Stony Brook University
School of Marine and Atmospheric Sciences

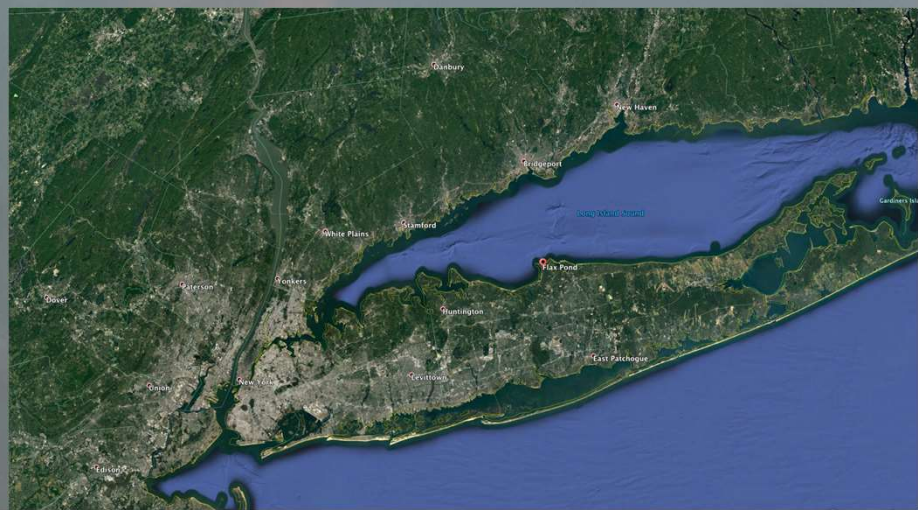
NESCAUM

NEW YORK STATE OF OPPORTUNITY. NYSERDA Supported

Observations of Volatile Organic Compounds during the Long Island Sound Tropospheric Ozone Study (LISTOS) and beyond

John E. Mak, Tim Christy, Cong Cao, Ziran Wei
School of Marine and Atmospheric Sciences, Stony Brook University, NY

April 10 2019



This work was supported in part by the New York State Energy Research and Development Authority under contract # 127262

During the summer of 2018 (late June-Sept) we used our high resolution PTR-TOFMS (Ionicon 8000) to characterize VOC abundances at Flax Pond Laboratory on the north shore of Long Island, which is now an EPA PAMS site operated by NYSDEC. With support from NESCAUM, those measurements were extended through the spring of 2019.

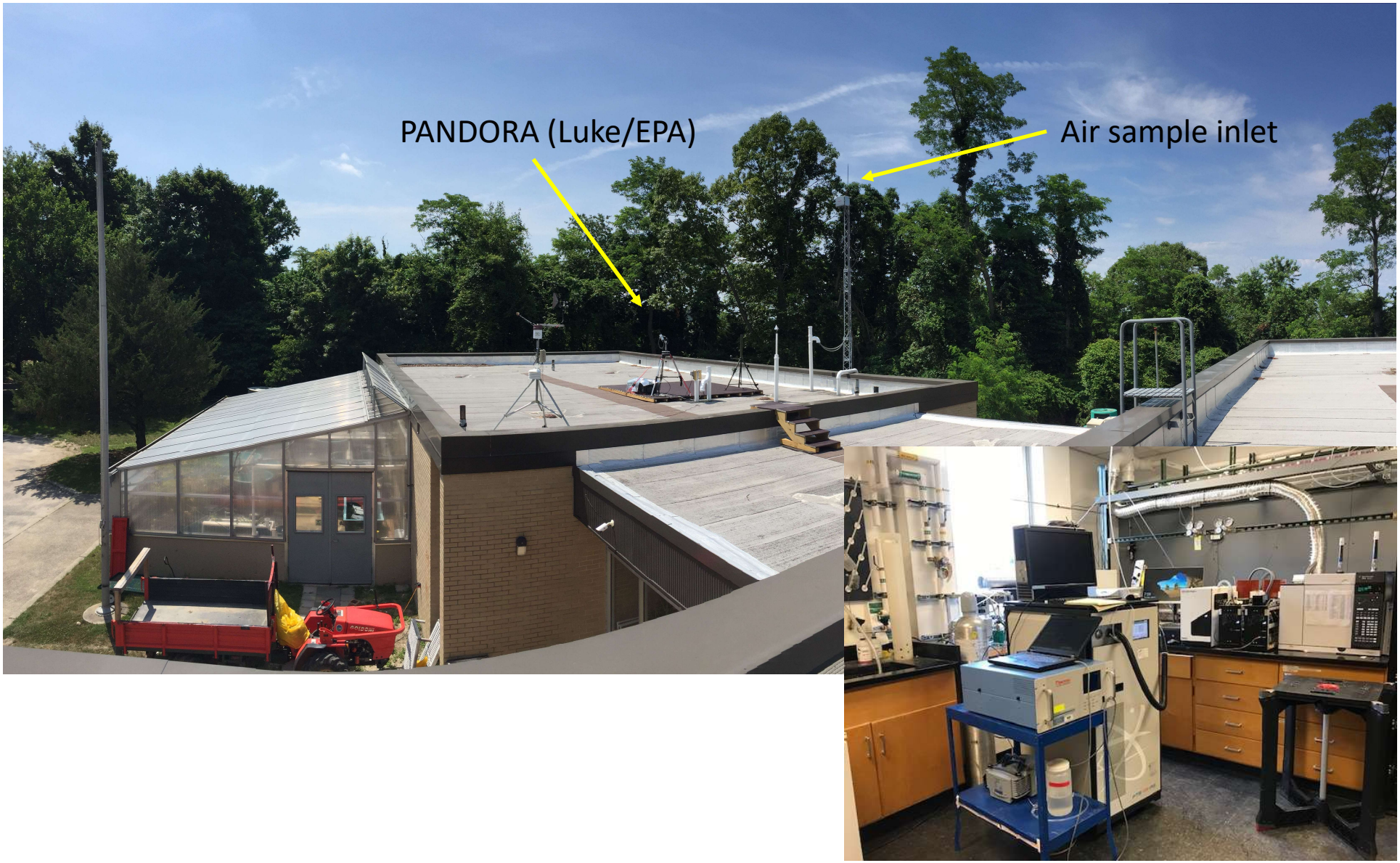
Scientific questions to be addressed (ultimately):

- What is the role of biogenic VOCs in the regional chemical processes leading to high O_3?
- What is the partitioning of biogenic vs anthropogenic VOCs?
- What are the optimal strategies for reducing episodic high O_3 in the Long Island Sound region?

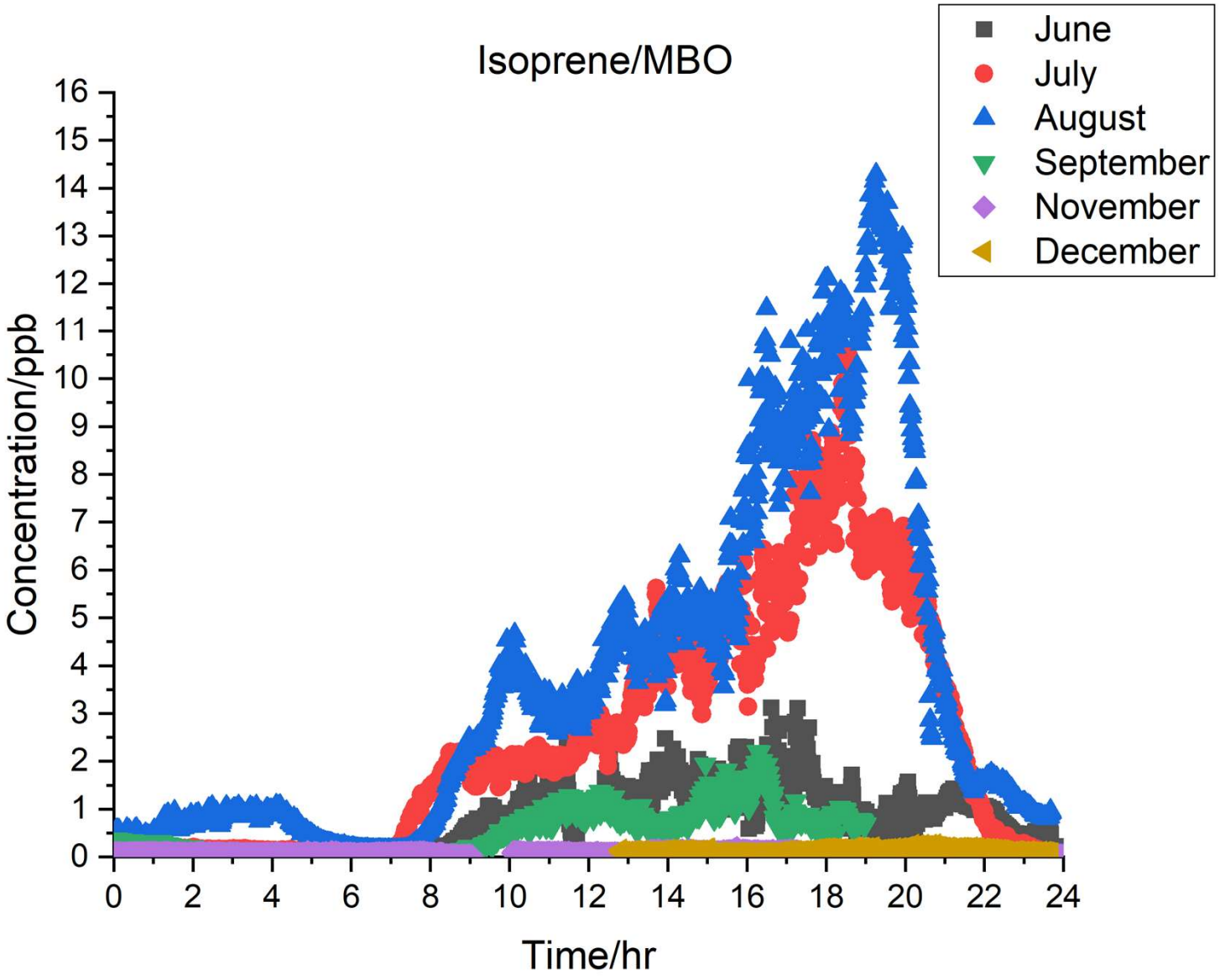
Ionicon PTR-TOFMS is useful for quantifying volatile species with a proton affinity greater than water; this includes alkenes and many oxygenated species. Typical mass range is up to about 300 amu. Fast response (not relevant for this study).

