Appendix A Supplementary information for Part 1

A.1 Measurement details

A.1.1 Summary of measurement techniques undertaken by Ecotech

Parameter	Instrument/s	Method/s	Description
Nitric oxide (NO) Nitrogen dioxide (NO_2) Nitrogen oxides (NO_x)	Ecotech Serinus 40 or Ecotech EC9841T	Australian standard method AS 3580.5.1-2011	Methods for sampling and analysis of ambient air. Method 5.1: Determination of nitrogen oxides – chemiluminescence method
		Ecotech laboratory method	In-house method 6.1 Nitrogen oxides by chemiluminescence
Carbon monoxide (CO)	Ecotech Serinus 30 or Ecotech EC9830T	Australian standard method AS 3580.7.1-2011	Methods for sampling and analysis of ambient air. Method 7.1: Determination of carbon monoxide - direct reading instrumental method
		Ecotech laboratory method	In-house method 6.3 Carbon monoxide by gas filter correlation spectrophotometry
Ozone (O_3)	Ecotech Serinus 10	Australian standard method AS/NZS 3580.6.1-2011	Methods for sampling and analysis of ambient air. Method 6.1: Determination of ozone – Direct reading instrumental method
		Ecotech laboratory method	In-house method 6.7 Ozone by UV photometry
TVOC	Baseline 9000	Australian standard method AS 3580.11.1-2013	Methods for sampling and analysis of ambient air. Method 11.1 Determination of volatile organic compounds – Methane and non-methane volatile organic compounds – Direct reading instrument method
		Ecotech laboratory method	In-house method 6.6 Hydrocarbons –methane, non-methane, total by flame ionization detection (FID)

TSP, PM10, PM2.5 (Fidas)	Fidas 200	Ecotech laboratory method based on Fidas instrument manual	In-house method 7.7 – PM10 and PM2.5 Particles – Light Scattering Method Using Palas Fidas® 200 Series Monitors
Carbon dioxide/methane	Picarro G2301 or LGR GGA	Ecotech laboratory methods	Methane and Carbon dioxide by Cavity Ring-Down Spectroscopy (CRDS). Laser absorption spectroscopy method.
Meteorology measurements (continuous sampling/insitu analysis)			
Vector Wind Speed (Horizontal)	RM young 85000	Australian standard method AS 3580.14-2014	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
		Ecotech laboratory method	In-house method 8.1 Wind speed (Horizontal) by anemometer (ultrasonic)
Vector Wind Direction	RM young 85000	Australian standard method AS 3580.14-2014	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
		Ecotech laboratory method	In-house method 8.3 Wind direction by anemometer (ultrasonic)
Temperature	MetOne 062MP	Australian standard method AS 3580.14-2014	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
		Ecotech laboratory method	In-house method 8.4 Temperature ambient by thermoelectric techniques
Relative Humidity	Vaisala HMP155	Australian standard method AS 3580.14-2014	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
		Ecotech laboratory method	In-house method 8.5 – Relative humidity by hygrometer
Rain	Hydrological Services TB6	Australian standard method AS 3580.14-2014	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications

		Ecotech laboratory method	In-house method 8.7 – Rainfall by tipping bucket rain gauge
Solar and net radiation	Middletone Solar Pyranometer SK-01-D2	Australian standard method AS 3580.14-2014	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
		Ecotech laboratory method	In-house method 8.6 – Global solar radiation and Net radiation by pyranometer and net pyradiometer

A.1.2 Ambient air quality station measurement specifications and uncertainty

Site	**Parameter**	**Units**	**Resolution**	**Uncertainty**	**Measurement Range**
H, M, C	NO, NO_x	ppb	1 ppb	±14 ppb K factor of 2.01	0 to 500 ppb
H, M, C	NO_2	ppb	1 ppb	±16 ppb K factor of 2.01	0 to 500 ppb
B, T	NO, NO_x	ppb	1 ppb	± 10 ppb K factor of 2.00	0 ppb to 250 ppb
B,T	NO_2	ppb	1 ppb	± 12 ppb K factor of 2.01	0 ppb to 250 ppb
H, M, C	CO	ppm	0.1 ppm	±1.1 ppm K factor of 2.00	0 to 50 ppm
B	CO	ppm	0.001 ppm	±0.002 ppm	1 to 5 ppm
H, M, C, B, T	O3	ppb	1 ppb	± 16 ppb between 0 - 125 ppb K factor of 2.02	0 ppb to 500 ppb
H, M, C	CH_4 (VOC1000)	ppm	0.1 ppm	4% of reading at span value K factor = 2	1 to 2000 ppm
H, M, C	NMHC (VOC1000)	ppm	0.1 ppm	4% of reading at span value K factor = 2	1 to 2000 ppm
H	CO_2 [a] (Picarro G2301)	ppm	0.1 ppm	0.05 ppm	0 to 1000 ppm
H	CH_4 [a] (Picarro G2301)	ppm	0.1 ppm	0.001 ppm	0 to 20 ppm
M, C	CH_4[a] (LGR GGA)	ppm	0.1 ppm	<1% without calibration	0.1-100 ppm
M, C	CO_2[a] (LGR GGA)	ppm	0.1 ppm	<1% without calibration	200-20000 ppm
H, M, C	Vector Wind Speed	m/s	0.1 m/s	±0.22 m/s or 3 % of reading (whichever is greater) K factor of 1.96	0 to 20 m/s
H, M, C	Vector Wind Direction	°	1°	±4° K factor of 2.11	0 to 360° Starting threshold: 0 m/s

