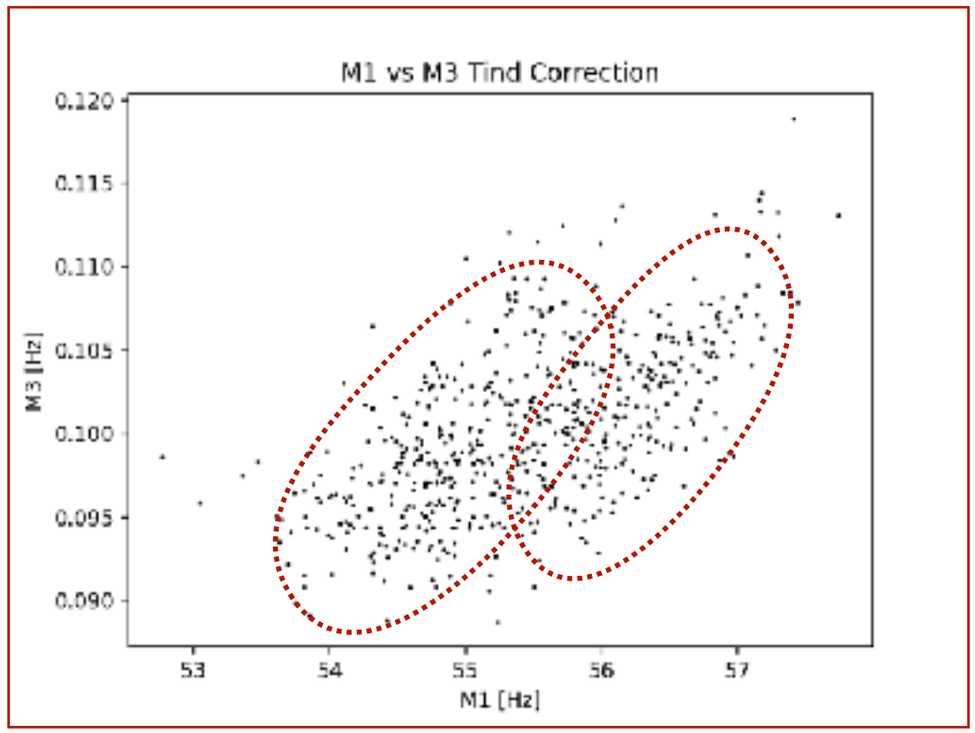


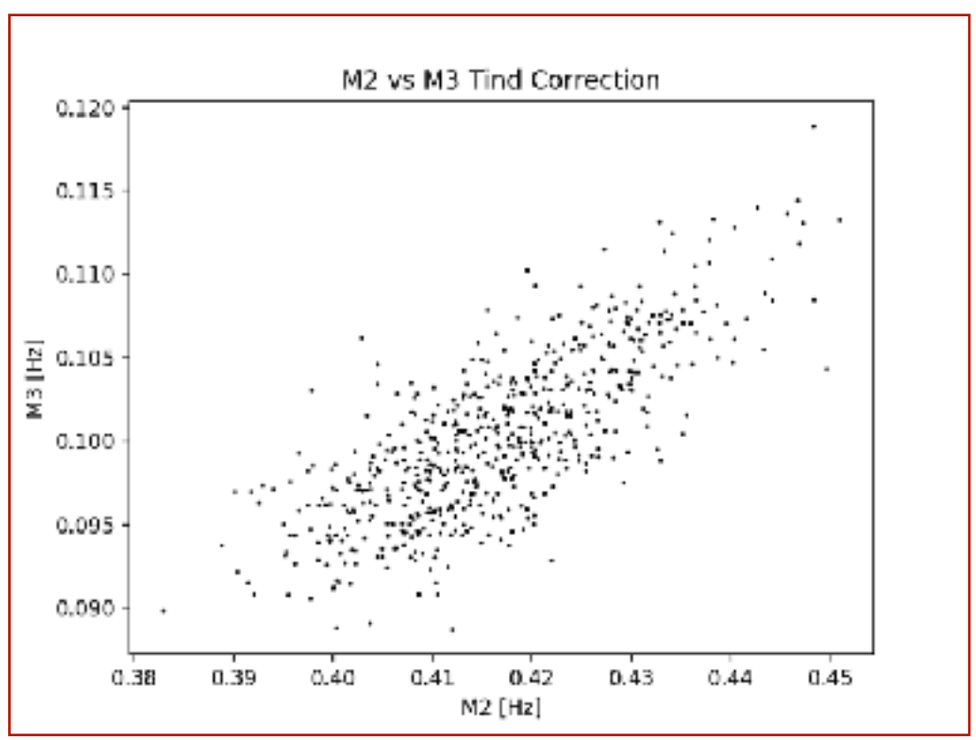


Short period: 2016Nov05-2017Apr05

Correlation between multiplicities: after temperature correction