This work was supported by the New York State Energy Research and Development Authority under contract # 127262

Flax Pond Laboratory rooftop (looking west-ish)

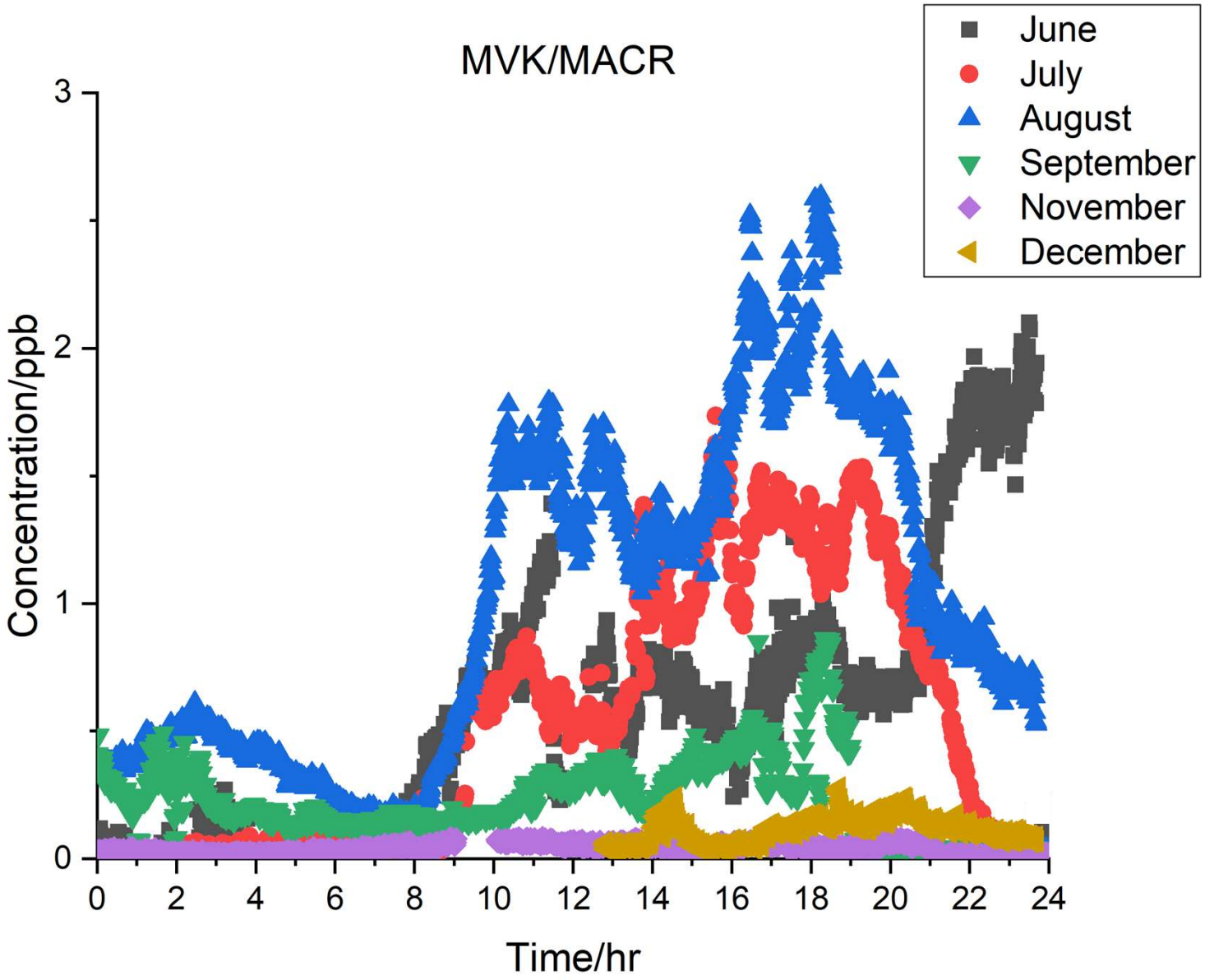



N

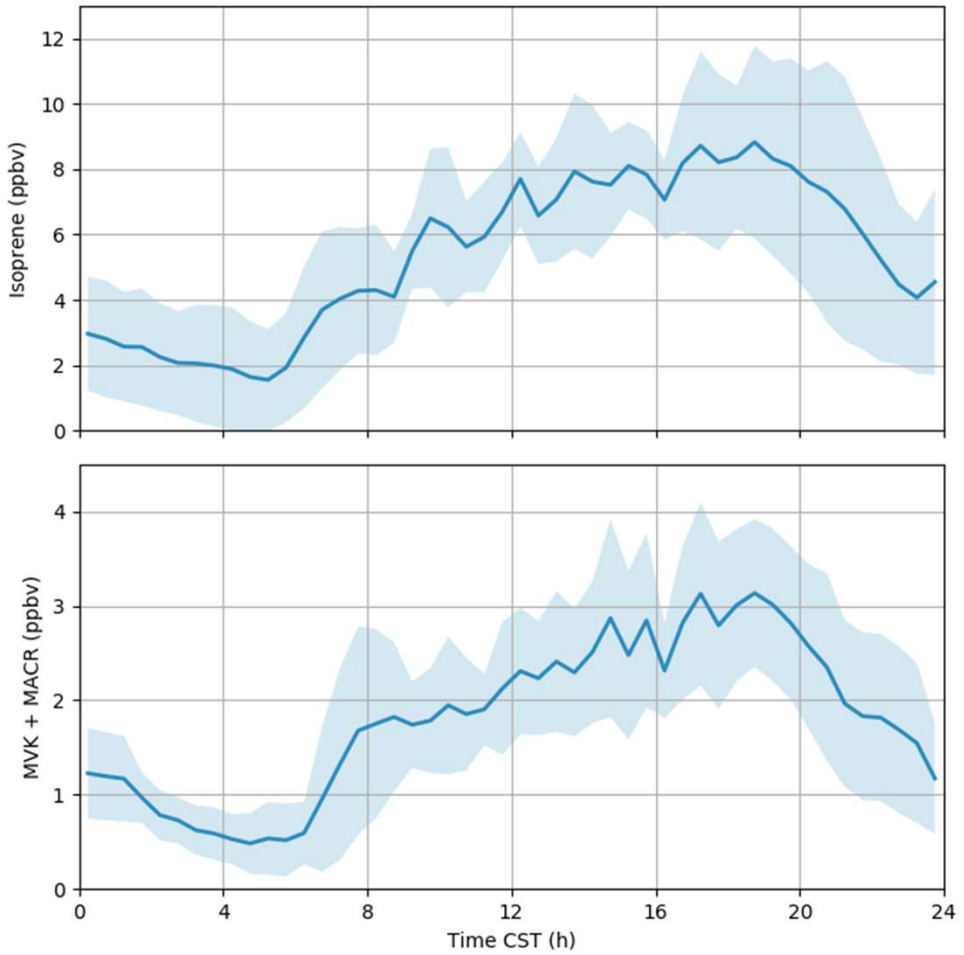


Isoprene/MBO were the most abundant species

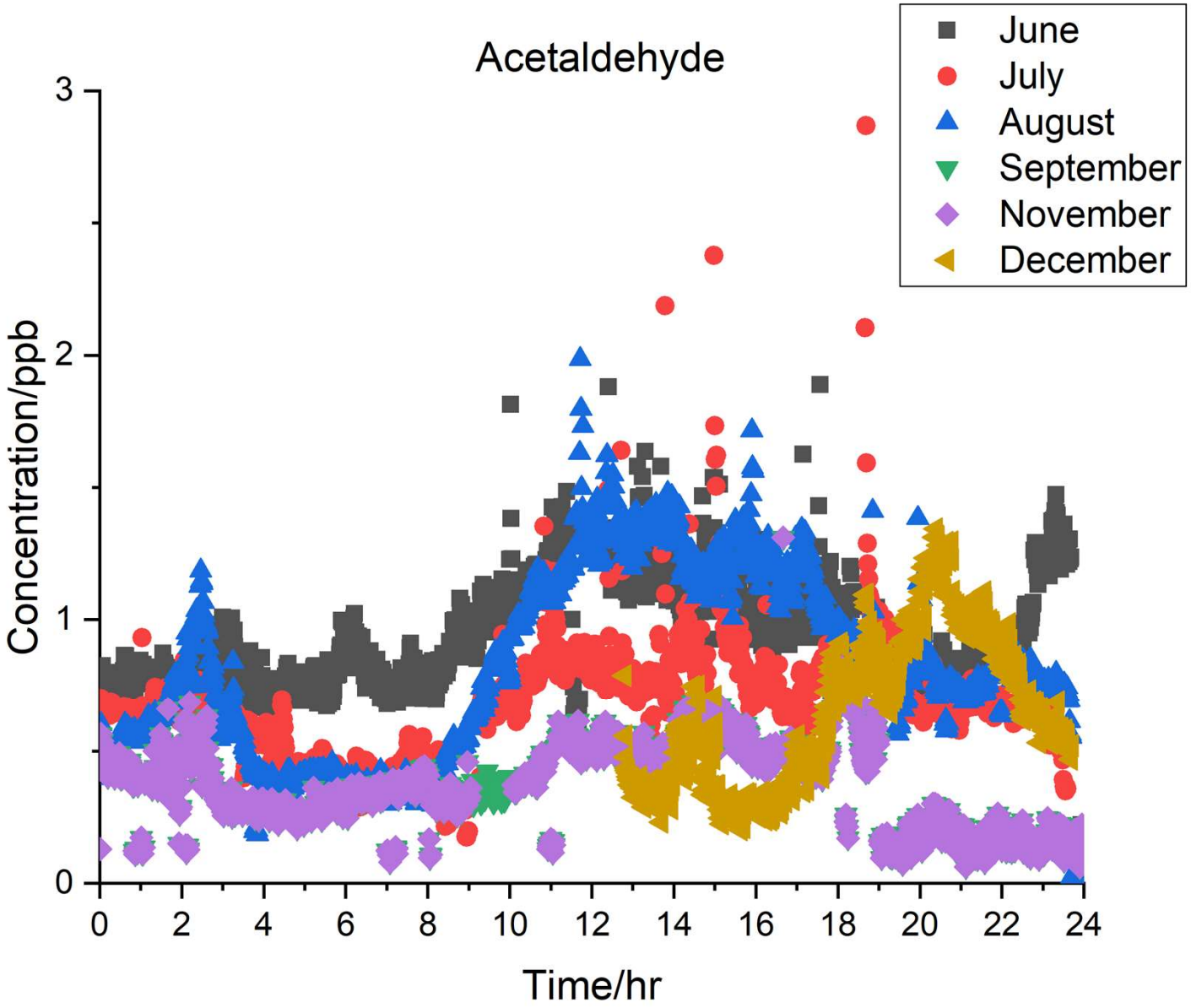
Methyl vinyl ketone/methacrolein: oxidation products of the terpenes/isoprene; SOA precursor