H, M, C	Solar Radiation	W/m2	1 W/m2	±5 % of reading or ±32 W/m^2 or whichever is greater K factor of 1.96	0 to 1100 W/m2
H, M, C	Rainfall	mm	0.2 mm	±0.60 mm or 7.5 % of reading, whichever is the greater K factor of 2.14	Rainfall rates of 0 to 80 mm/hr
H, M, C	Ambient Temperature	°C	0.1 °C	±0.25 °C K factor of 2.01	0 to 50 °C
H, M, C	Relative Humidity	%	1 %	±5 % K factor of 2.31	0-100 %
H, M, C	TSP, PM_{10}, PM_4, $PM_{2.5}$, PM_1 (Dust)[b]	µg/m^3	0.1 µg/m^3	PM_{10} 91.% of reading at 50 µg m^{-3} $PM_{2.5}$ 16.8% of reading at 30 µg m^{-3}	0 to 10,000 µg/m^3

a) Measurement of carbon dioxide and methane by cavity ring-down spectroscopy is not covered by Ecotech's NATA scope of accreditation. Manufacturer instrument manuals are followed for recommended calibration intervals (seeA.4.2). Instrument response was checked using overnight spans and zeroes and against methane measurements from another co-located instrument using a different measurement technique. Specifications are taken from manufacturer Specifications sheet

b) Measurement of ambient TSP, PM_{10}, PM_4, $PM_{2.5}$, PM_1 using the Fidas 200 (optical light scattering spectroscopy) is not covered by Ecotech's NATA scope of accreditation. Instrument performance was determined via a comparison against a reference method at the Miles Airport site (see A.2)

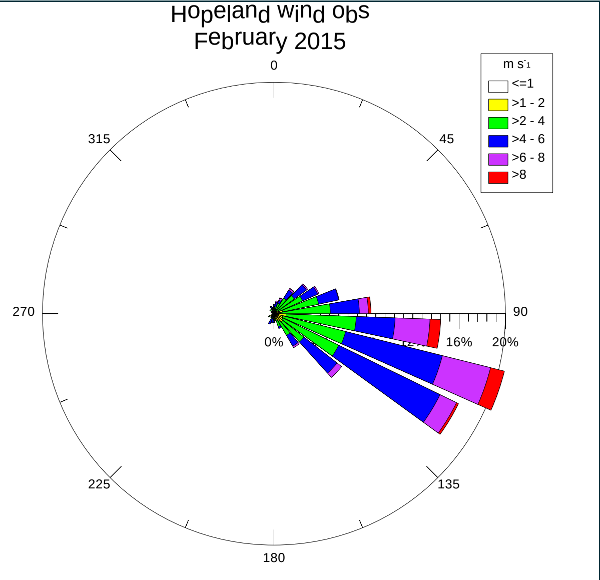
H=Hopeland, M=Miles Airport, C=Condamine, T=Tara, B=Burncluith

A.2 Particle method comparison

The PM instrumentation (Fidas – see A.1) deployed at the Gas field sites was selected because it provided a cost effective means of simultaneously measuring TSP, $PM_{2.5}$ and PM_{10}. The Fidas uses an optical technique and is a European certified method for measurements of $PM_{2.5}$ and PM_{10}. However, because the accuracy of the optical technique is influenced by the chemical composition of particles, CSIRO made independent measurements of $PM_{2.5}$ and PM_{10} alongside the existing particle instrumentation at the Miles Airport site. CSIRO deployed a dual channel Model 602 BetaPLUS Particle Measurement System based on beta attenuation which produces data equivalent to Australian Standard Methods (AS/NZS 3580.9.11.2008 (PM_{10}) and AS/NZS 3580.9.12:2013 ($PM_{2.5}$)). A comparison of $PM_{2.5}$ and PM_{10} data obtained using the Fidas and the Beta attenuation monitor will be provided in the final report, and any implications discussed.