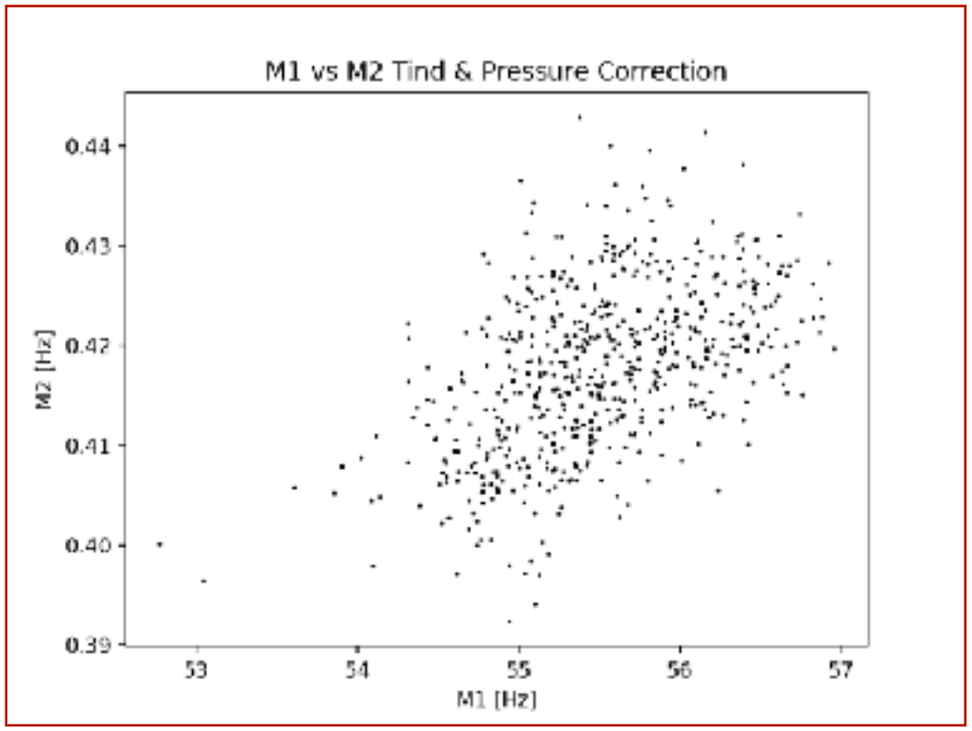


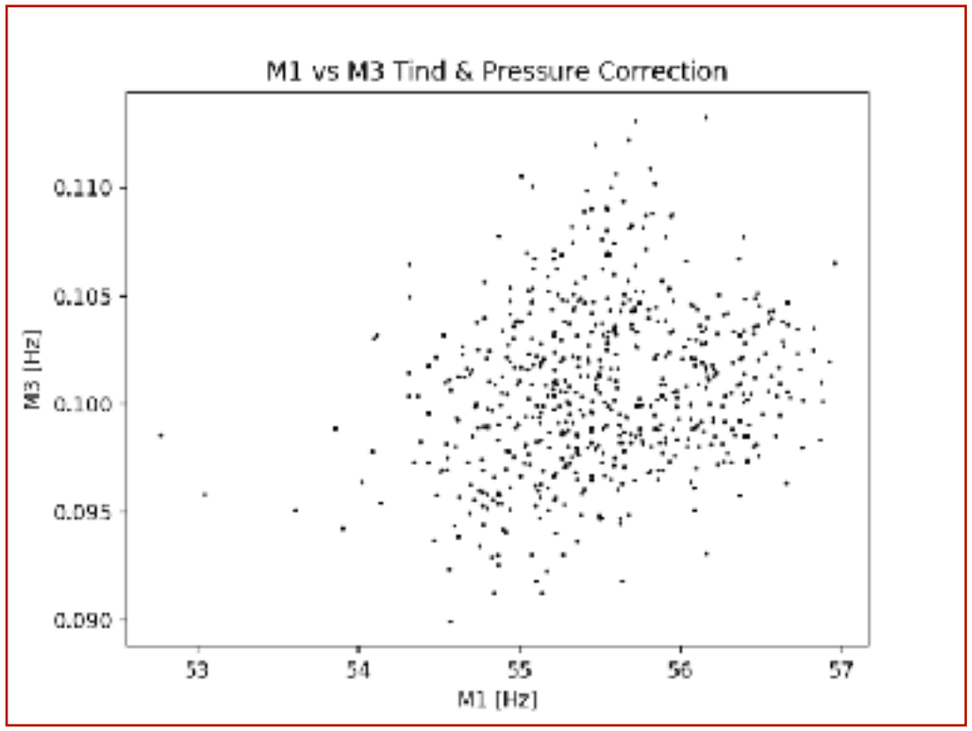


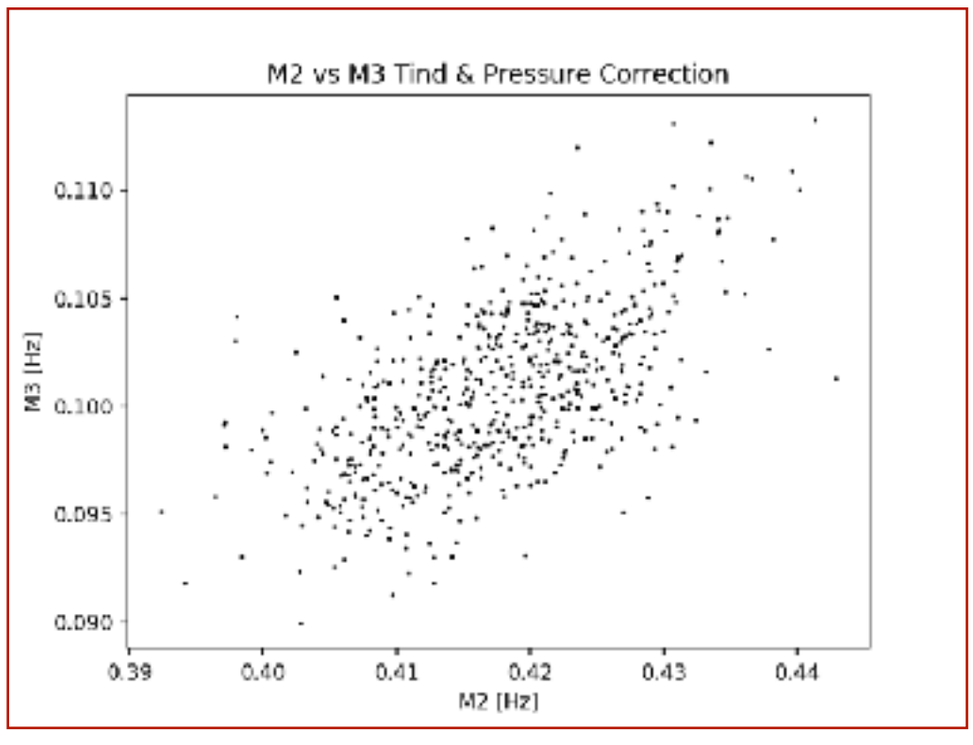


Short period: 2016Nov05-2017Apr05