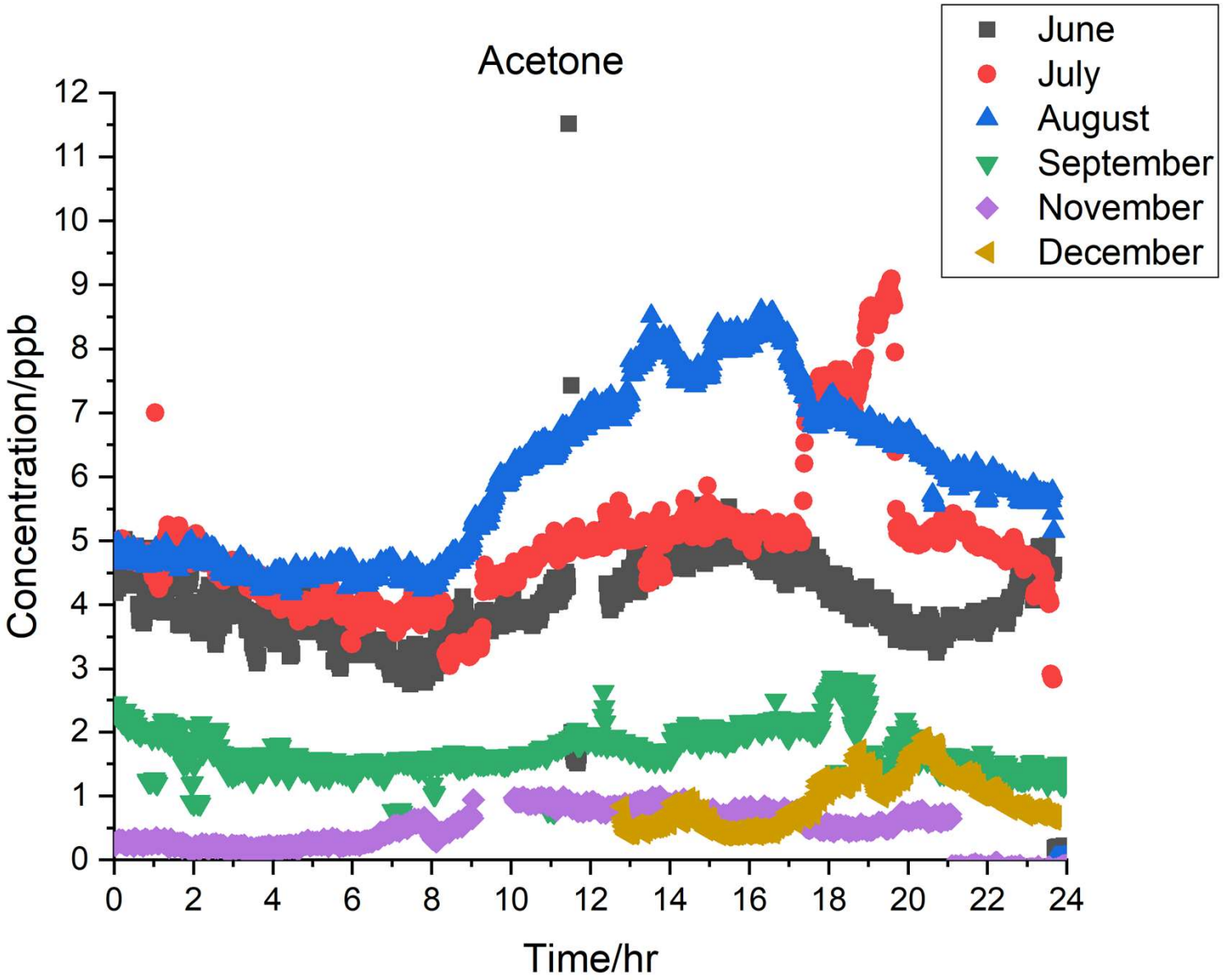


Top of canopy forested site (AABC)
SOAS, Alabama, summer 2013 (multiple day composite)

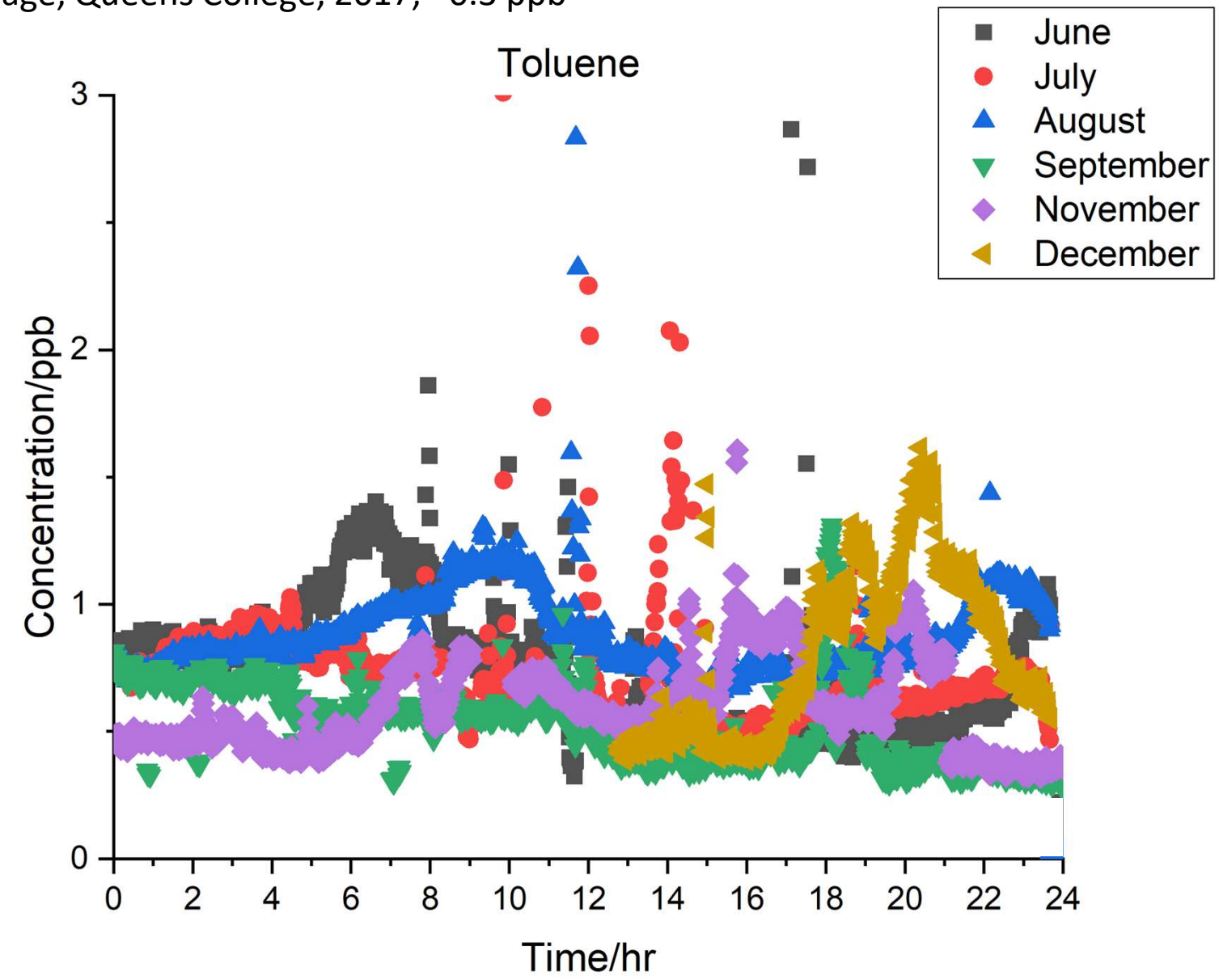


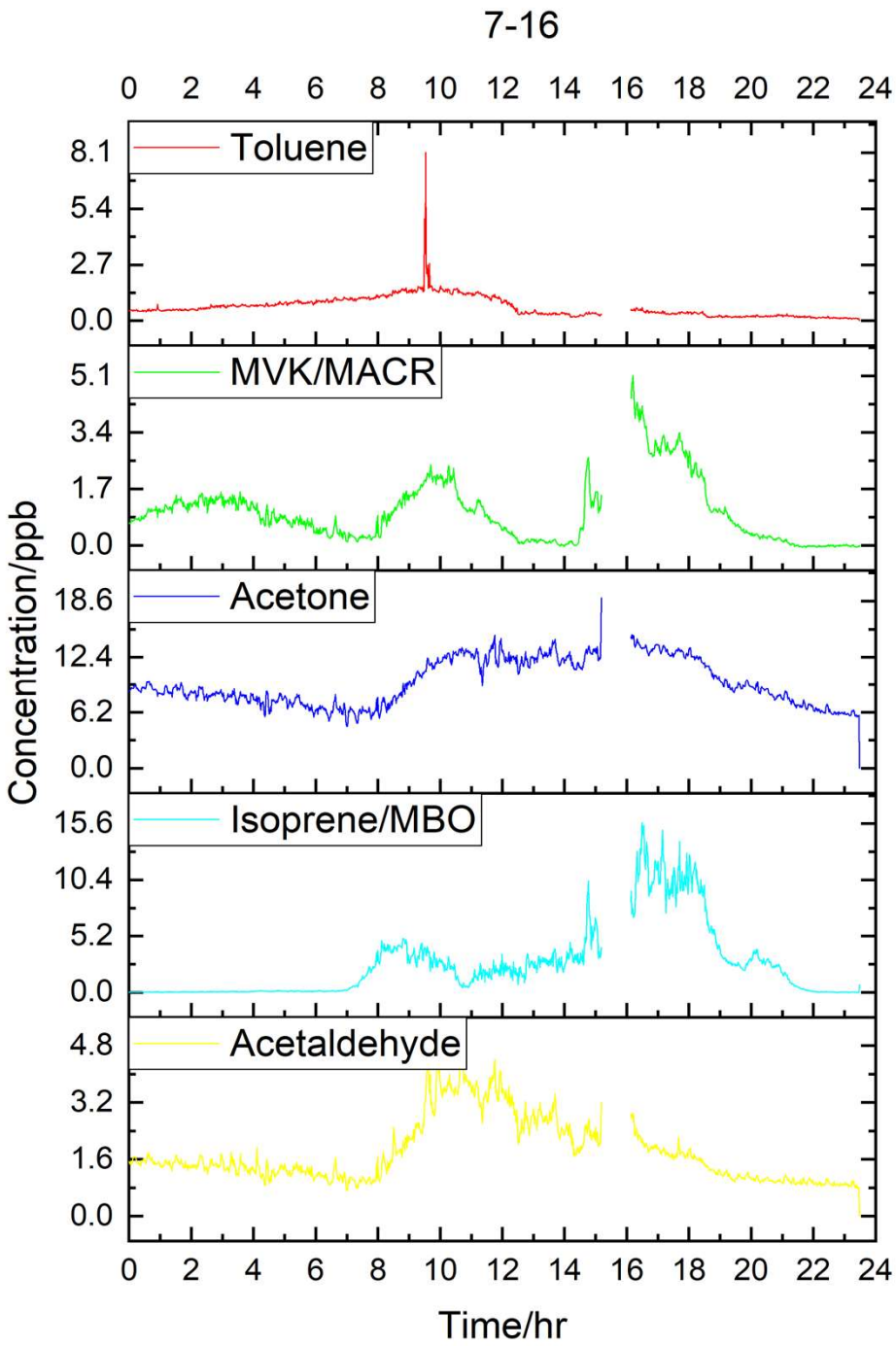
Annual average, Queens College, 2017, 1.6 ppb