A.3 Monthly Wind roses from observations

A.3.1 Hopeland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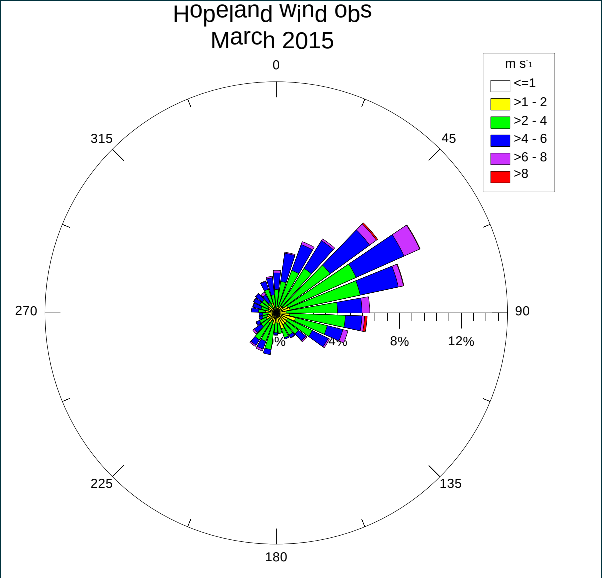
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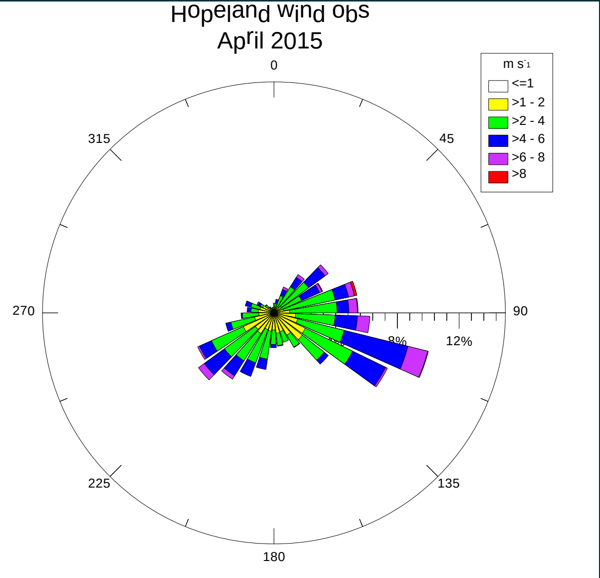
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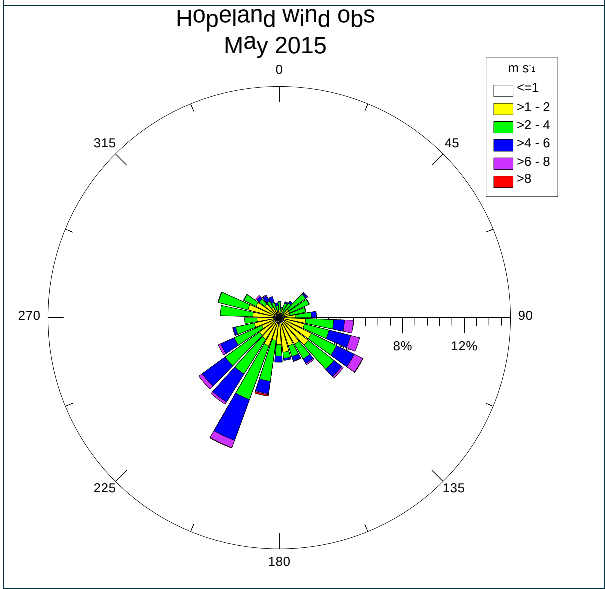
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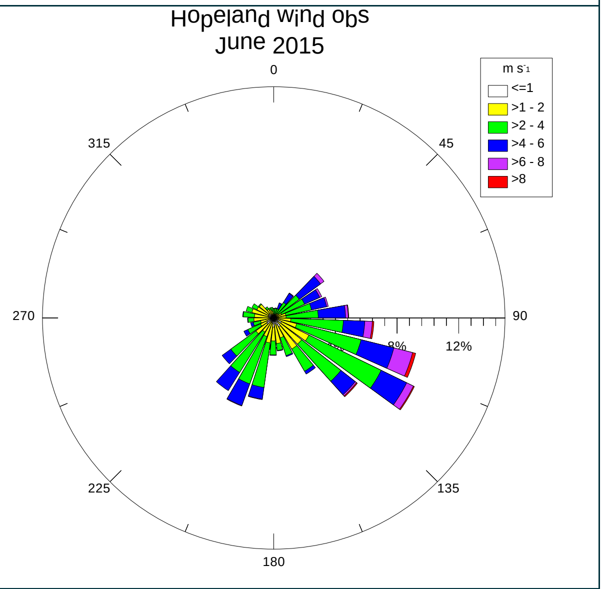
