Levels and Sources of Formaldehyde in the Lewiston-Clarkston Valley

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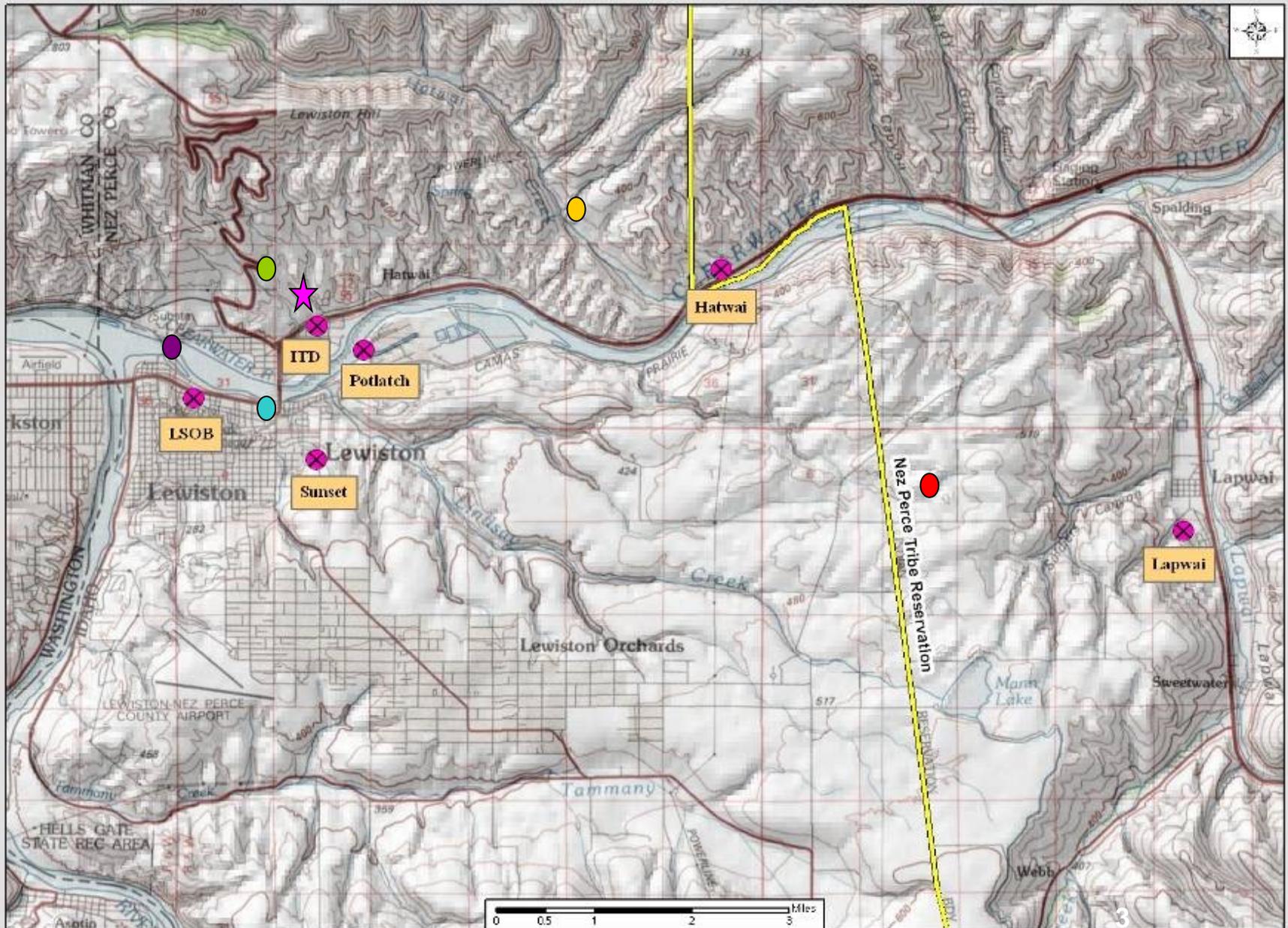Idaho Department of Health and Welfare

NW AIRQUEST Annual Meeting, June 28-29, 2022

Motivation

- **Adverse health effects**
- **One of the key pollutants responsible for overall cancer risk nationwide**

Concern: A previous study discovered elevated HCHO levels in the LC Valley

24-HR HCHO CONCENTRATIONS (2006-2007)