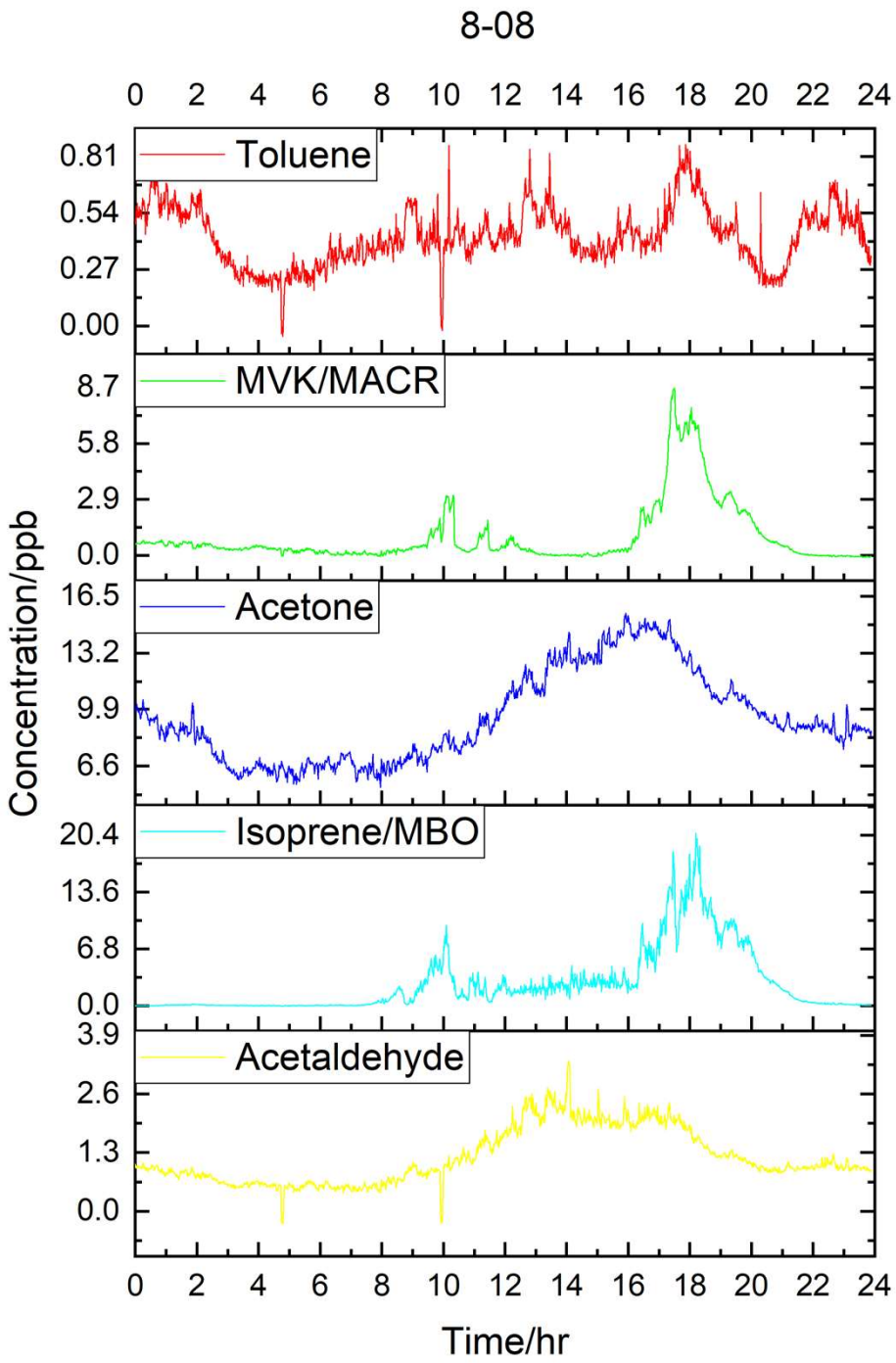


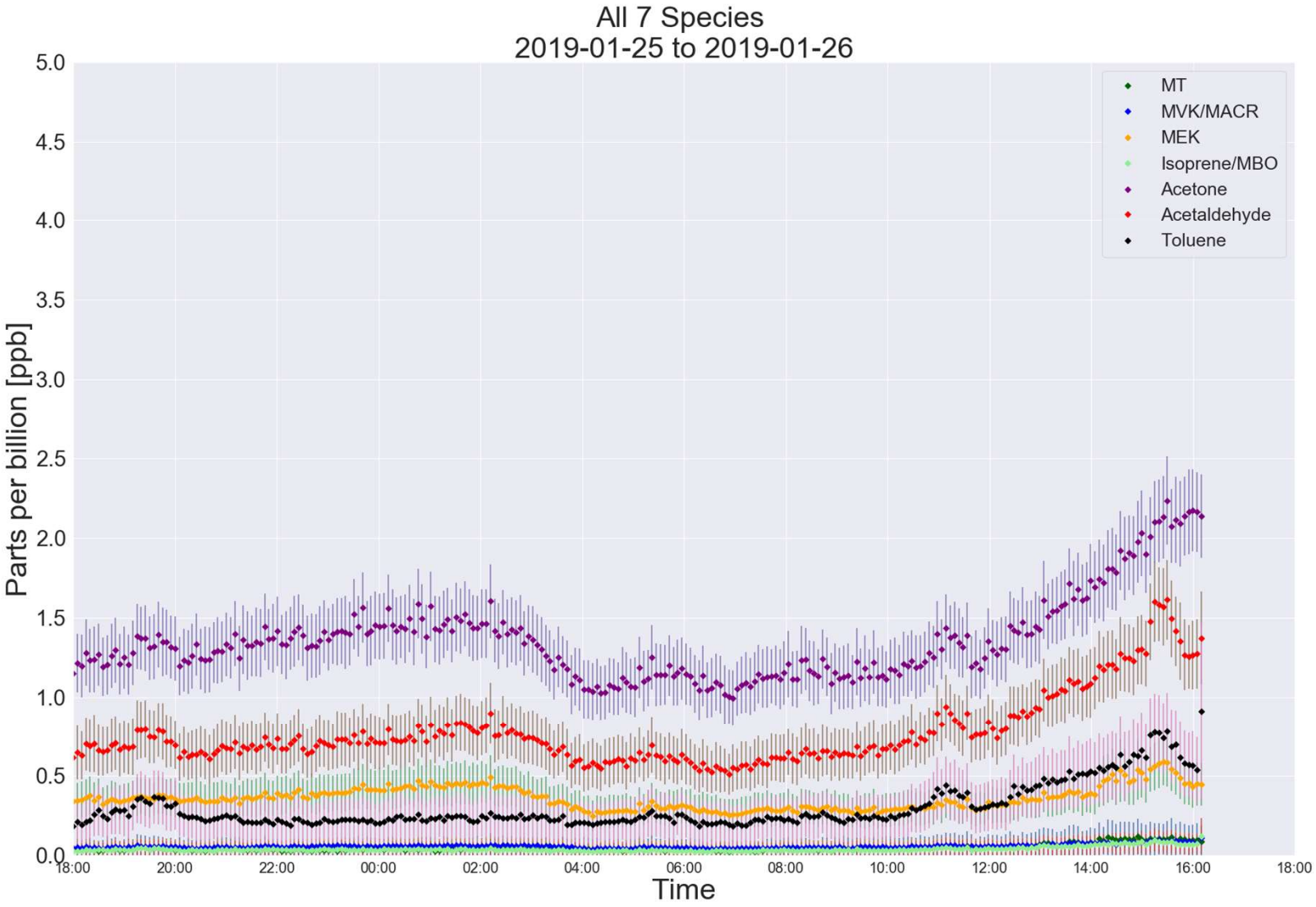

Acetone
June
July
August
September
November
December
Concentration/ppb
Time/hr
0
1
2
3
4
5
6
7
8
9
10
11
12
0
2
4
6
8
10
12
14
16
18
20
22
24

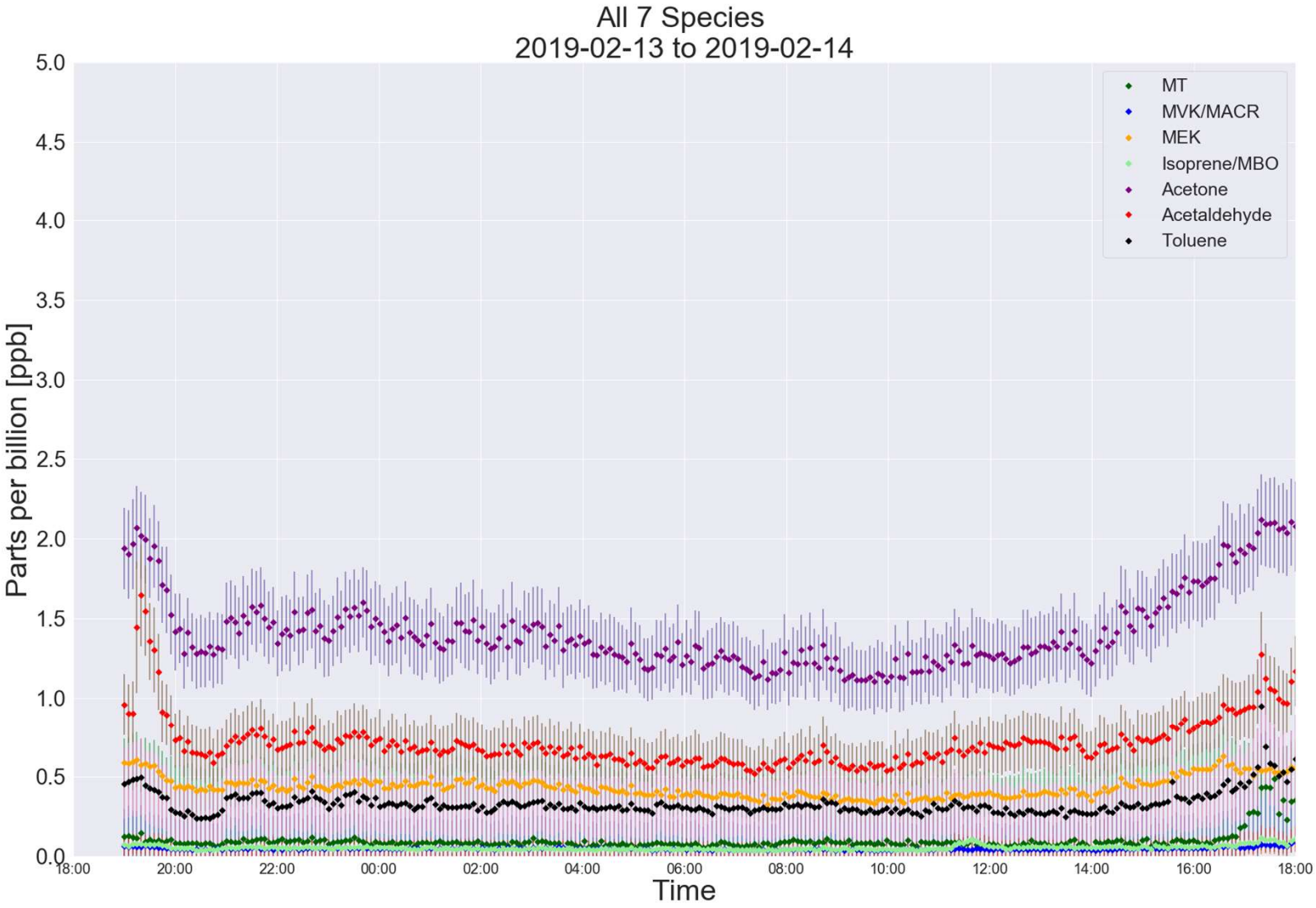
Annual average, Queens College, 2017, ~0.3 ppb