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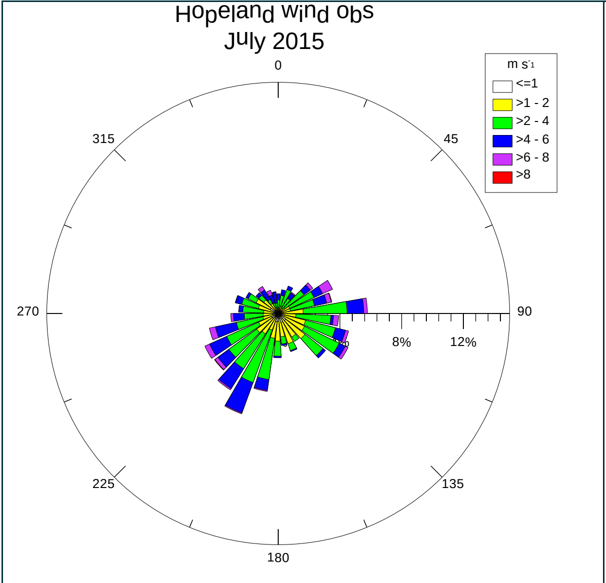
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July 2015
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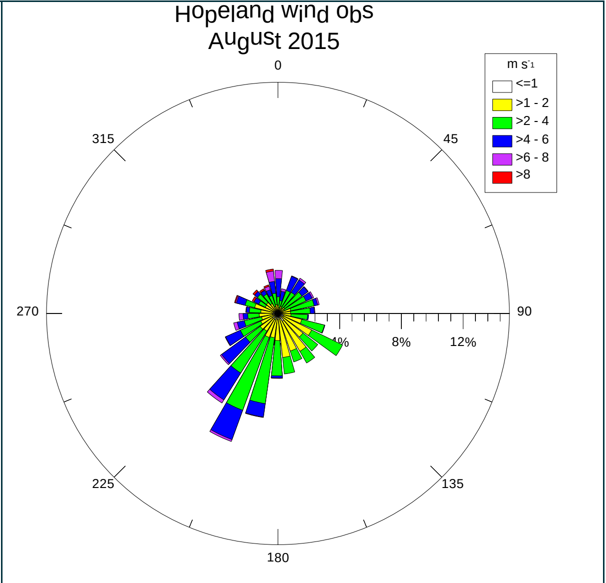
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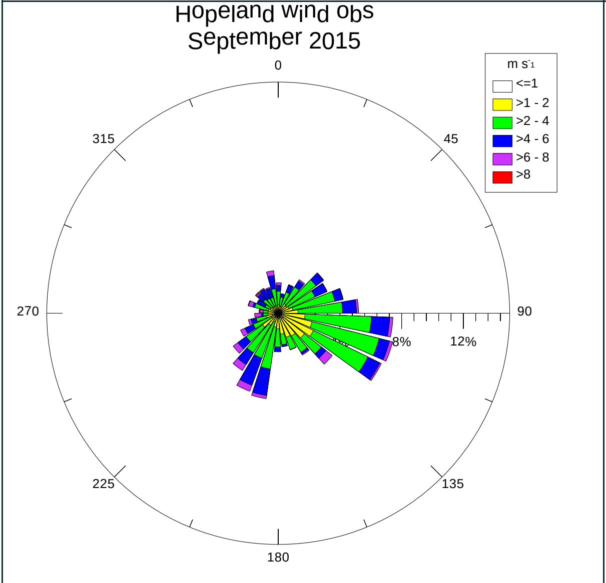
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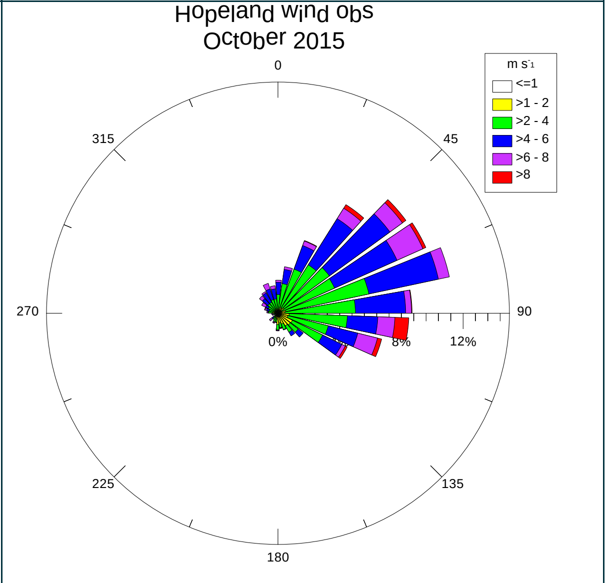