Legend: ◆ HATWAI 1 ■ ITD average ▲ LAPWAI ◆ LSOB ■ SUNSET — 5-site average

> **Elevated HCHO levels in July warrant further investigation into the current levels and sources of HCHO in the LC Valley**
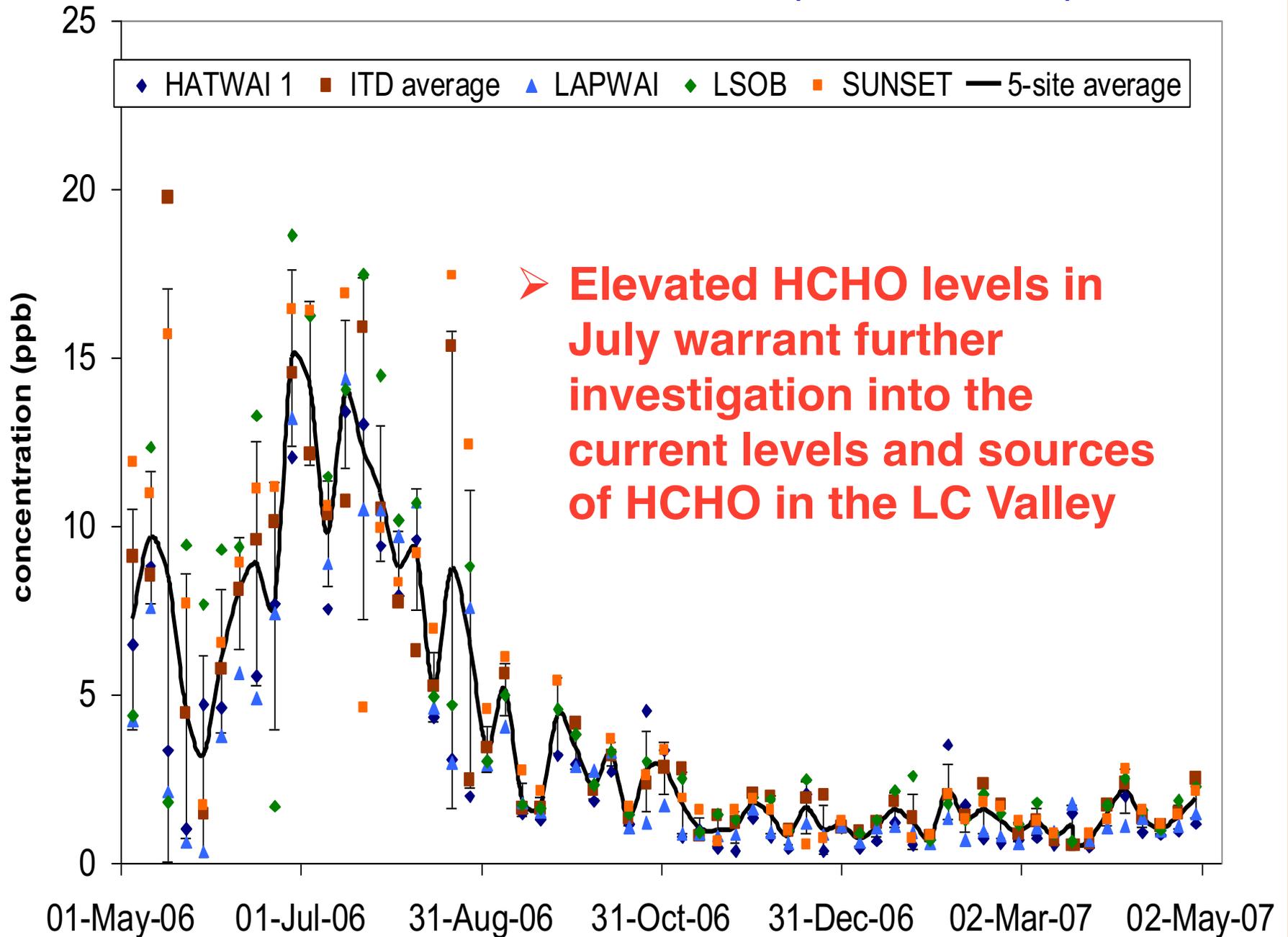
MEASUREMENTS (4 WEEKS EACH SUMMER 2016-2017)

12-hr sampling: 7 AM to 7 PM & 7 PM to 7 AM

MACL at Sunset site (2016-2017)

1-min measurements in addition to 12-hr sampling

AVERAGE CONCENTRATIONS

	Species	Site	Average (ppbv)	Standard Deviation	Samples
2016	**HCHO**	**Sunset**	**2.02**	**0.93**	**86**
		Hatwai	**2.35**	**0.75**	**53**
		Asotin	**2.97**	**1**	**50**
	CH3CHO	Sunset	1	0.64	86
		Hatwai	0.99	0.5	53
		Asotin	1.2	0.77	50

	Species	Site	Average (ppbv)	Standard Deviation	Samples
2017	**HCHO**	**Sunset**	**4.81**	**0.85**	**56**
		Hatwai	**3.19**	**0.92**	**56**
		Asotin	**4.63**	**1.12**	**56**
	CH3CHO	Sunset	1.98	0.76	56
		Hatwai	1.79	0.52	56
		Asotin	2.02	0.70	56