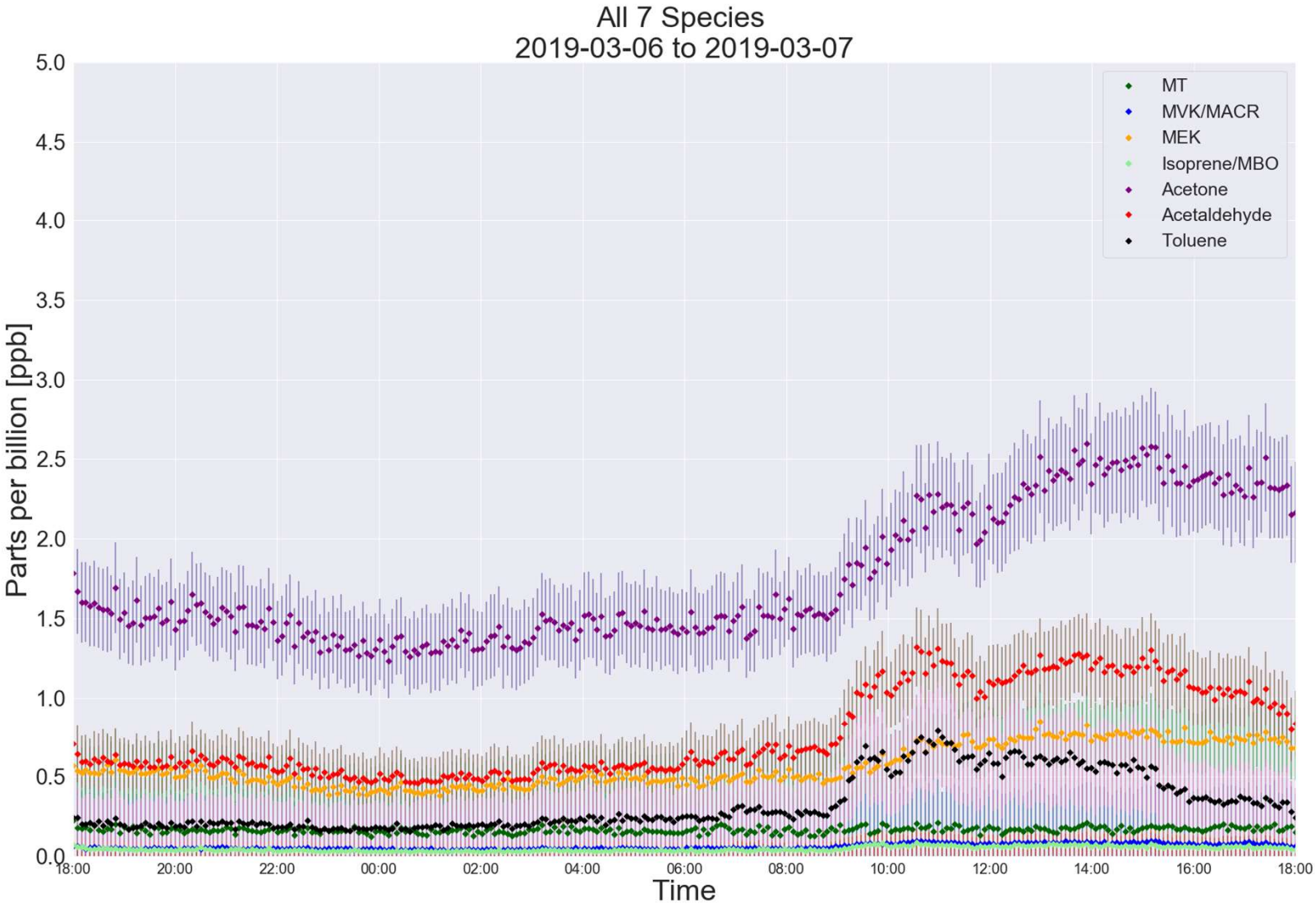


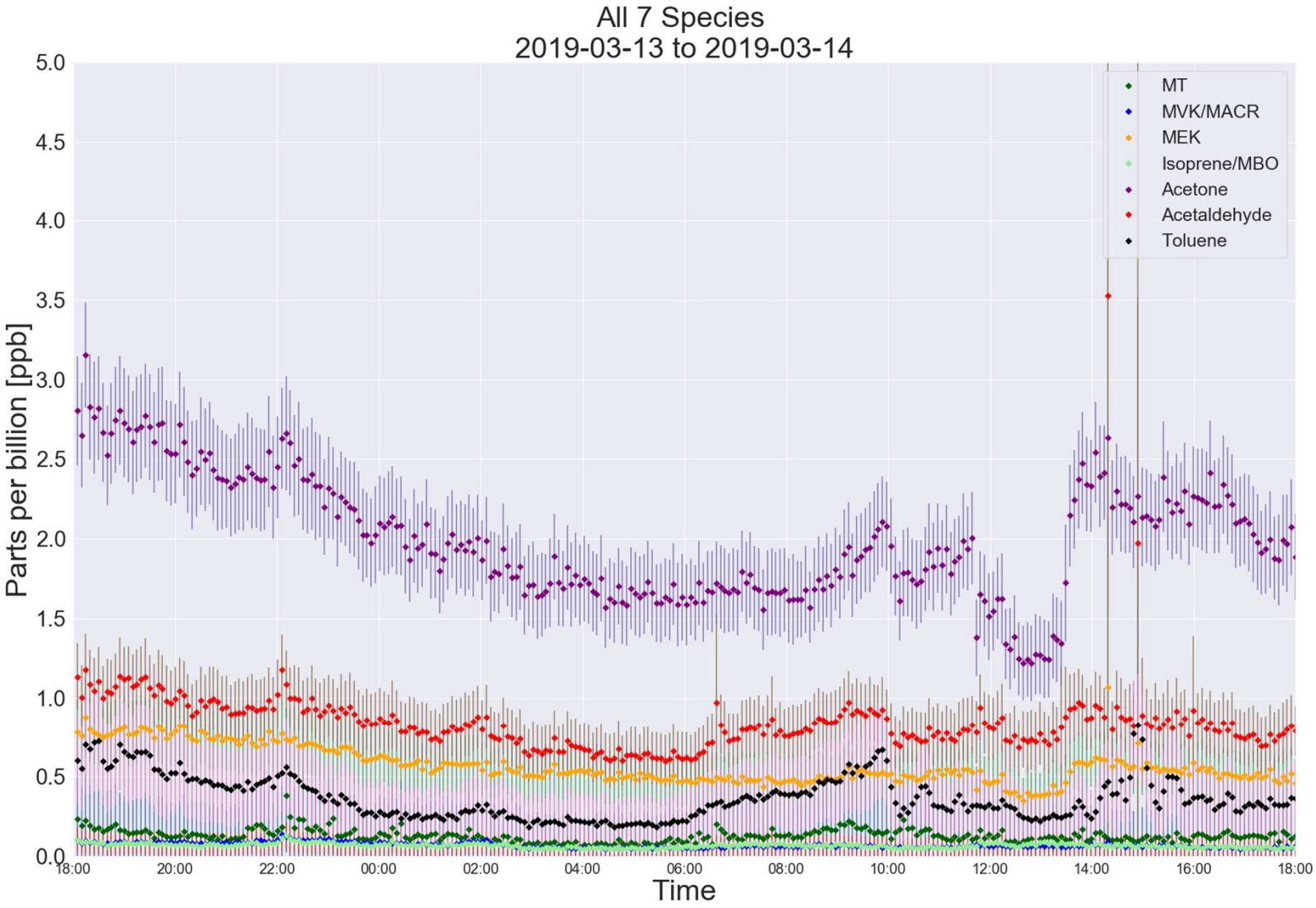

7-16
Toluene
MVK/MACR
Acetone
Isoprene/MBO
Acetaldehyde
Concentration/ppb
Time/hr
0 2 4 6 8 10 12 14 16 18 20 22 24
8.1 5.4 2.7 0.0
5.1 3.4 1.7 0.0
18.6 12.4 6.2 0.0
15.6 10.4 5.2 0.0
4.8 3.2 1.6 0.0


8-08
0 2 4 6 8 10 12 14 16 18 20 22 24
Toluene
0.81
0.54
0.27
0.00
MVK/MACR
8.7
5.8
2.9
0.0
Acetone
16.5
13.2
9.9
6.6
Isoprene/MBO
20.4
13.6
6.8
0.0
Acetaldehyde
3.9
2.6
1.3
0.0
Concentration/ppb
Time/hr


All 7 Species
2019-01-25 to 2019-01-26
Parts per billion [ppb]
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
18:00
20:00
22:00
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
Time
MT
MVK/MACR
MEK
Isoprene/MBO
Acetone
Acetaldehyde
Toluene


All 7 Species
2019-02-13 to 2019-02-14
Parts per billion [ppb]
Time
MT
MVK/MACR
MEK
Isoprene/MBO
Acetone
Acetaldehyde
Toluene
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
18:00
20:00
22:00
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00


All 7 Species
2019-03-06 to 2019-03-07
Parts per billion [ppb]
Time
MT
MVK/MACR
MEK
Isoprene/MBO
Acetone
Acetaldehyde
Toluene
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
18:00
20:00
22:00
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00

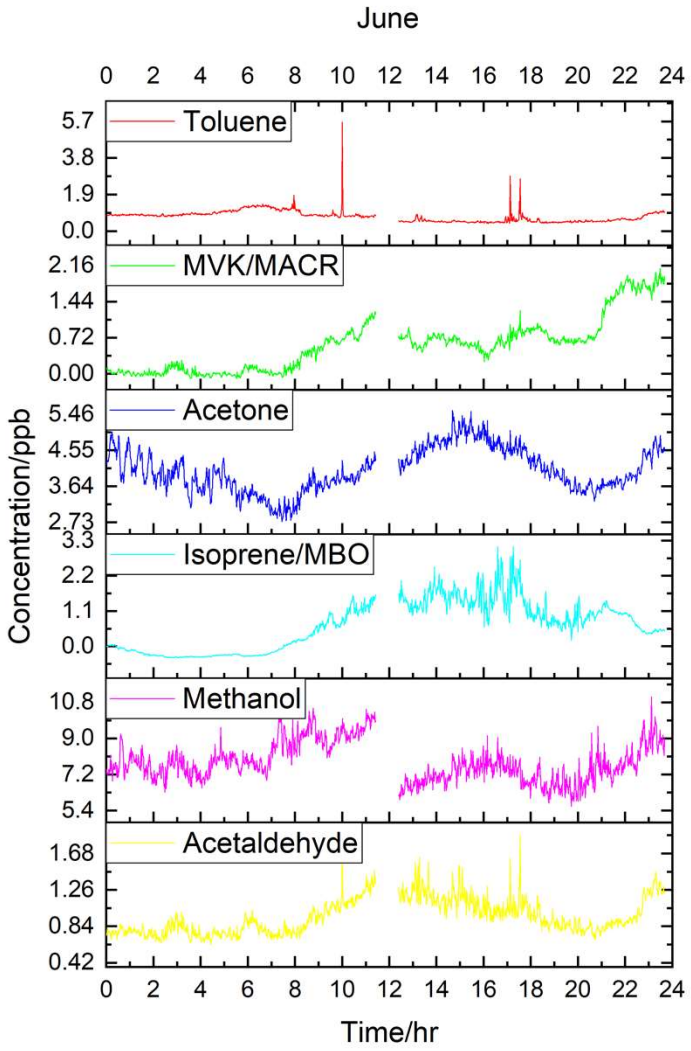

All 7 Species
2019-03-13 to 2019-03-14
Parts per billion [ppb]
Time
MT
MVK/MACR
MEK
Isoprene/MBO
Acetone
Acetaldehyde
Toluene
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
18:00
20:00
22:00
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00

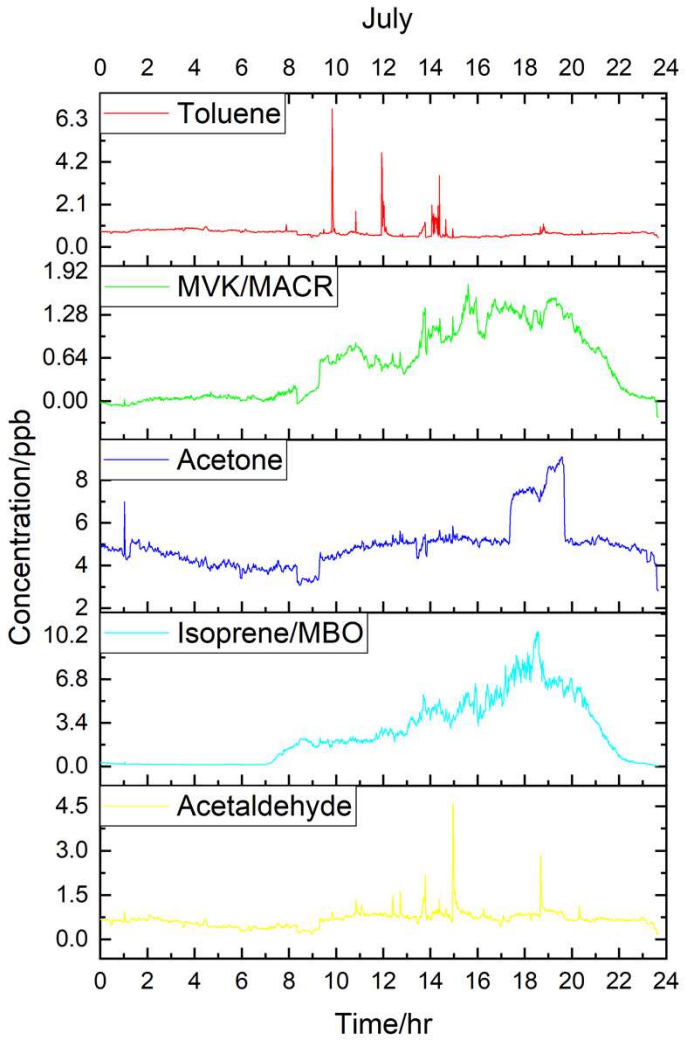
Biogenic VOC concentrations at Flax, within canopy, are very high during the summer.
[Isoprene] is among the highest in-canopy isoprene concentrations observed in the US.
[MVK/MACR]:[C5H8] may indicate significant SOA formation.