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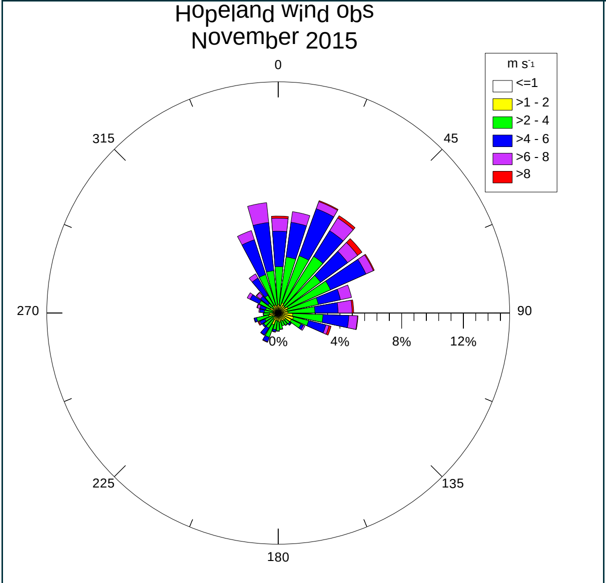
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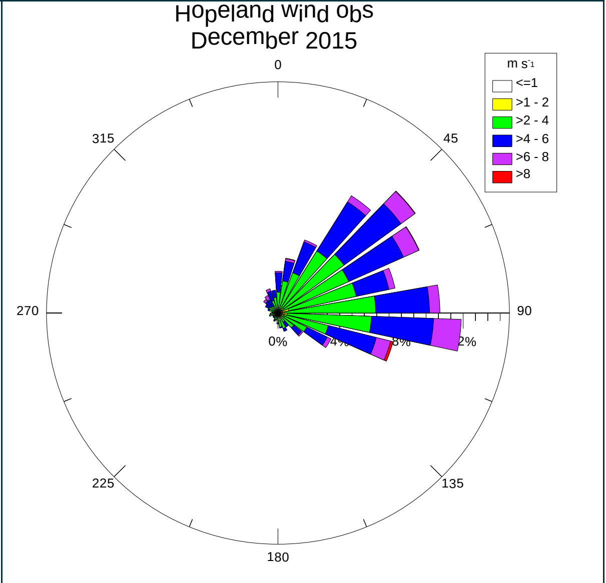
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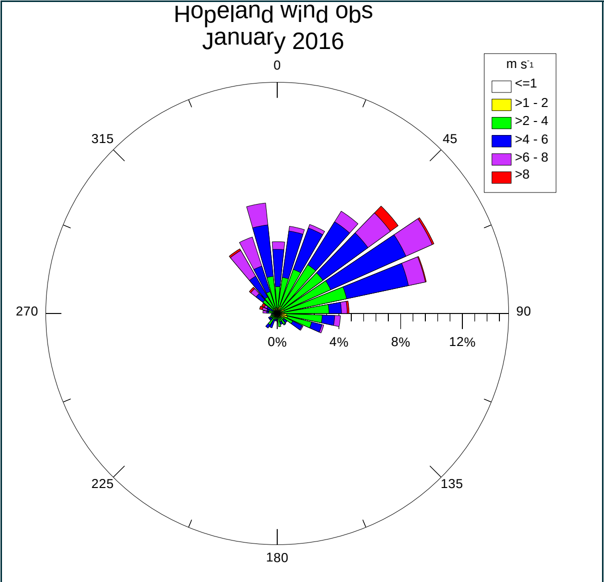
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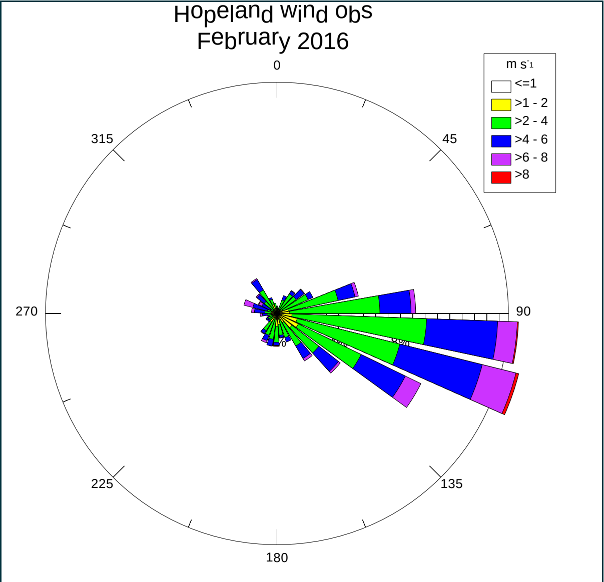