Correlation between multiplicities: after pressure and temperature correction

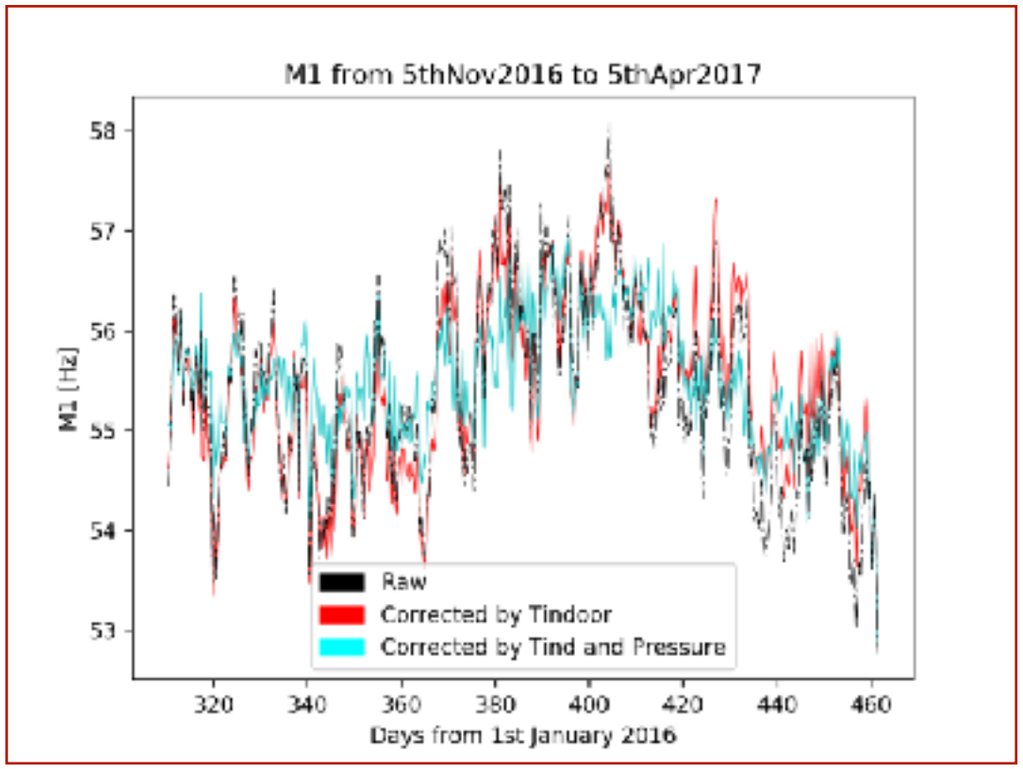


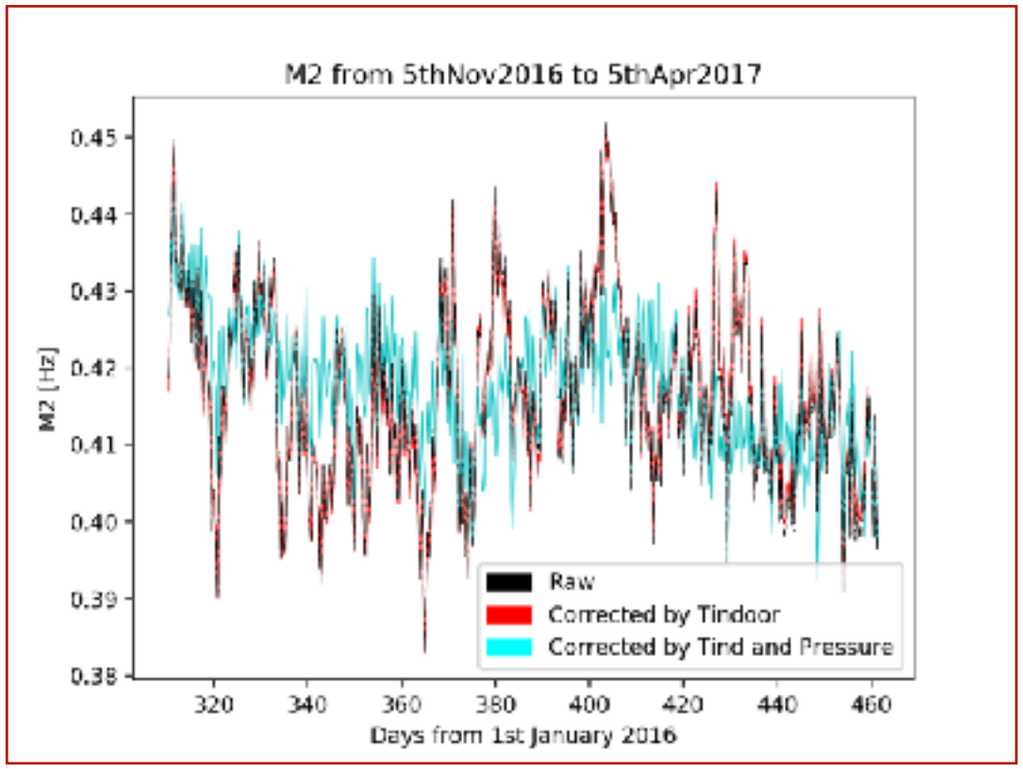