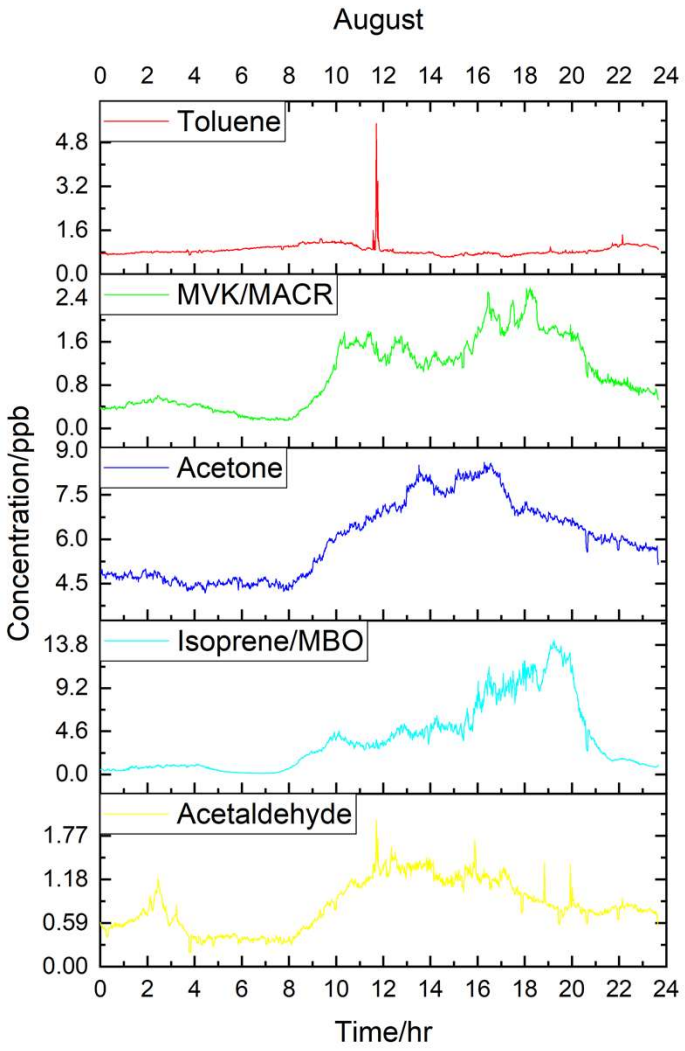
We see significant levels of acetone and toluene during nonsummer months.
Other species can be quantified.
All VOC data are available to the community. Just ask us and we can send it to you.
John.mak@stonybrook.edu

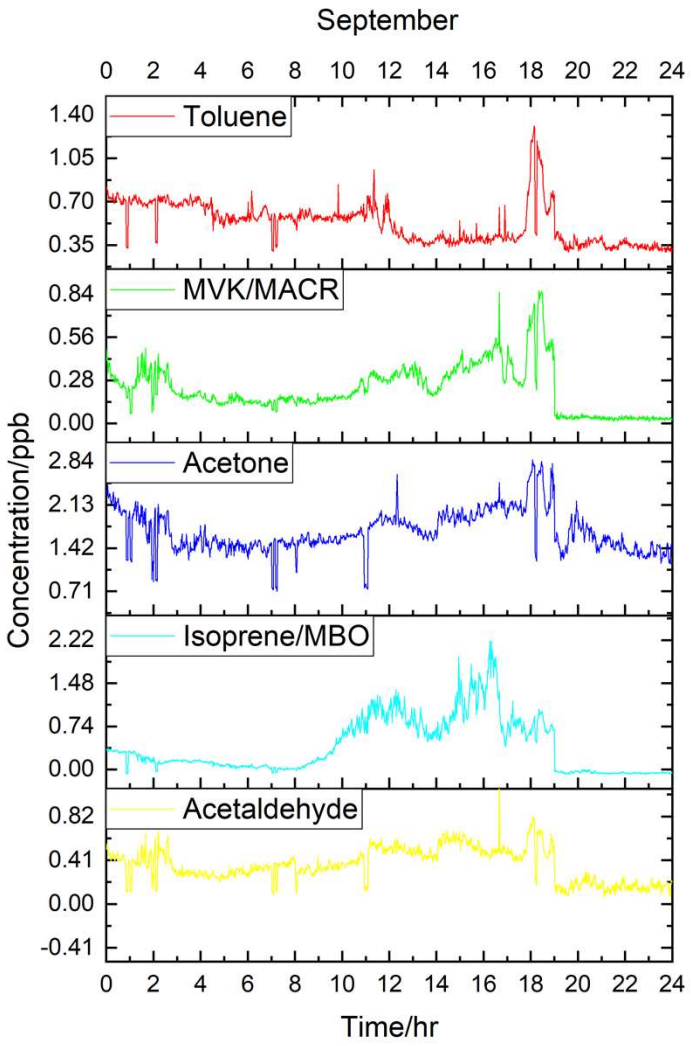
We also plan to upload data sets to the NASA archiving site.

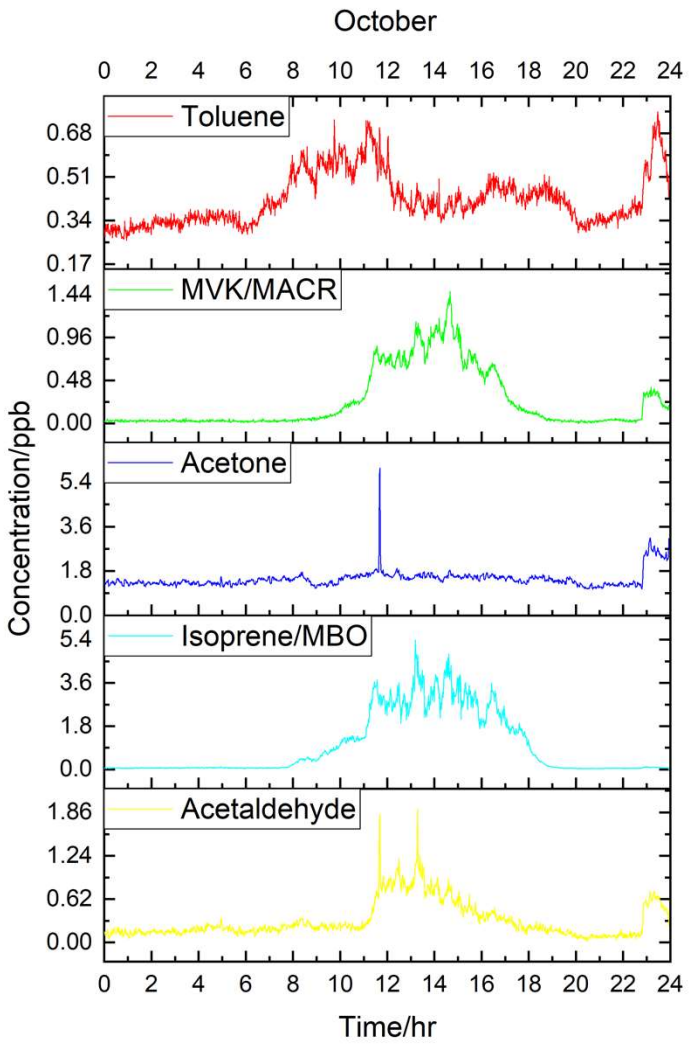
Currently we have no plans to operate the PTRTOFMS at Flax in the summer 2019.

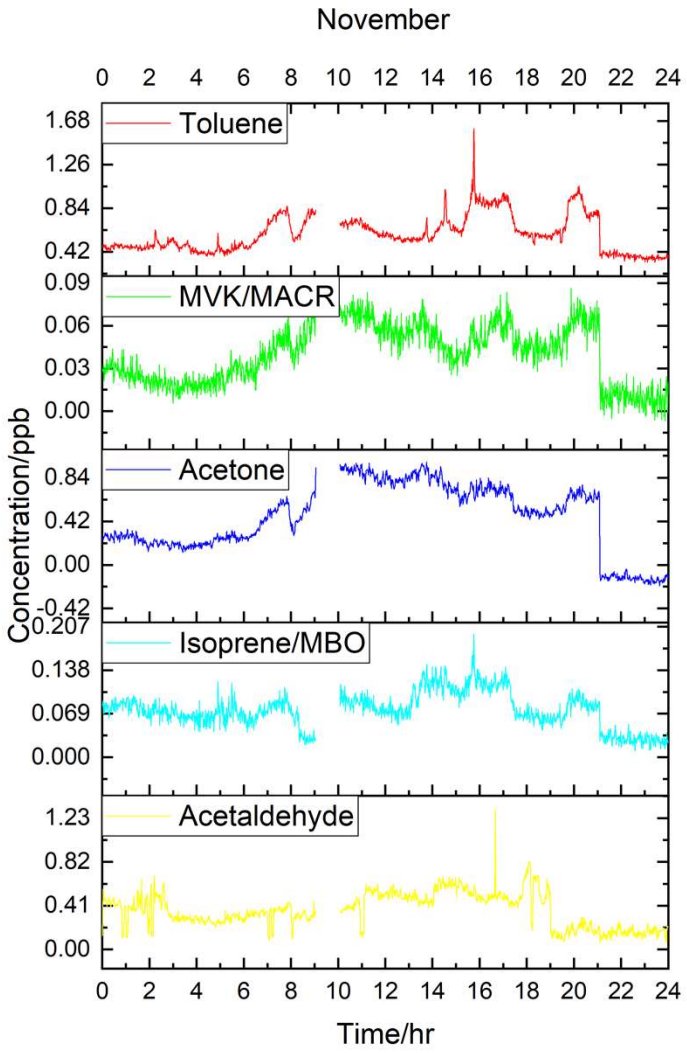

June
0 2 4 6 8 10 12 14 16 18 20 22 24
Toluene
5.7
3.8
1.9
0.0
MVK/MACR
2.16
1.44
0.72
0.00
Acetone
5.46
4.55
3.64
2.73
Isoprene/MBO
3.3
2.2
1.1
0.0
Methanol
10.8
9.0
7.2
5.4
Acetaldehyde
1.68
1.26
0.84
0.42
Concentration/ppb
Time/hr