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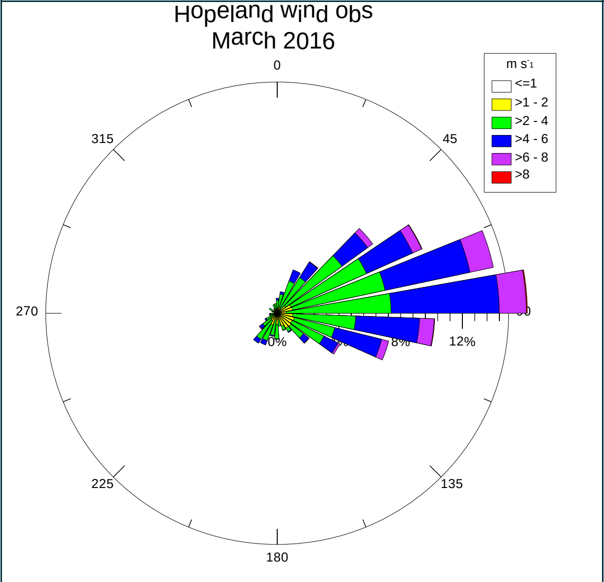
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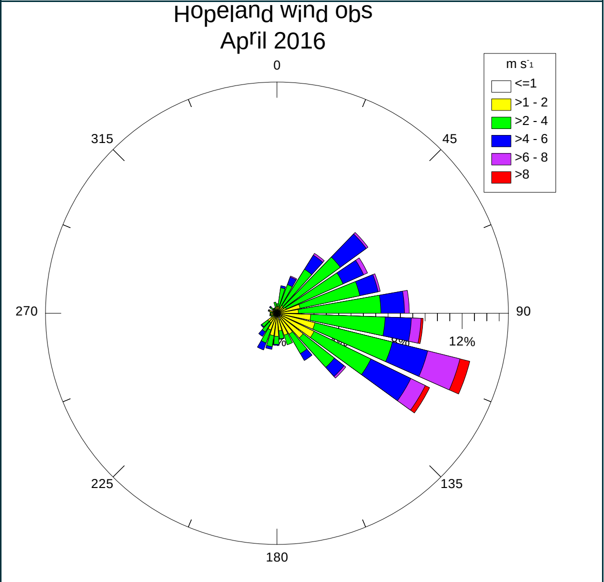
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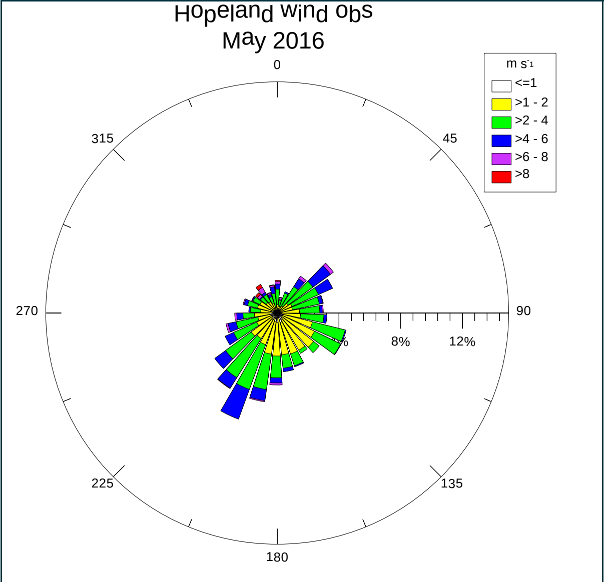
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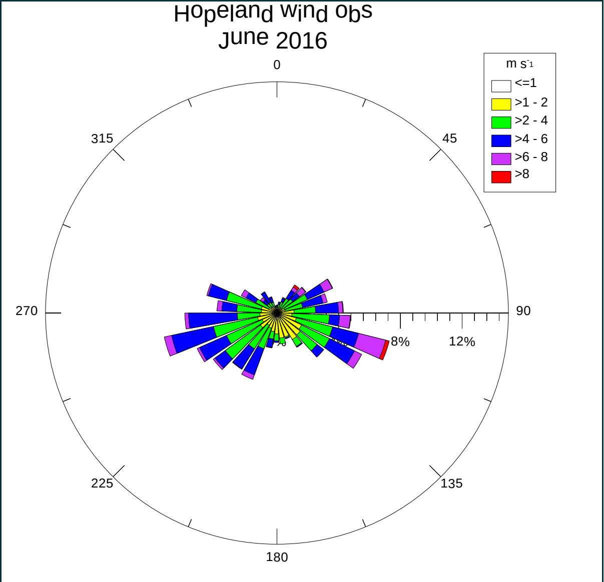
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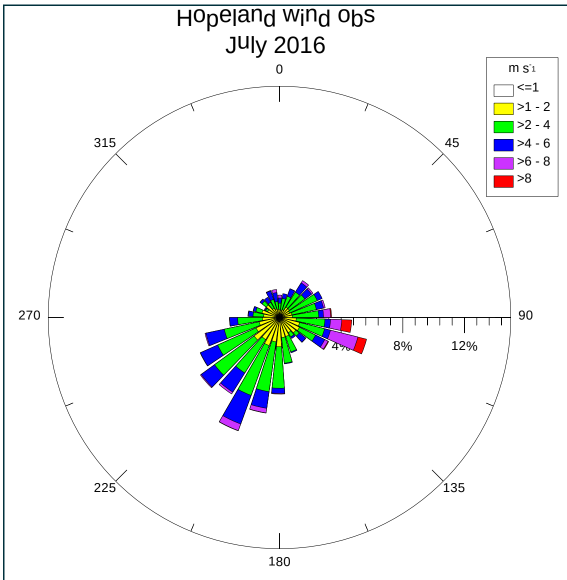