< HCHO levels in July 2006:10-20 ppb

MACL measurements:
Time series of HCHO at the Sunset site in 2016
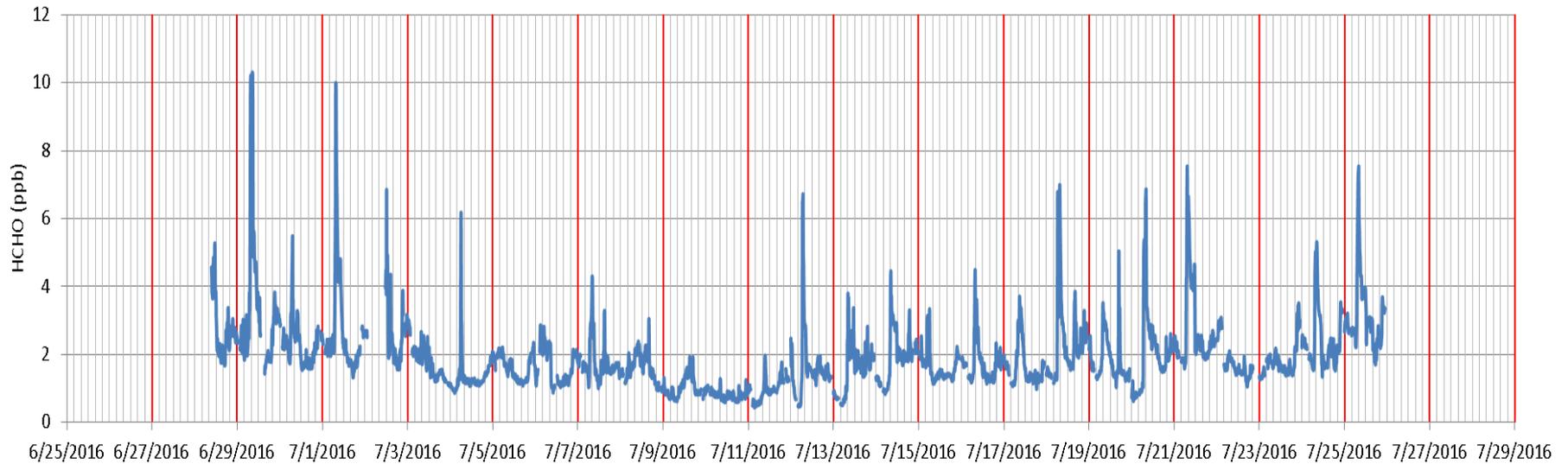
MACL measurements:
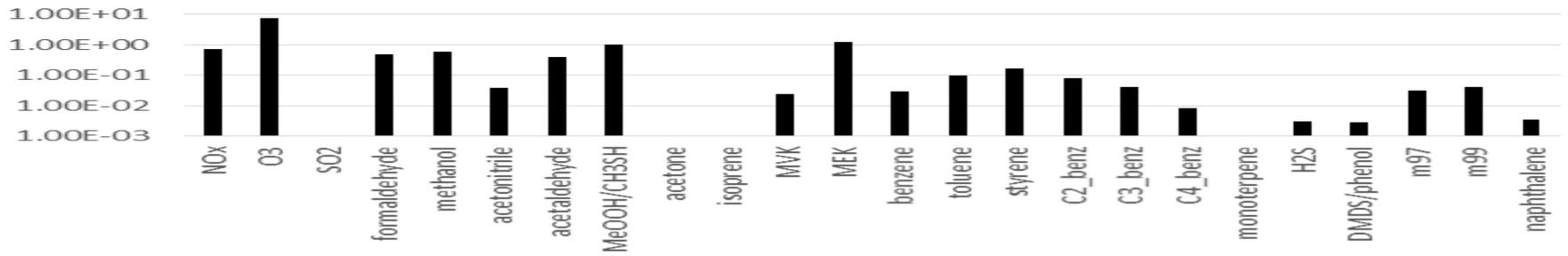# Time series of HCHO at the Sunset site in 2017
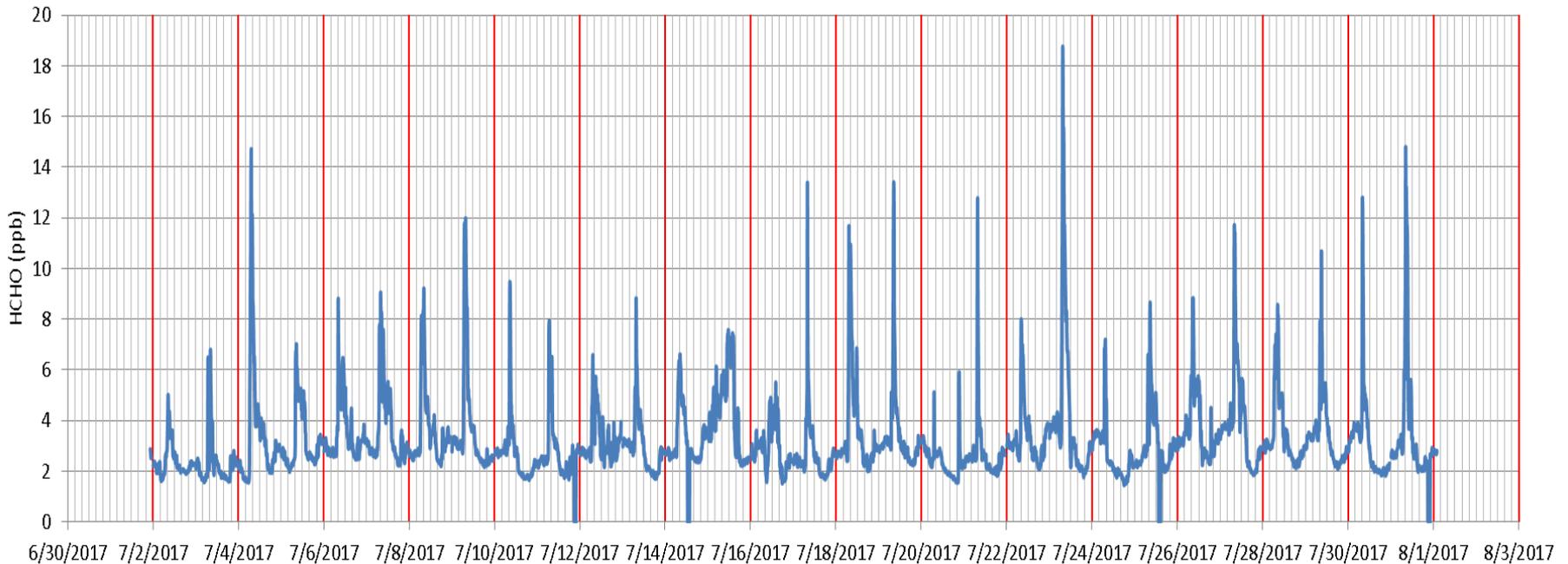
PMF runs