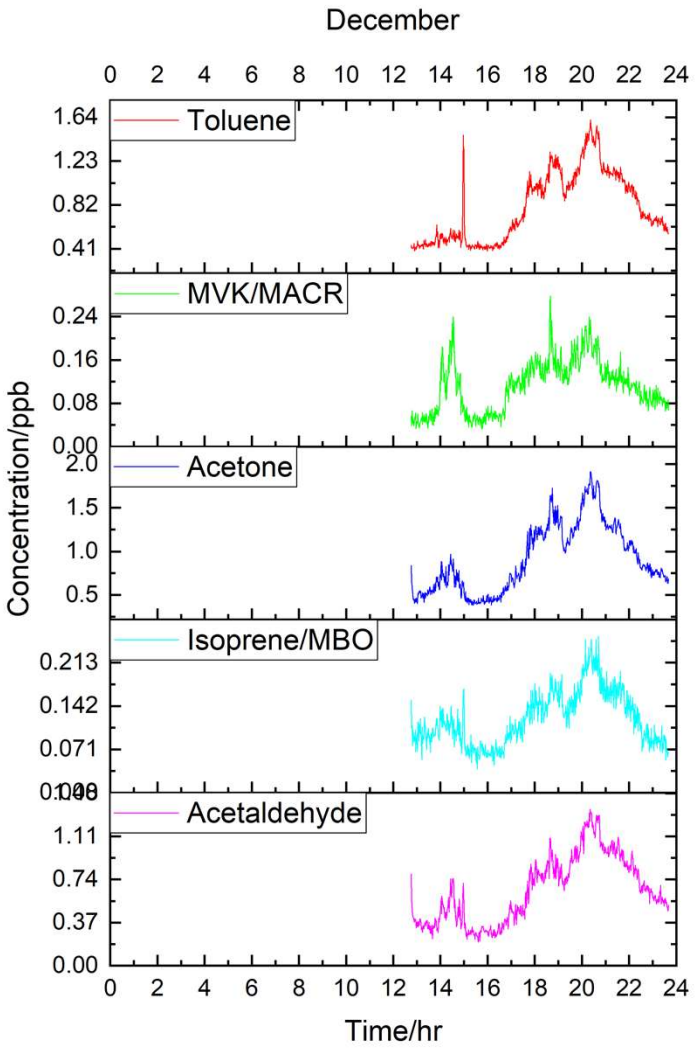

July
0 2 4 6 8 10 12 14 16 18 20 22 24
Toluene
6.3
4.2
2.1
0.0
MVK/MACR
1.92
1.28
0.64
0.00
Acetone
8
6
4
2
Isoprene/MBO
10.2
6.8
3.4
0.0
Acetaldehyde
4.5
3.0
1.5
0.0
Concentration/ppb
Time/hr

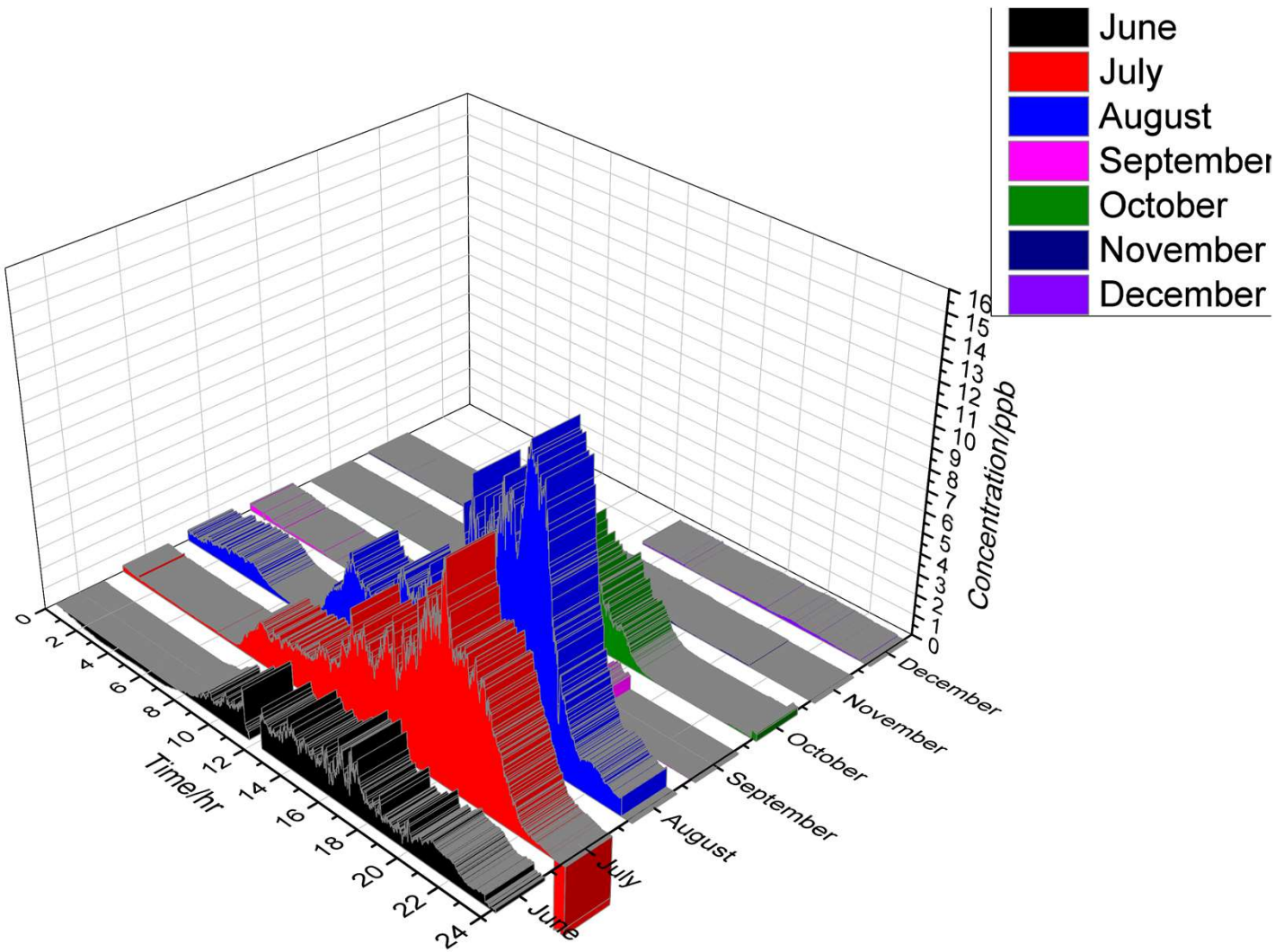

August
Toluene
MVK/MACR
Acetone
Isoprene/MBO
Acetaldehyde
Concentration/ppb
Time/hr
0 2 4 6 8 10 12 14 16 18 20 22 24
4.8
3.2
1.6
0.0
2.4
1.6
0.8
0.0
9.0
7.5
6.0
4.5
13.8
9.2
4.6
0.0
1.77
1.18
0.59
0.00

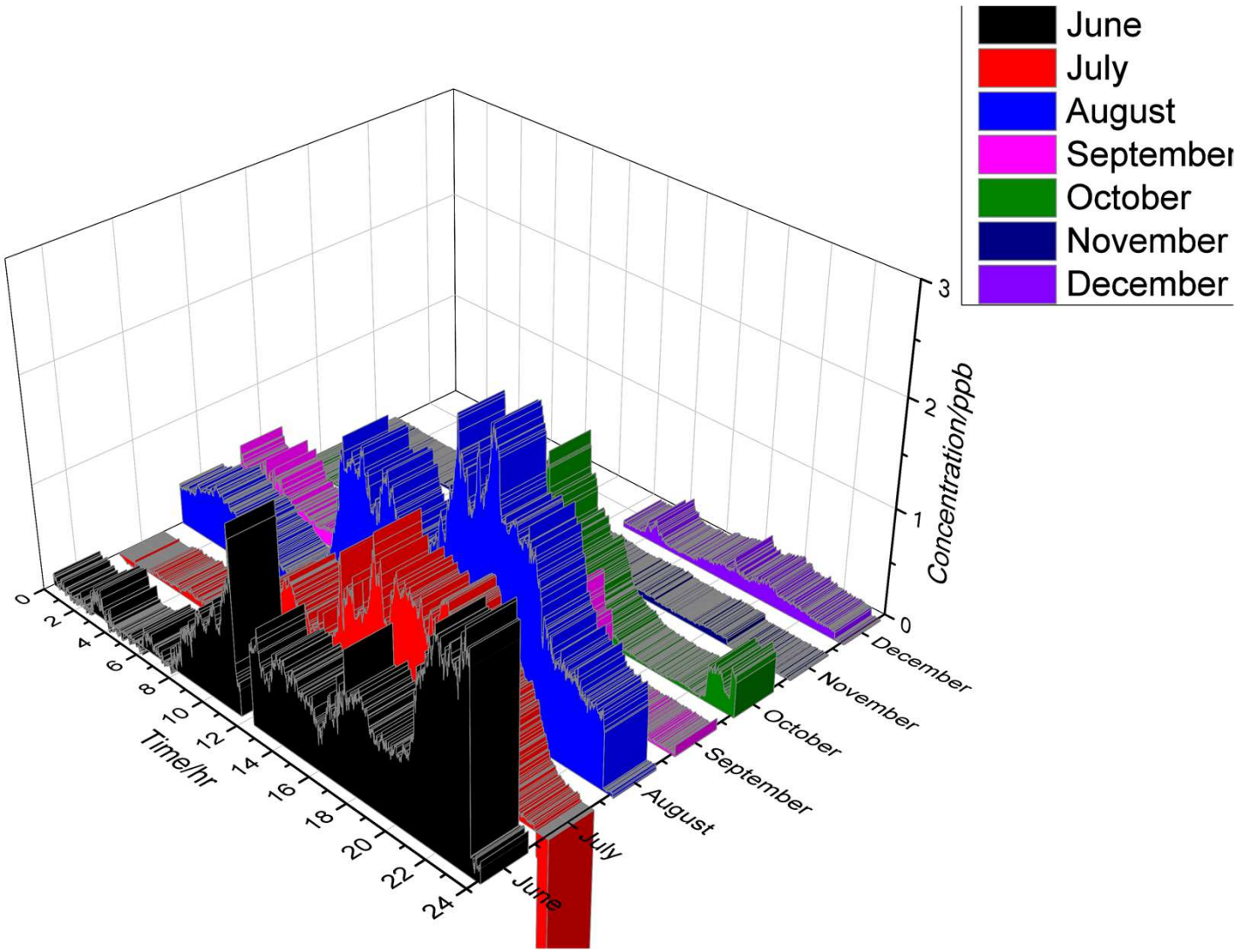

September
0 2 4 6 8 10 12 14 16 18 20 22 24
Toluene
1.40
1.05
0.70
0.35
MVK/MACR
0.84
0.56
0.28
0.00
Acetone
2.84
2.13
1.42
0.71
Isoprene/MBO
2.22
1.48
0.74
0.00
Acetaldehyde
0.82
0.41
0.00
-0.41
Concentration/ppb
Time/hr