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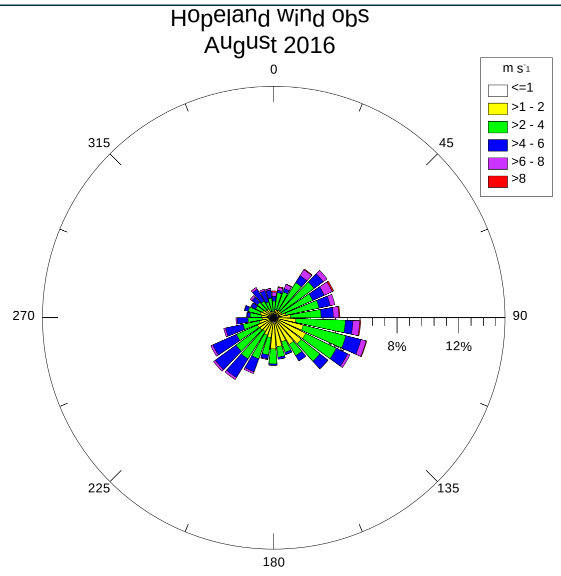
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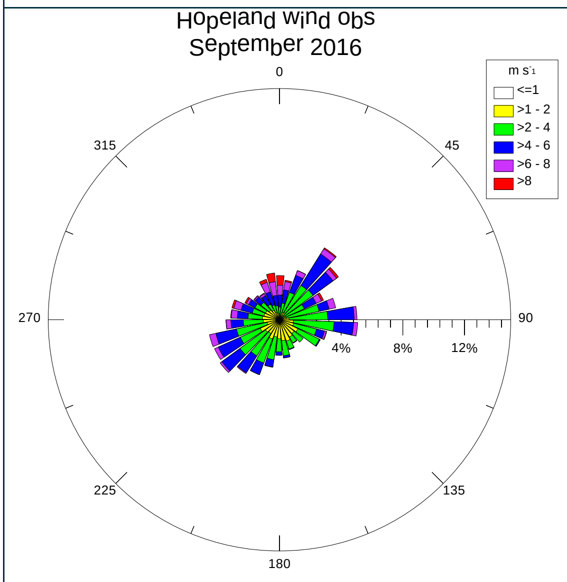
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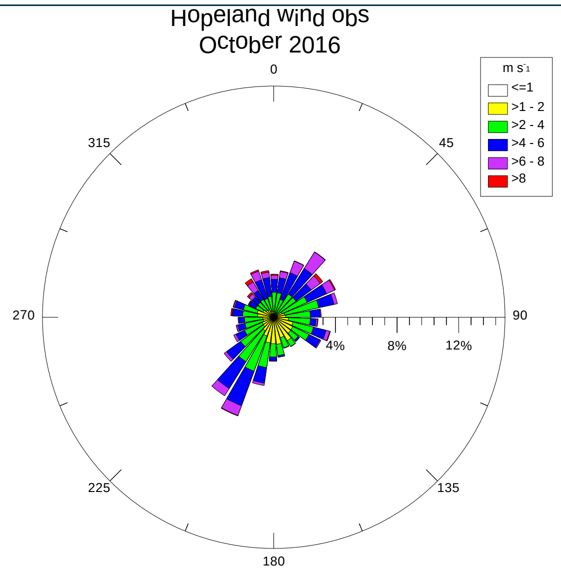
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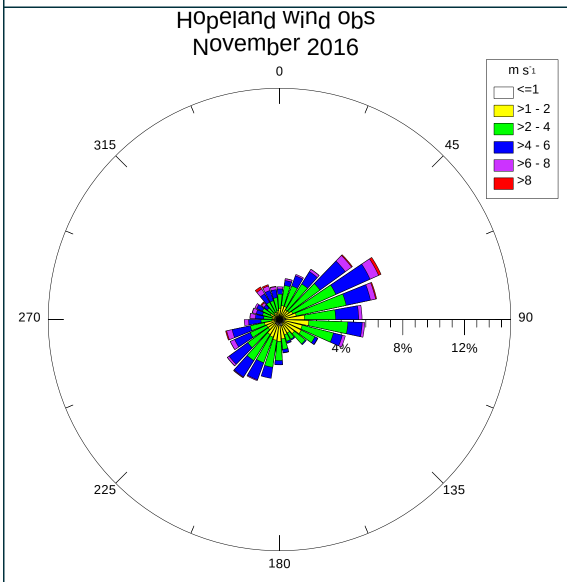