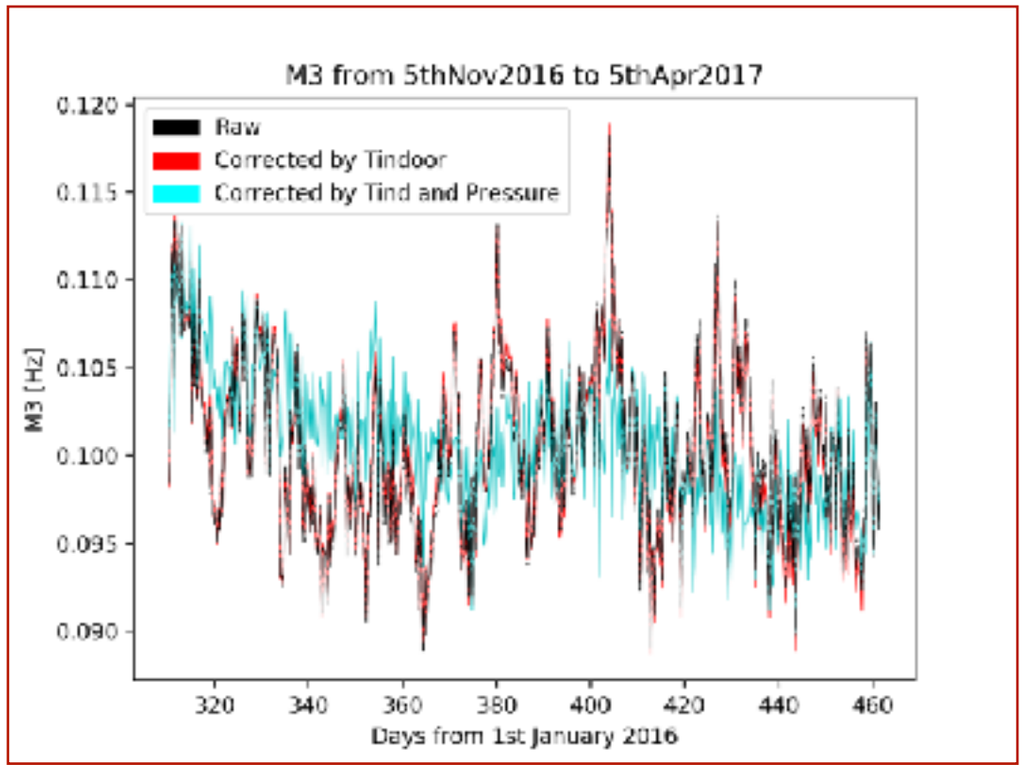


Short period: 2016Nov05-2017Apr05

Uncorrected and corrected rates vs Time





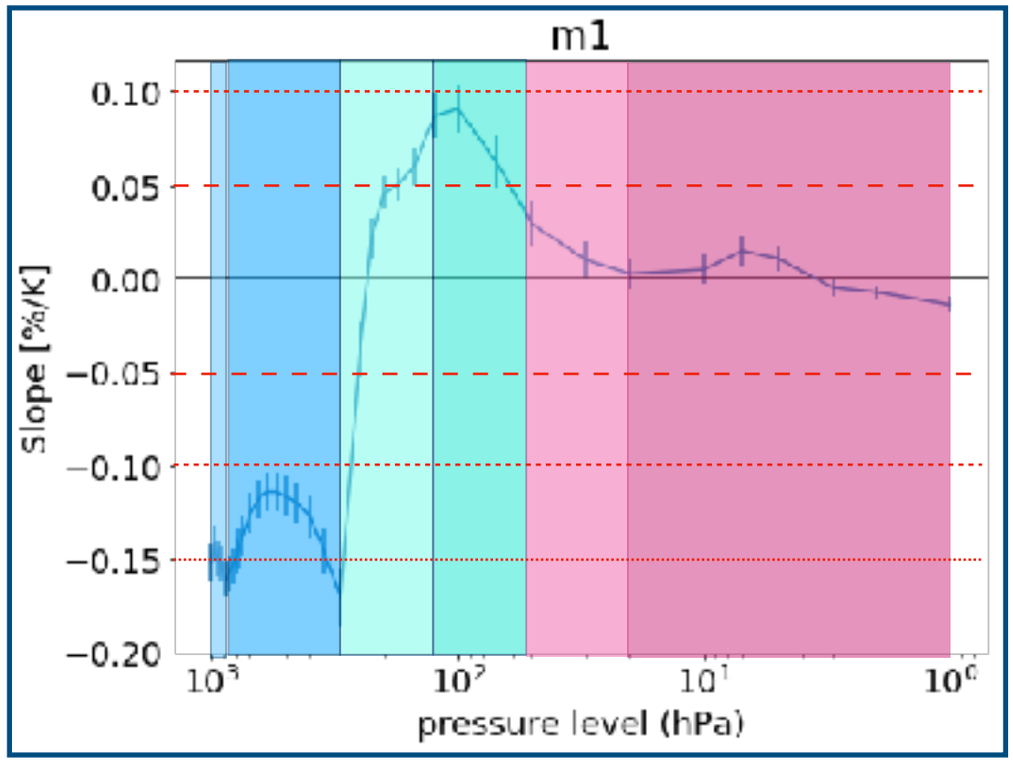


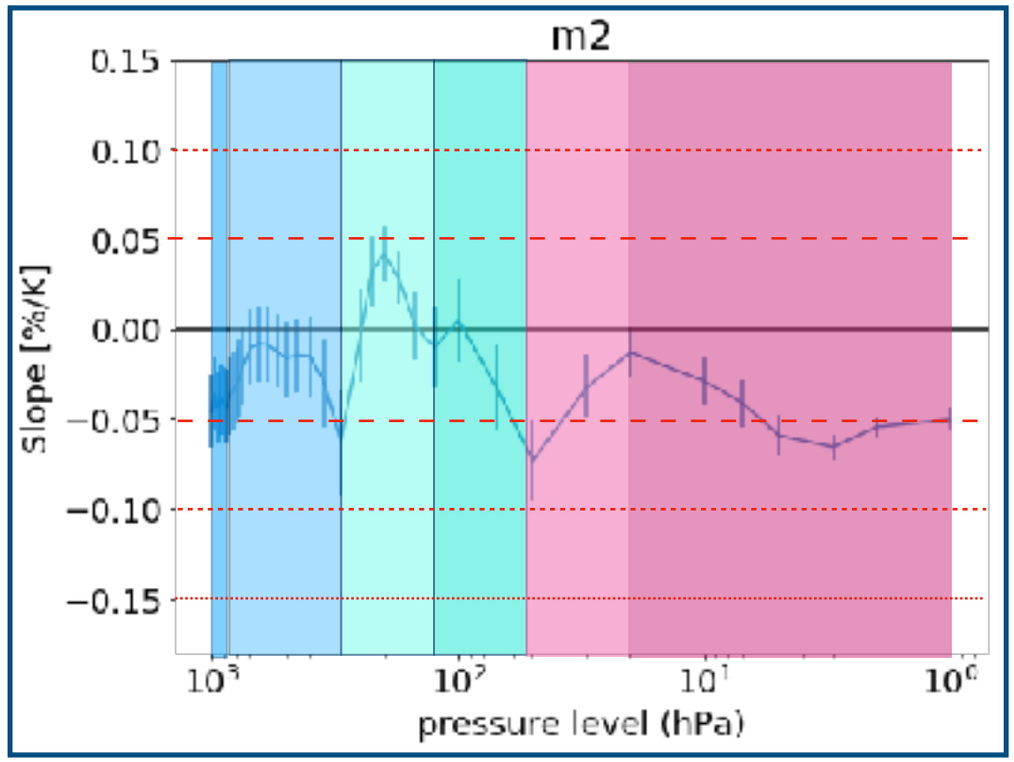