➢ Positive Matrix Factorization (PMF) model
➢ Newest version PFM5.0
➢ Goal: Identify sources of air pollutants (e.g. Toxics)
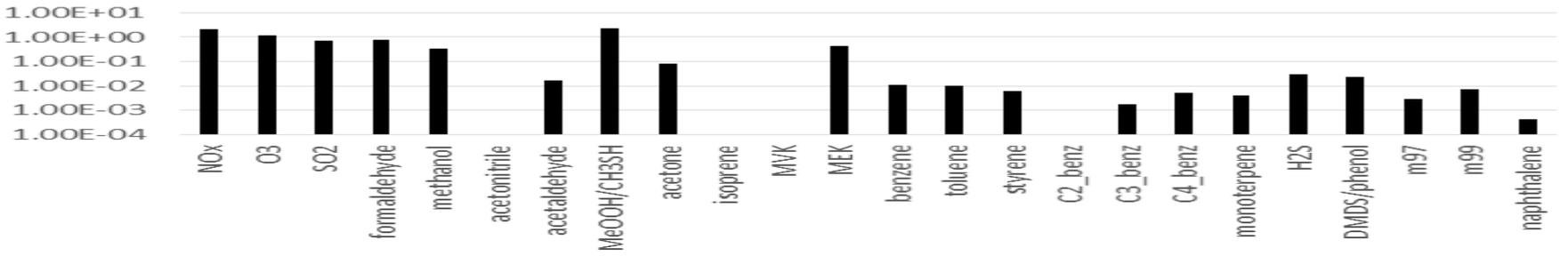➢ MACL measurements at the Sunset site
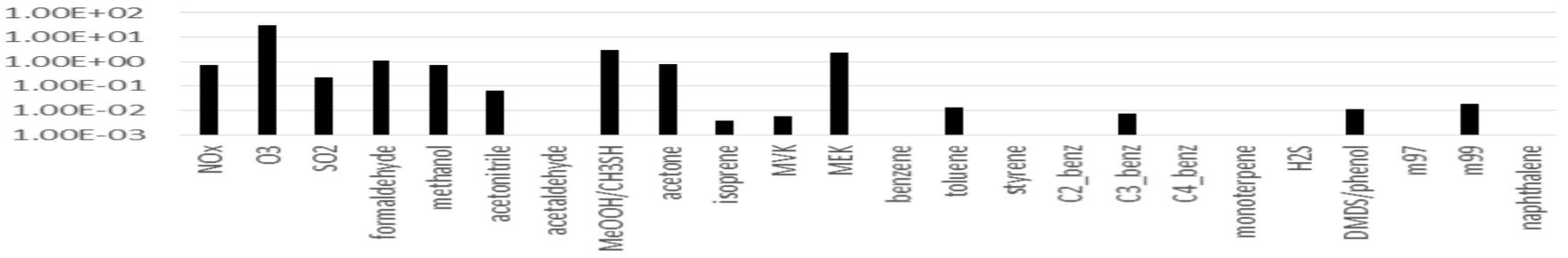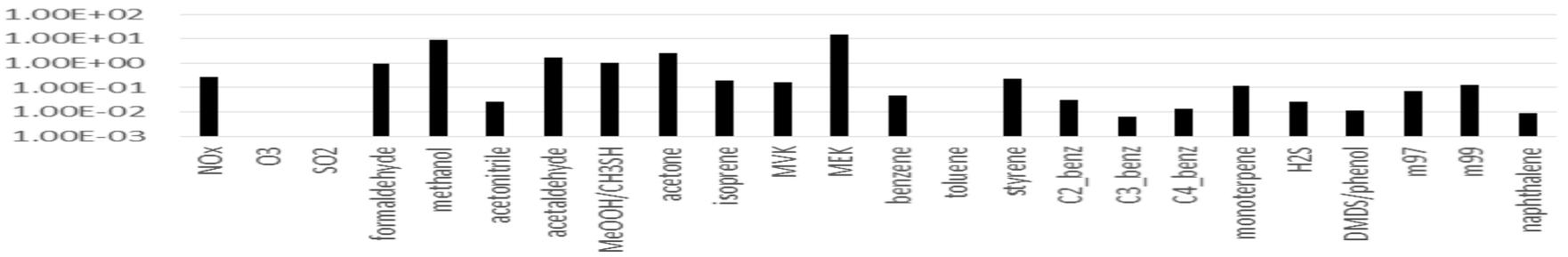 ❖ 10-min data
  ❖ 2016
  ❖ 2017

2017 PMF results

traffic

Bar chart (logarithmic scale, 1.00E-03 to 1.00E+01) of concentrations for: NOx, O3, SO2, formaldehyde, methanol, acetonitrile, acetaldehyde, MeOOH/CH3SH, acetone, isoprene, MVK, MEK, benzene, toluene, styrene, C2_benz, C3_benz, C4_benz, monoterpene, H2S, DMDS/phenol, m97, m99, naphthalene

paper mill

Bar chart (logarithmic scale, 1.00E-04 to 1.00E+01) of concentrations for: NOx, O3, SO2, formaldehyde, methanol, acetonitrile, acetaldehyde, MeOOH/CH3SH, acetone, isoprene, MVK, MEK, benzene, toluene, styrene, C2_benz, C3_benz, C4_benz, monoterpene, H2S, DMDS/phenol, m97, m99, naphthalene

secondary formation

Bar chart (logarithmic scale, 1.00E-03 to 1.00E+02) of concentrations for: NOx, O3, SO2, formaldehyde, methanol, acetonitrile, acetaldehyde, MeOOH/CH3SH, acetone, isoprene, MVK, MEK, benzene, toluene, styrene, C2_benz, C3_benz, C4_benz, monoterpene, H2S, DMDS/phenol, m97, m99, naphthalene