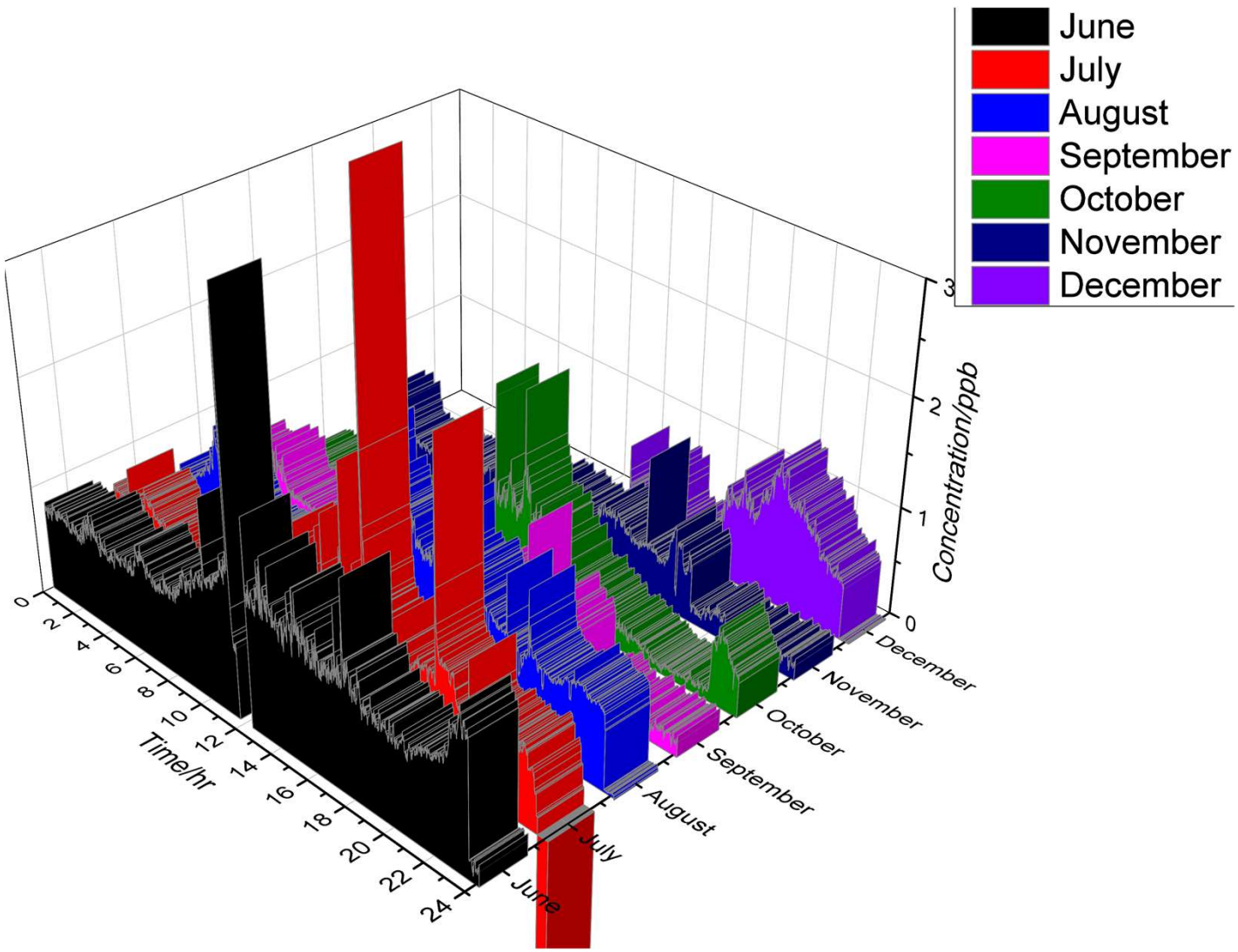

October
0 2 4 6 8 10 12 14 16 18 20 22 24
Toluene
0.68
0.51
0.34
0.17
MVK/MACR
1.44
0.96
0.48
0.00
Acetone
5.4
3.6
1.8
0.0
Isoprene/MBO
5.4
3.6
1.8
0.0
Acetaldehyde
1.86
1.24
0.62
0.00
Concentration/ppb
0 2 4 6 8 10 12 14 16 18 20 22 24
Time/hr

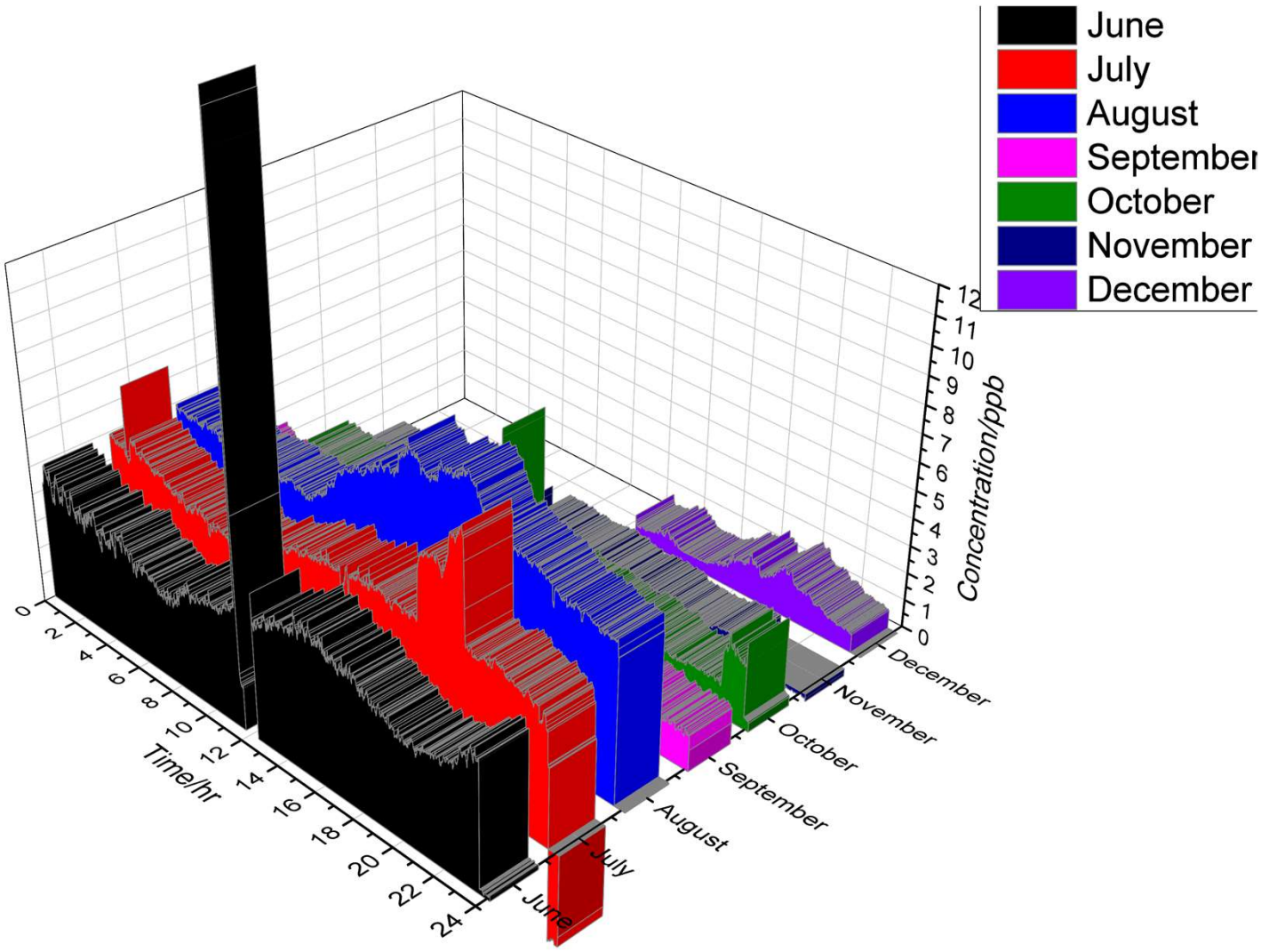

November
0 2 4 6 8 10 12 14 16 18 20 22 24
Toluene
1.68
1.26
0.84
0.42
MVK/MACR
0.09
0.06
0.03
0.00
Acetone
0.84
0.42
0.00
-0.42
Isoprene/MBO
0.207
0.138
0.069
0.000
Acetaldehyde
1.23
0.82
0.41
0.00
Concentration/ppb
Time/hr

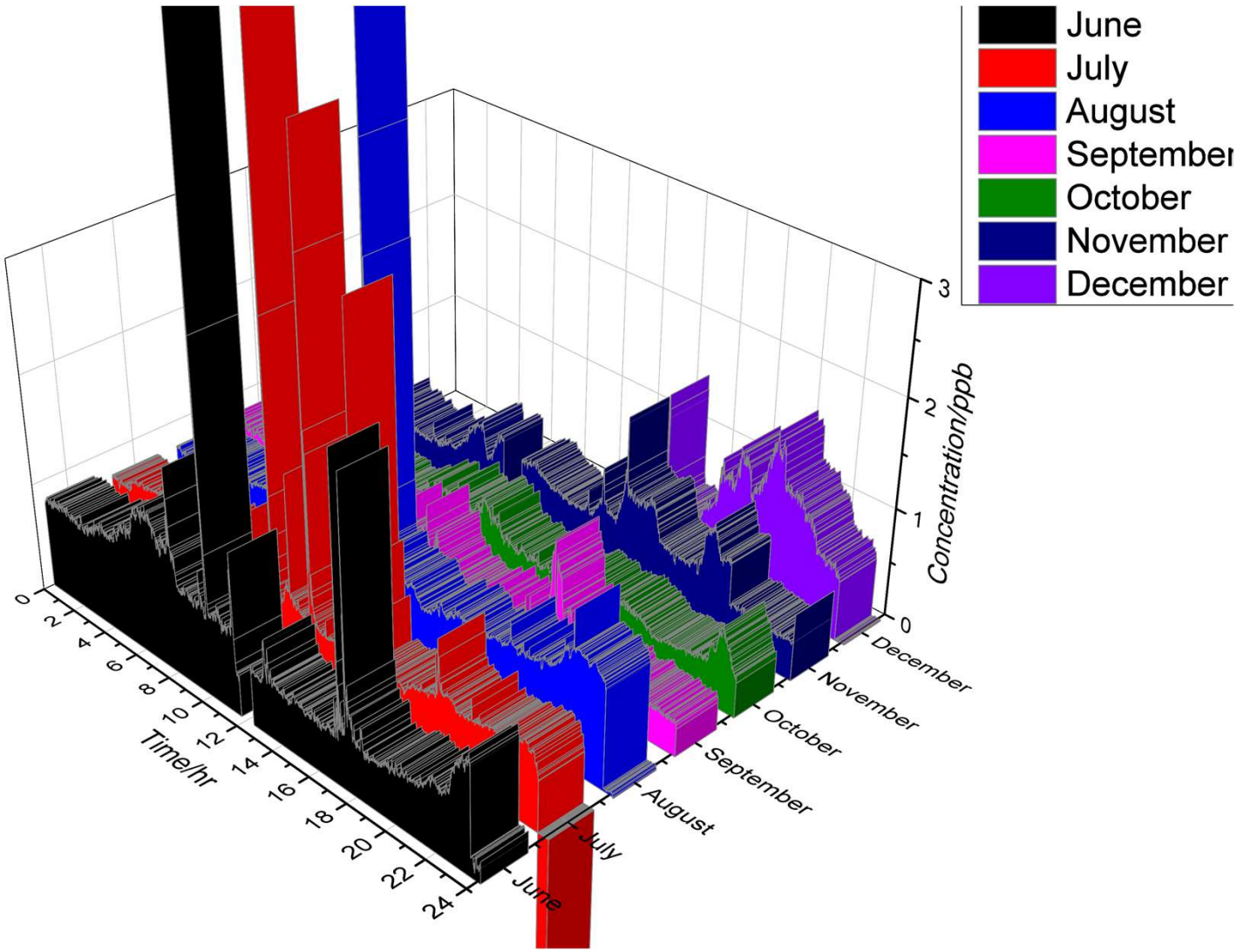

December
0 2 4 6 8 10 12 14 16 18 20 22 24
Toluene
1.64
1.23
0.82
0.41
MVK/MACR
0.24
0.16
0.08
0.00
Acetone
2.0
1.5
1.0
0.5
Isoprene/MBO
0.213
0.142
0.071
Acetaldehyde
1.11
0.74
0.37
0.00
Concentration/ppb
Time/hr


June
July
August
September
October
November
December
Concentration/ppb
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Time/hr
0
2
4
6
8
10
12
14
16
18
20
22
24
June
July
August
September
October
November
December


June
July
August
September
October
November
December
Concentration/ppb
0
1
2
3
Time/hr
0
2
4
6
8
10
12
14
16
18
20
22
24
June
July
August
September
October
November
December


June
July
August
September
October
November
December
Concentration/ppb
0
1
2
3
Time/hr
0
2
4
6
8
10
12
14
16
18
20
22
24
December
November
October
September
August
July
June


June
July
August
September
October
November
December
Concentration/ppb
0
1
2
3
4
5
6
7
8
9
10
11
12
Time/hr
0
2
4
6
8
10
12
14
16
18
20
22
24
June
July
August
September
October
November
December


June
July
August
September
October
November
December
Concentration/ppb
0
1
2
3
Time/hr
0
2
4
6
8
10
12
14
16
18
20
22
24
June
July
August
September
October
November
December