Preliminary data analysis

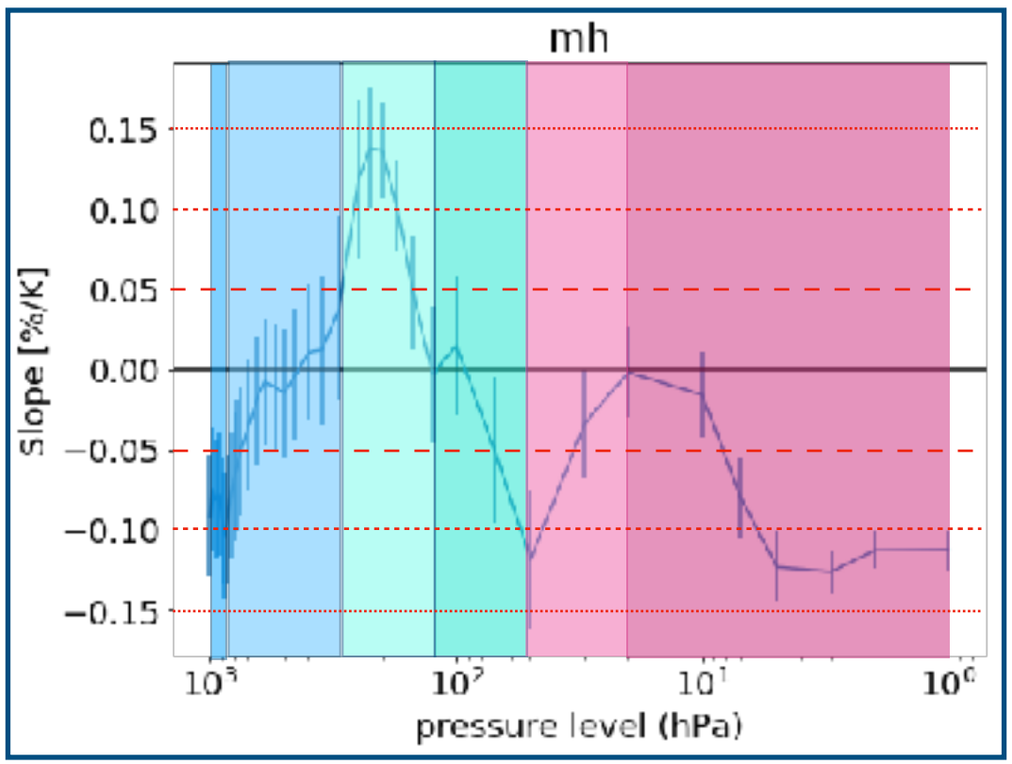
Slope analysis for M1, M2 and Mn

Period : 5.11.16 - 1.5.17

Slope in dN/N vs dT, at different layers