biogenic

Bar chart (logarithmic scale, 1.00E-03 to 1.00E+02) of concentrations for: NOx, O3, SO2, formaldehyde, methanol, acetonitrile, acetaldehyde, MeOOH/CH3SH, acetone, isoprene, MVK, MEK, benzene, toluene, styrene, C2_benz, C3_benz, C4_benz, monoterpene, H2S, DMDS/phenol, m97, m99, naphthalene
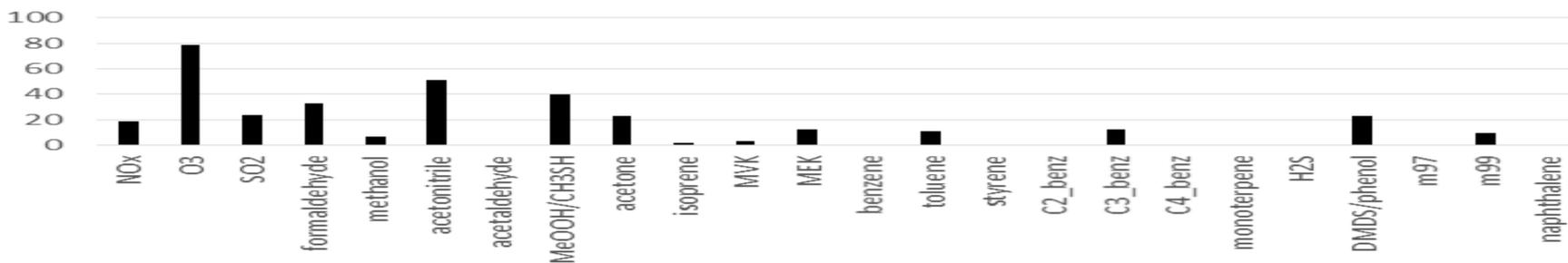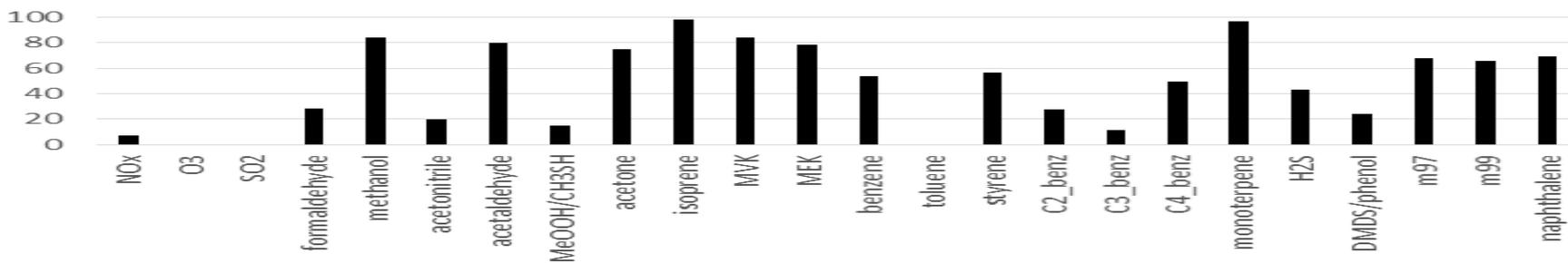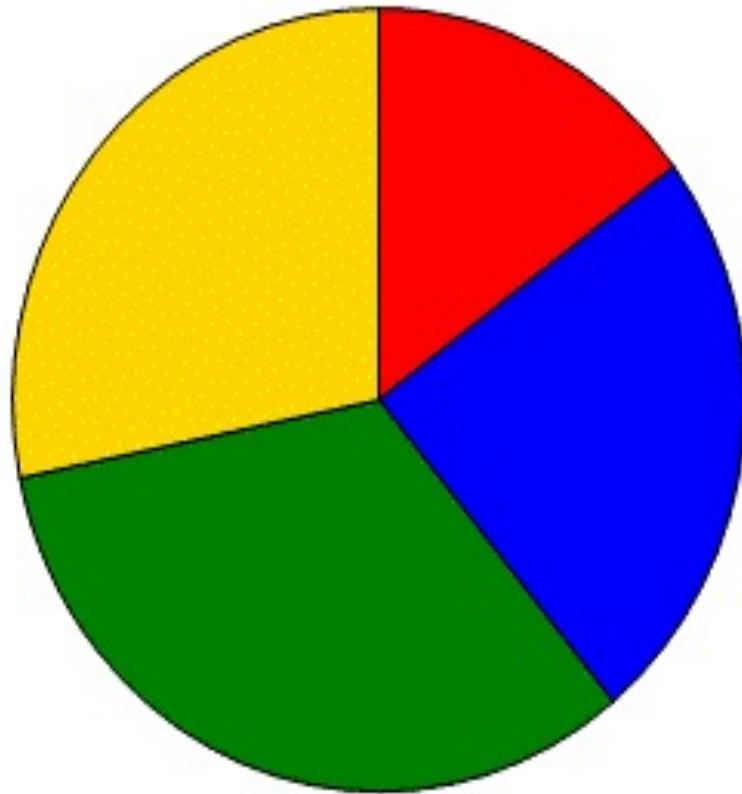
traffic

paper mill
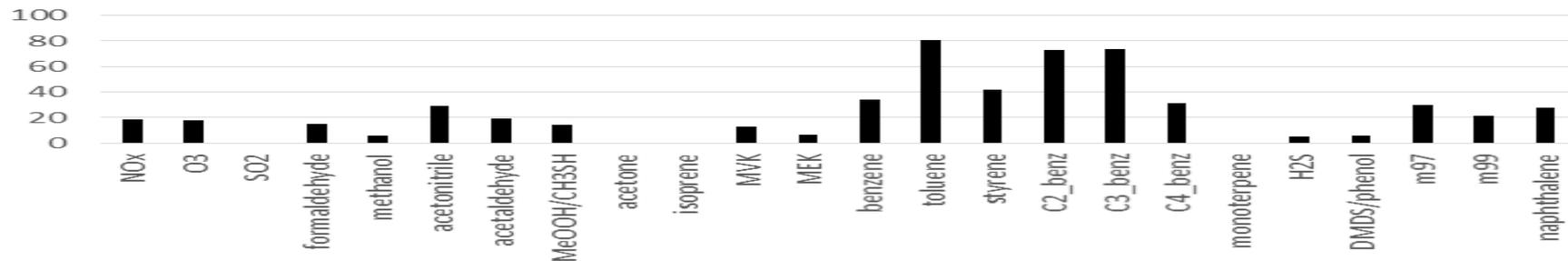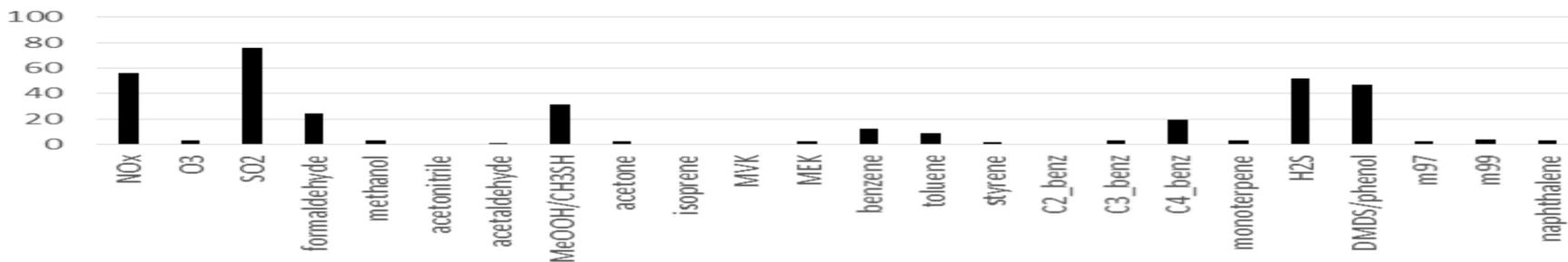
secondary formation

biogenic

Contributions of the sources. Factor 1-4 represent traffic sources mixed with a little photochemical formation, the influence of the paper mill, secondary formation & mixing from residual layer, and biogenic sources
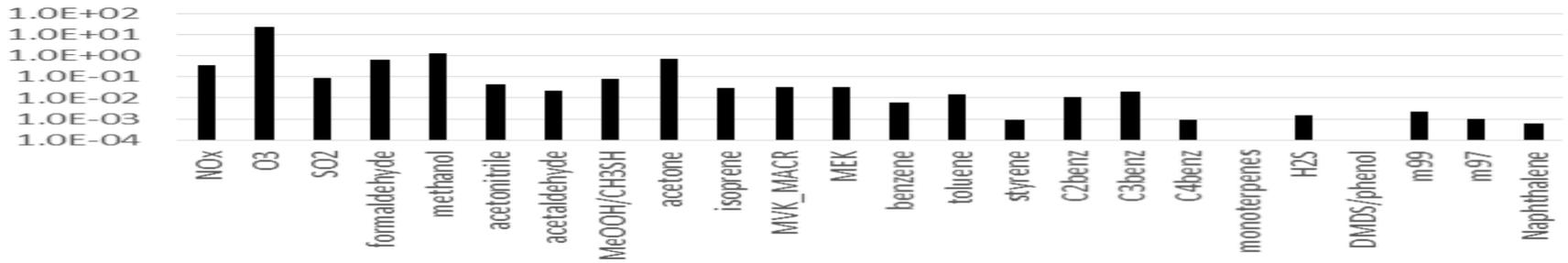

formaldehyde - Run 1
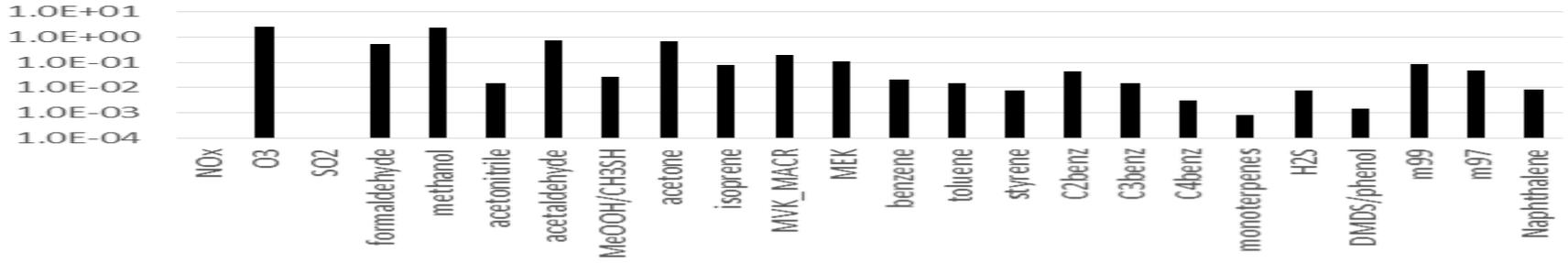
Factor Contribution > 0.05 %