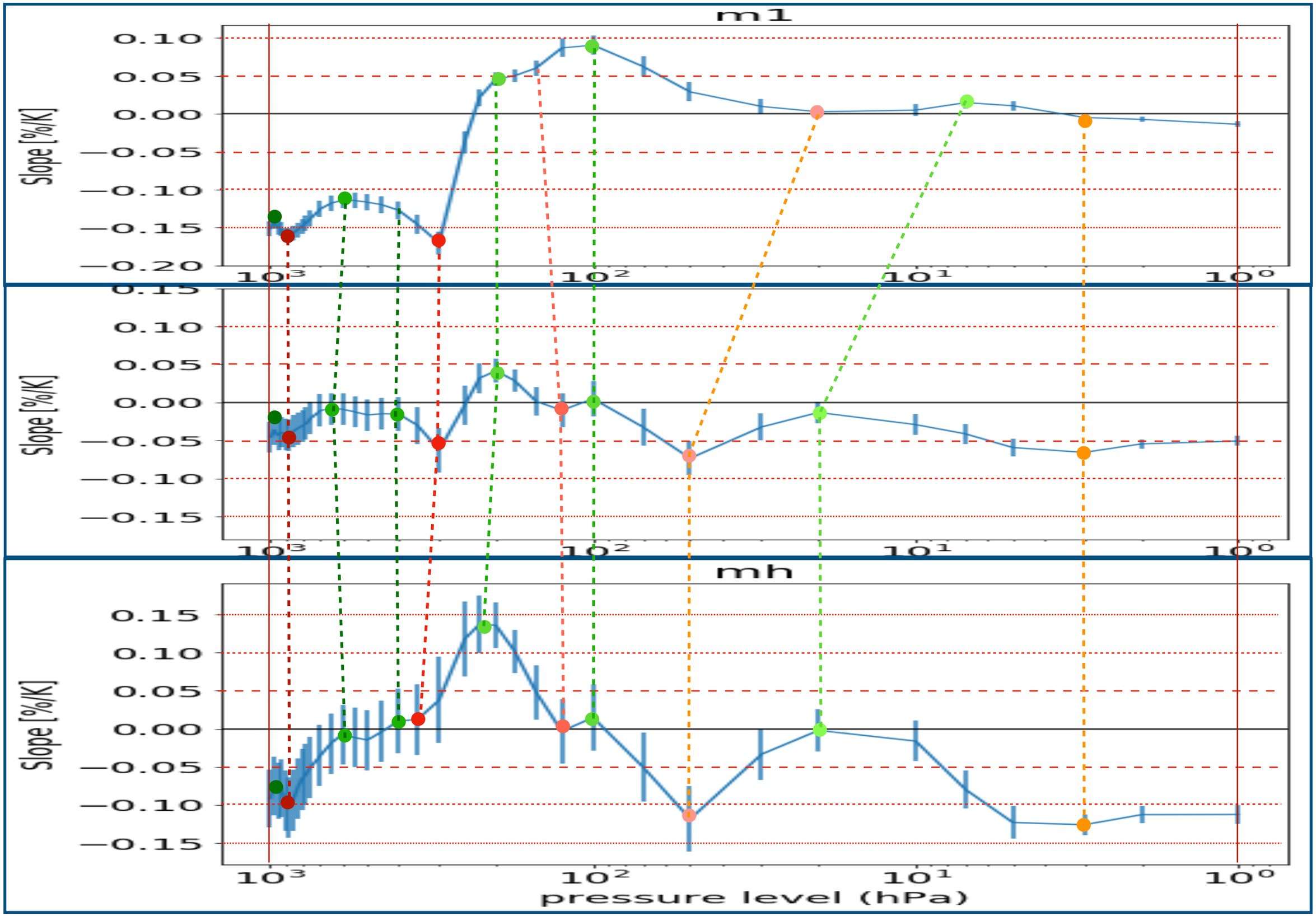




Slope analysis for M1, M2 and Mn

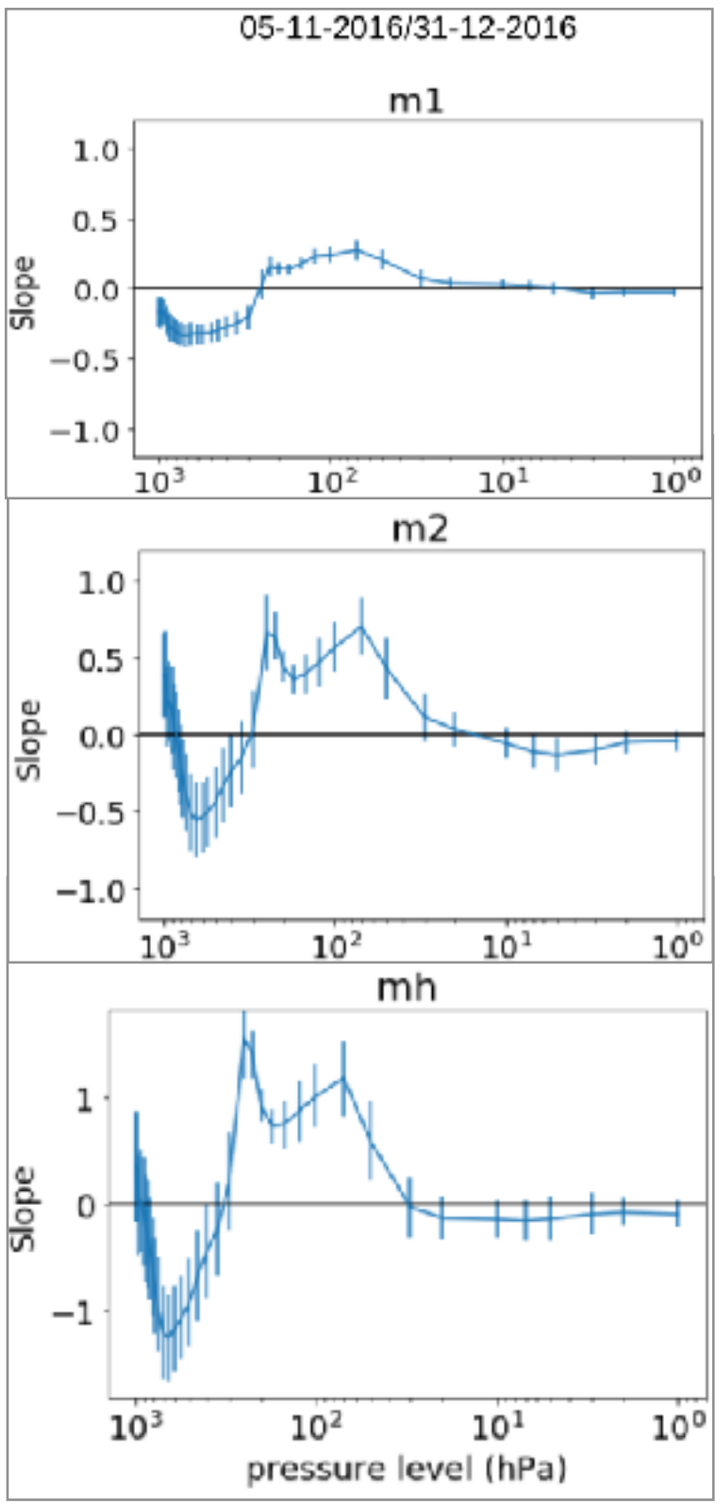
Period : 5.11.16 - 1.5.17

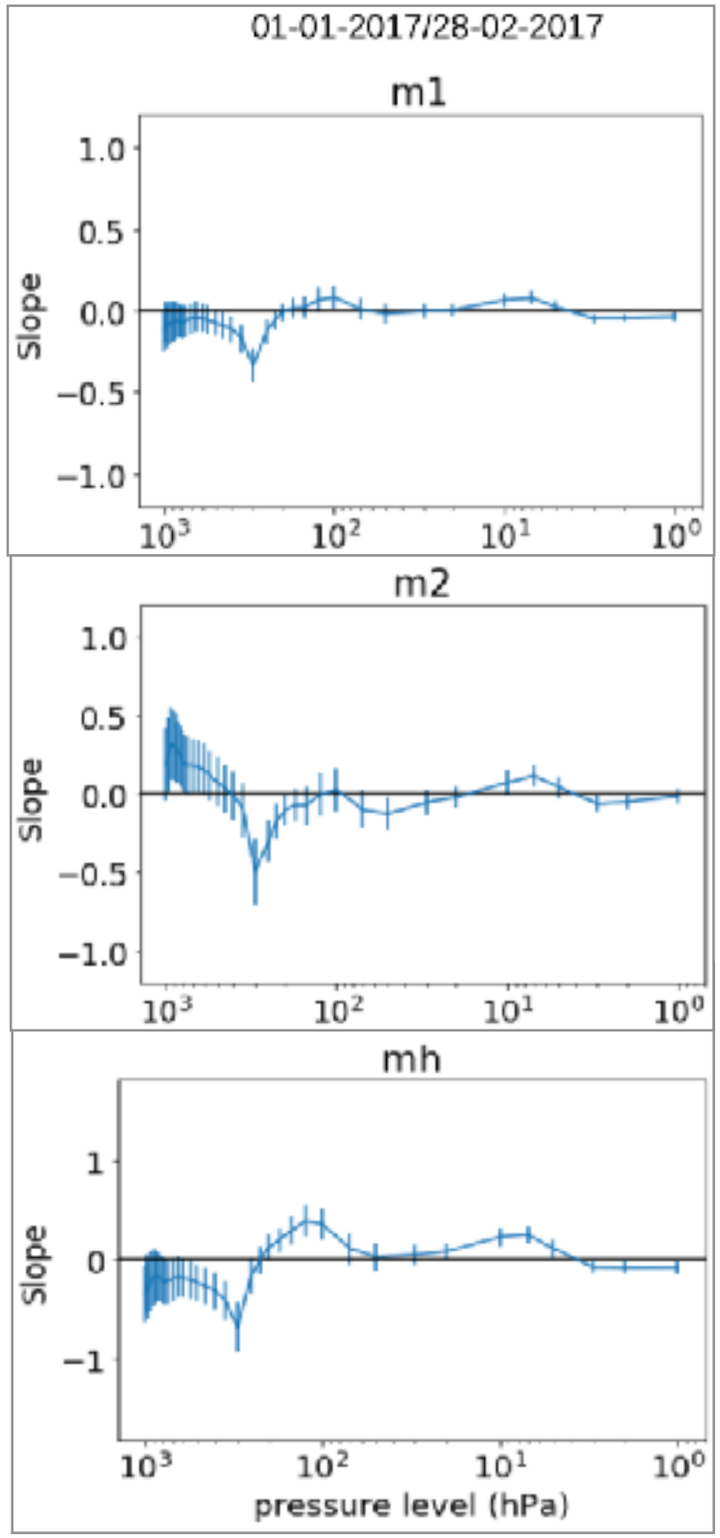