- ■ Factor 1 = 0.48568 (14.9 %)
- ■ Factor 2 = 0.78920 (24.1 %)
- ■ Factor 3 = 1.07290 (32.8 %)
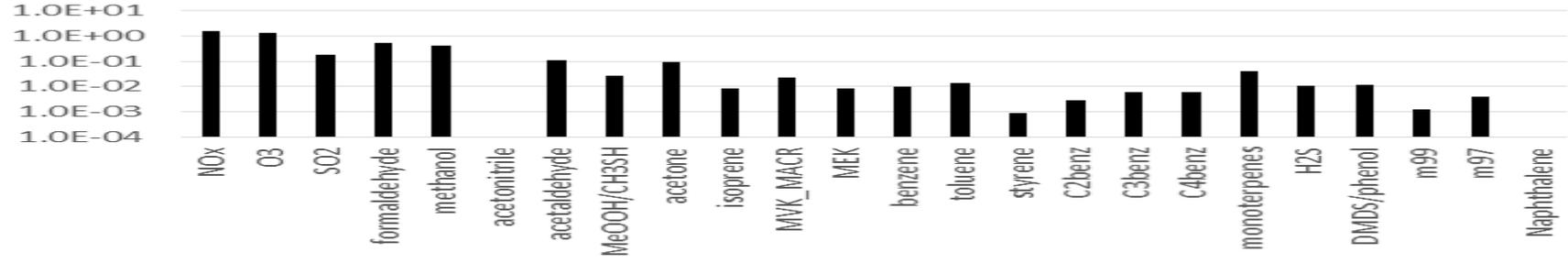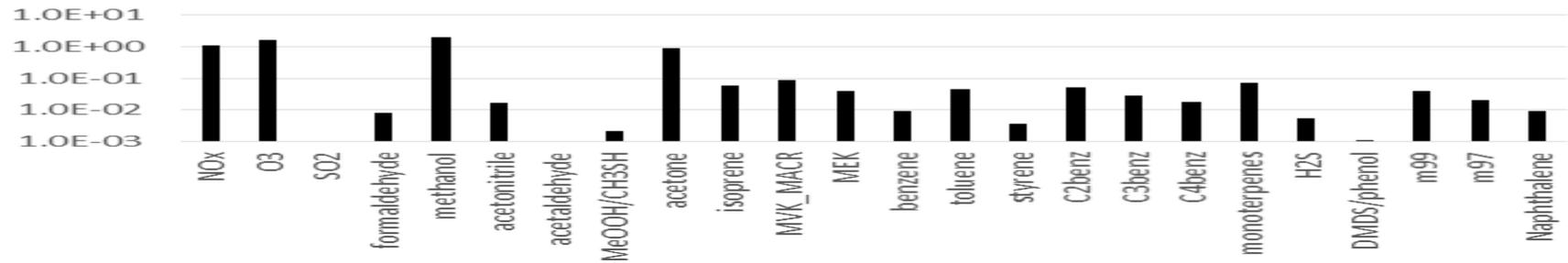- ■ Factor 4 = 0.92168 (28.2 %)
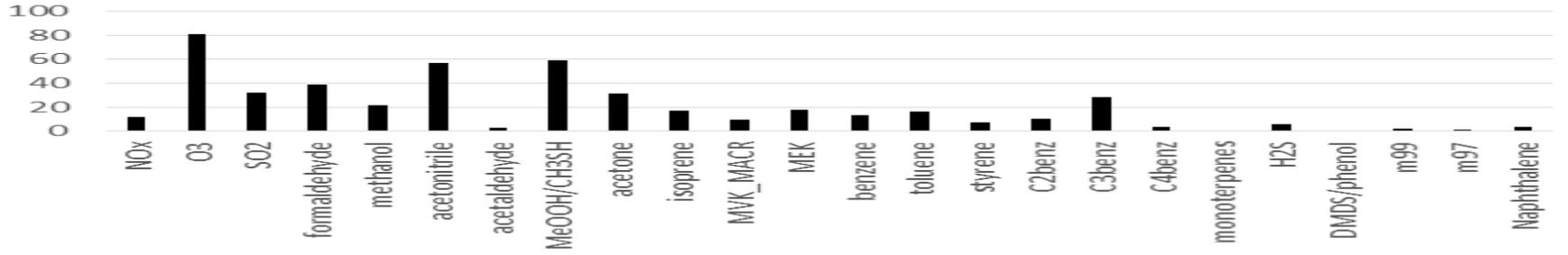
2016 PMF results

secondary formation

y-axis: 1.0E+02, 1.0E+01, 1.0E+00, 1.0E-01, 1.0E-02, 1.0E-03, 1.0E-04

x-axis: NOx, O3, SO2, formaldehyde, methanol, acetonitrile, acetaldehyde, MeOOH/CH3SH, acetone, isoprene, MVK_MACR, MEK, benzene, toluene, styrene, C2benz, C3benz, C4benz, monoterpenes, H2S, DMDS/phenol, m99, m97, Naphthalene

biogenic

y-axis: 1.0E+01, 1.0E+00, 1.0E-01, 1.0E-02, 1.0E-03, 1.0E-04

x-axis: NOx, O3, SO2, formaldehyde, methanol, acetonitrile, acetaldehyde, MeOOH/CH3SH, acetone, isoprene, MVK_MACR, MEK, benzene, toluene, styrene, C2benz, C3benz, C4benz, monoterpenes, H2S, DMDS/phenol, m99, m97, Naphthalene

paper mill

y-axis: 1.0E+01, 1.0E+00, 1.0E-01, 1.0E-02, 1.0E-03, 1.0E-04

x-axis: NOx, O3, SO2, formaldehyde, methanol, acetonitrile, acetaldehyde, MeOOH/CH3SH, acetone, isoprene, MVK_MACR, MEK, benzene, toluene, styrene, C2benz, C3benz, C4benz, monoterpenes, H2S, DMDS/phenol, m99, m97, Naphthalene