Singular points evolution

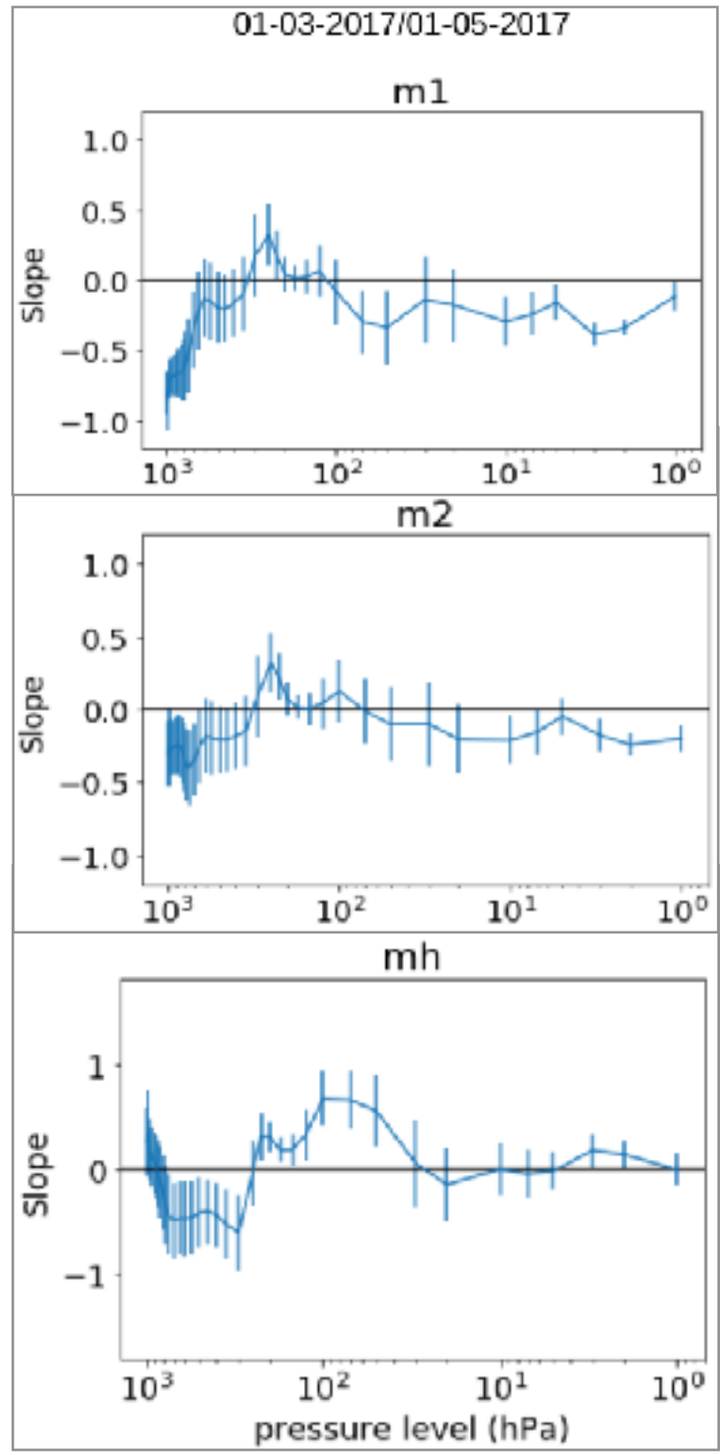


Slope analysis for M1, M2 and Mn

Separated analysis in 3 periods (2-day dN/N x dT slopes)