traffic

y-axis: 1.0E+01, 1.0E+00, 1.0E-01, 1.0E-02, 1.0E-03

x-axis: NOx, O3, SO2, formaldehyde, methanol, acetonitrile, acetaldehyde, MeOOH/CH3SH, acetone, isoprene, MVK_MACR, MEK, benzene, toluene, styrene, C2benz, C3benz, C4benz, monoterpenes, H2S, DMDS/phenol, m99, m97, Naphthalene
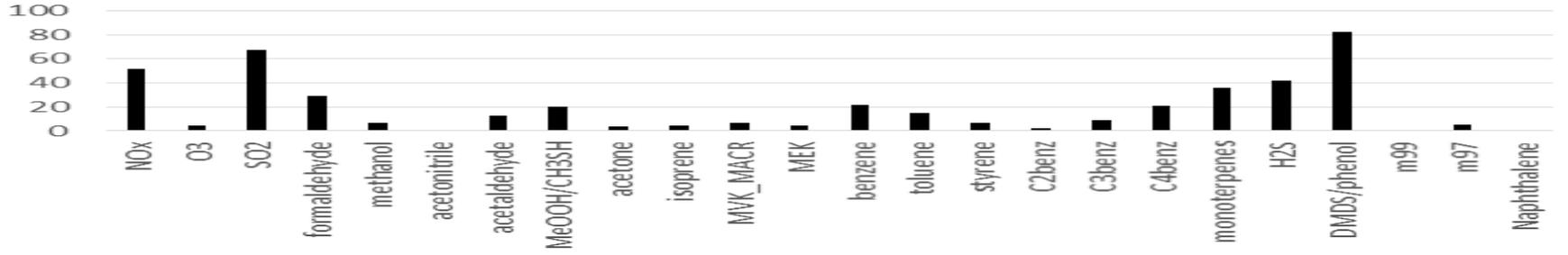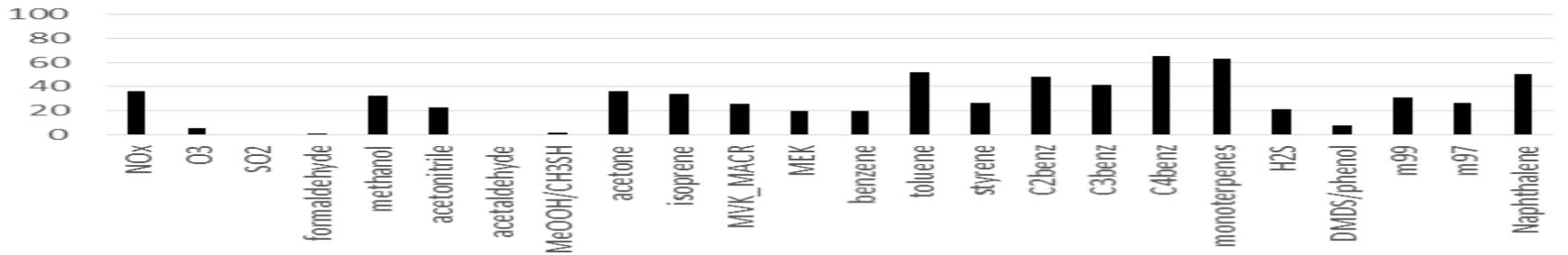
secondary formation

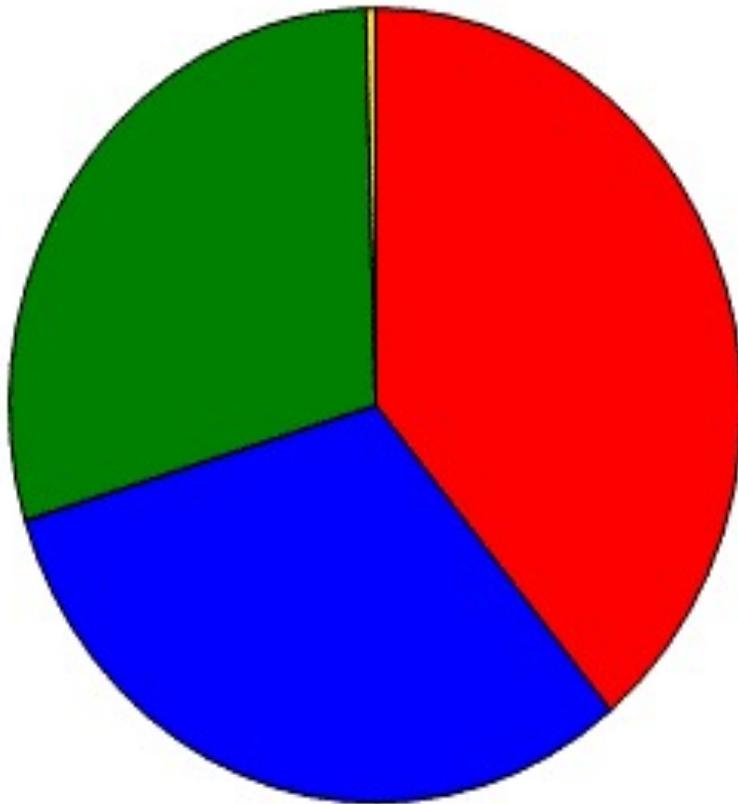biogenic

paper mill
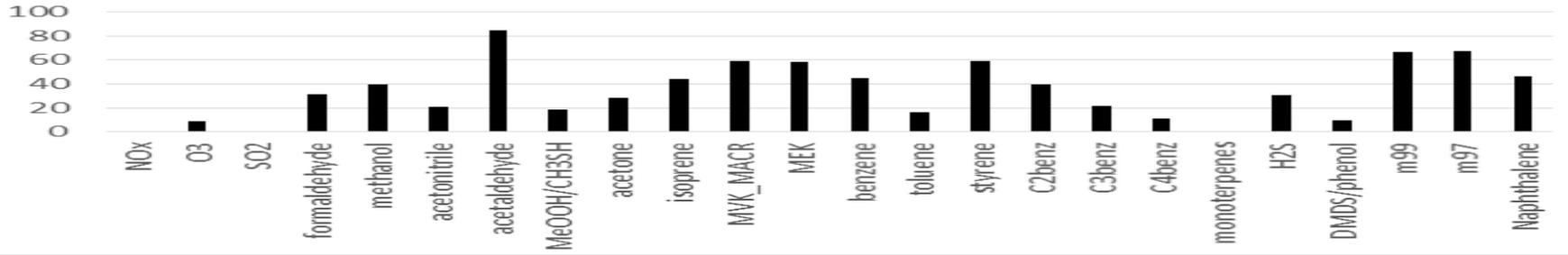
traffic

Contributions of the sources. Factor 1-4 represents secondary formation & mixing from residual layer, biogenic & other surface sources, the influence of the paper mill, and traffic sources

formaldehyde - Run 7

Factor Contribution > 0.05 %

- Factor 1 = 0.69222 (38.9 %)
- Factor 2 = 0.55748 (31.4 %)
- Factor 3 = 0.51950 (29.2 %)
- Factor 4 = 0.00800 (0.5 %)

Summary and Conclusion

➢ Performed PMF modeling to understand the sources of formaldehyde
➢ Four major sources:
   ❖ Secondary formation & mixing from residual layer
   ❖ Biogenic sources
   ❖ Emissions from the paper mill
   ❖ Traffic sources