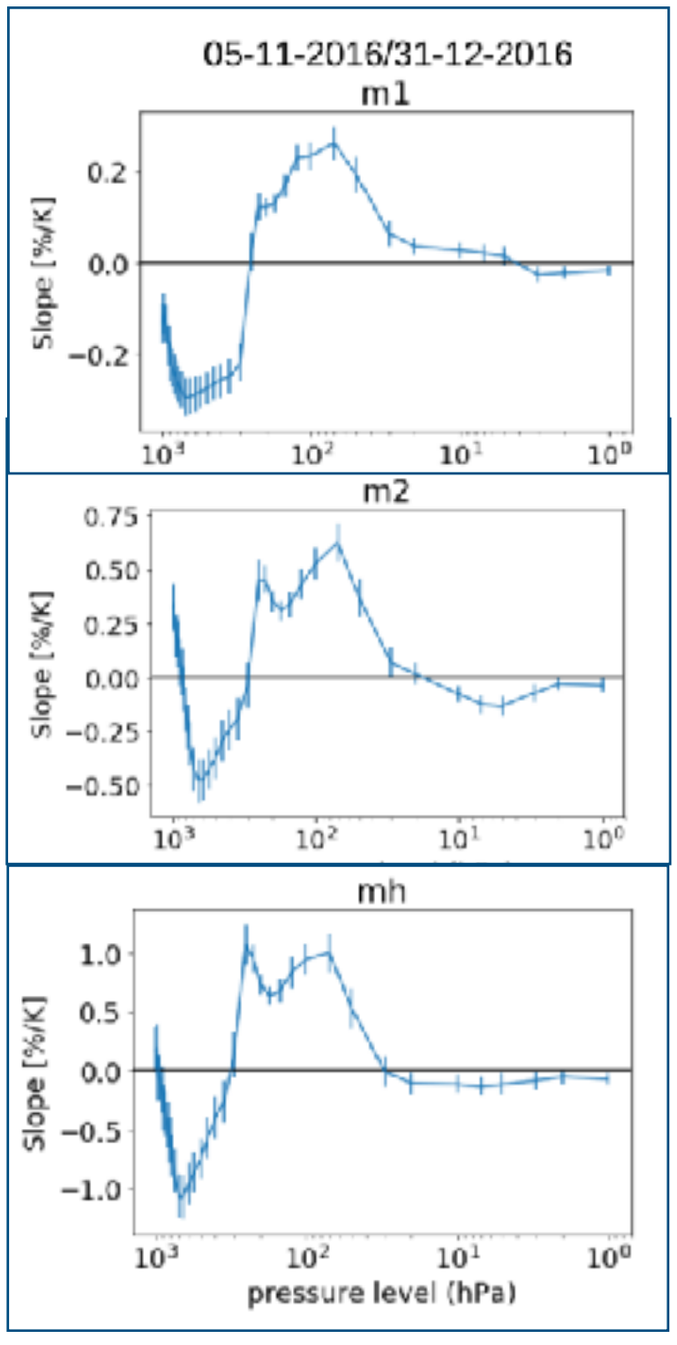


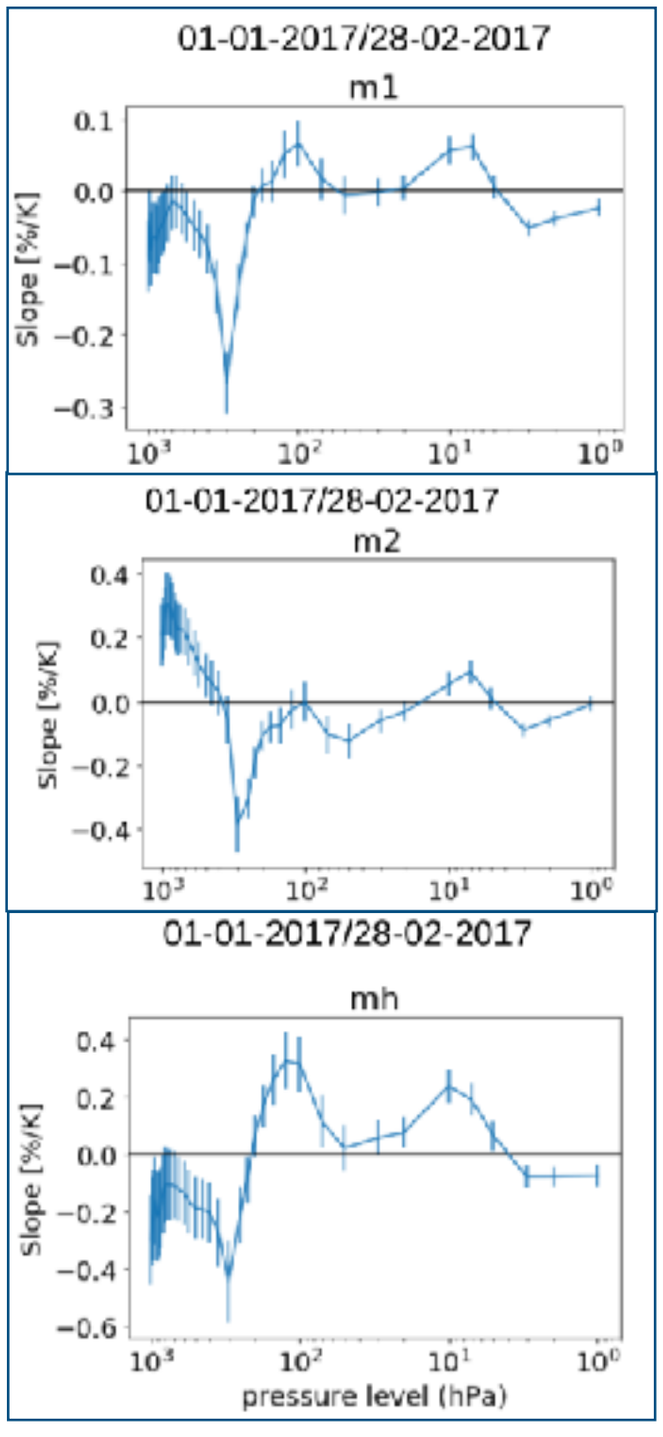


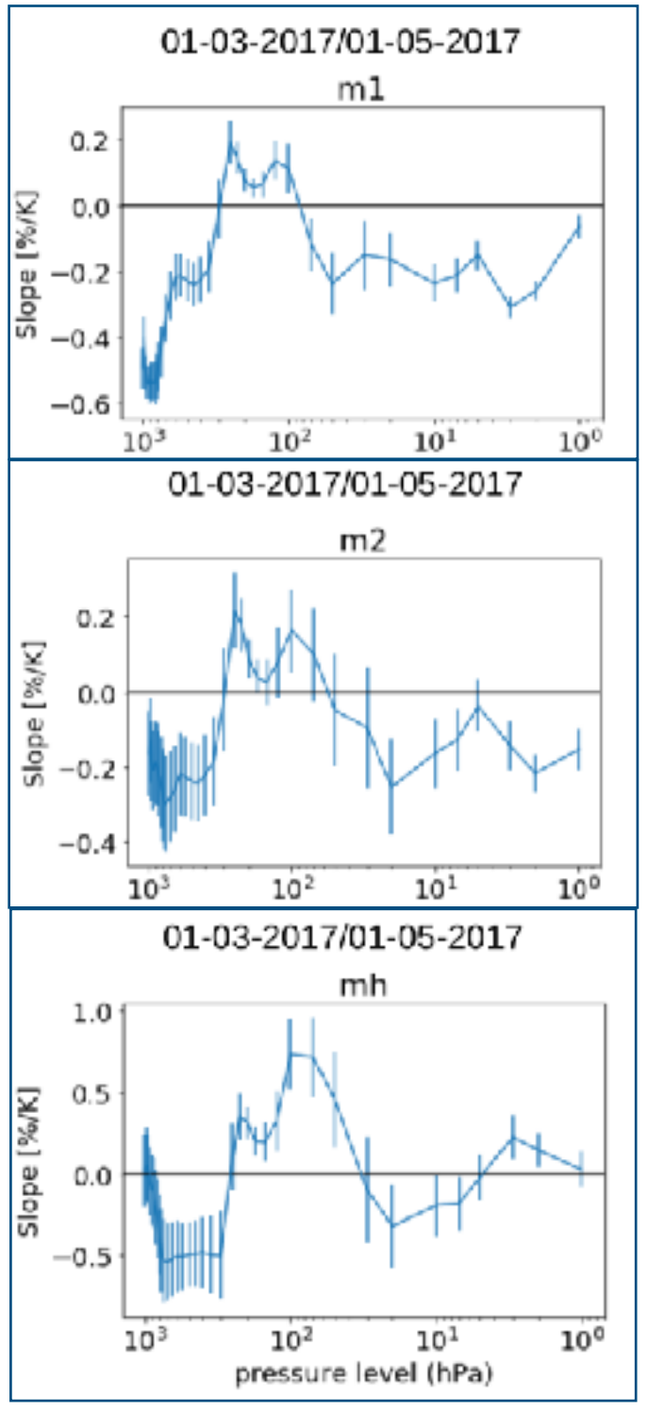


Slope analysis for M1, M2 and Mn

Separated analysis in 3 periods (6h dN/N x dT slopes)







Slope analysis for M1

Separated analysis in 3 periods
(using intermediate PCA analysis)