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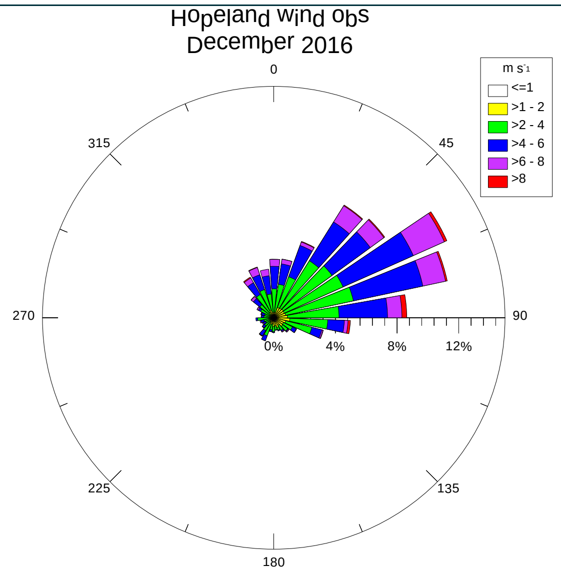
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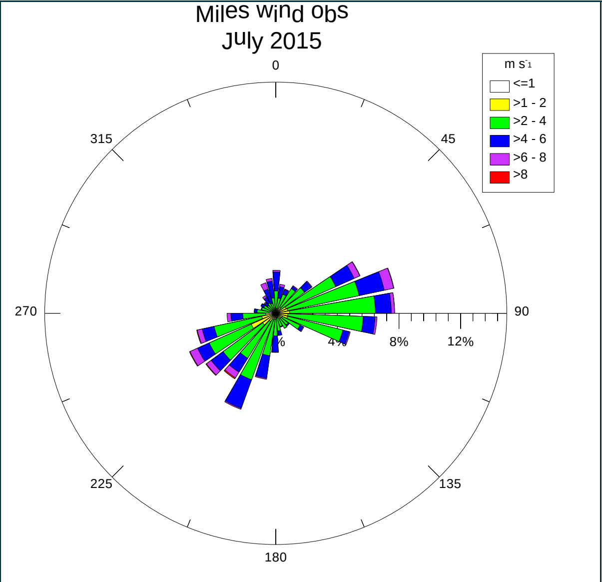
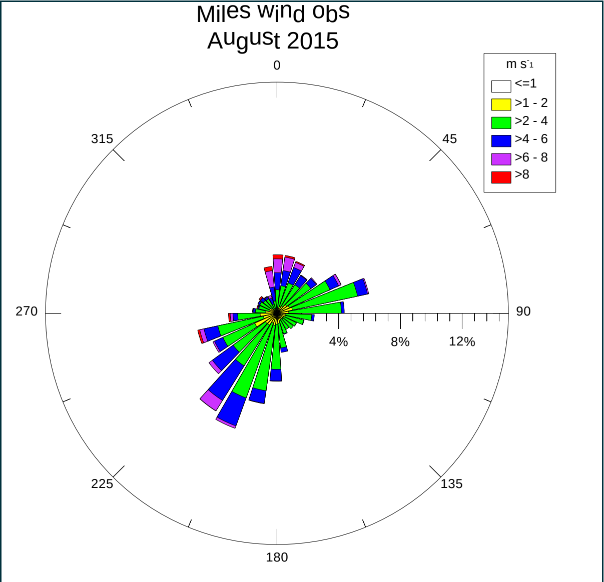
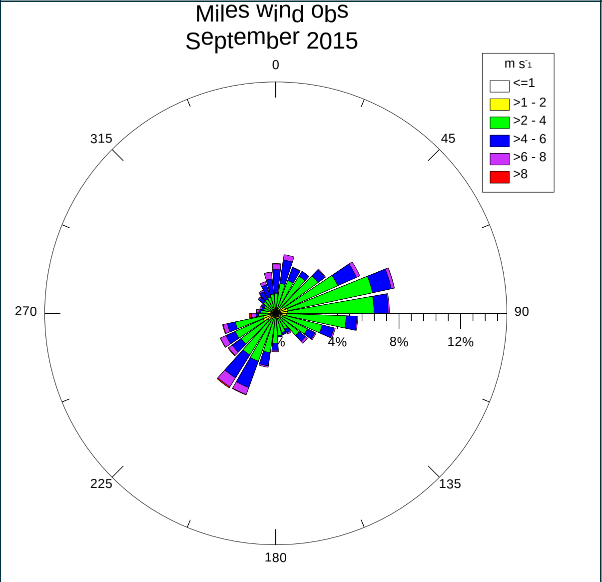
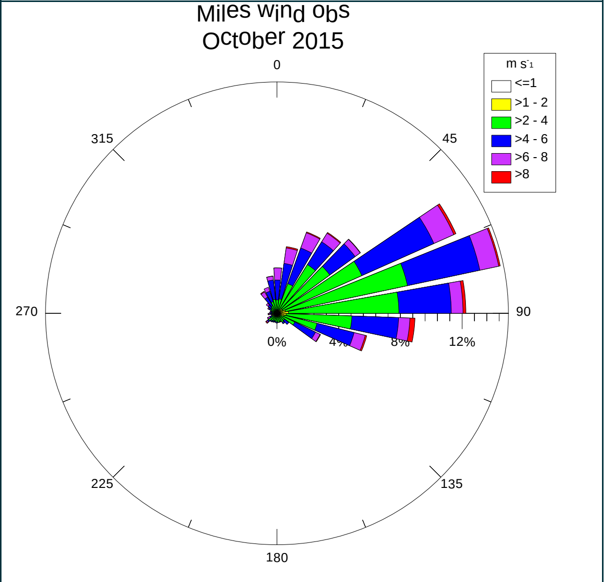
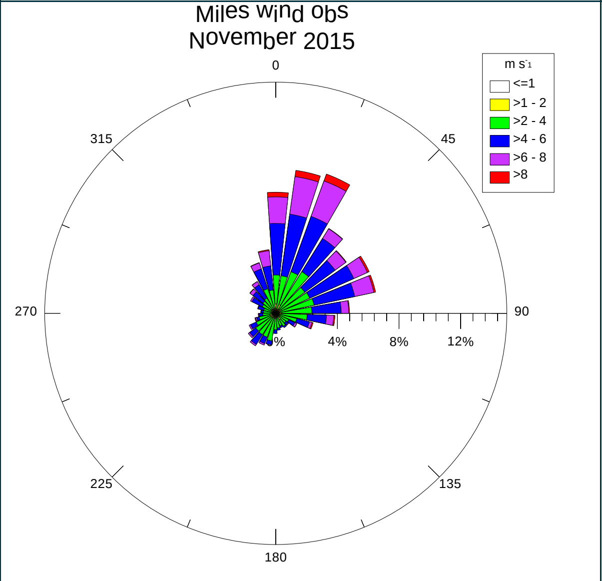
A.3.2 Miles Airport

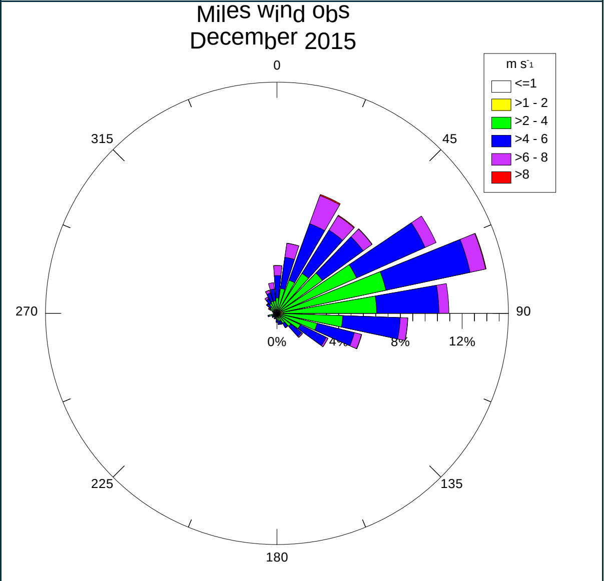


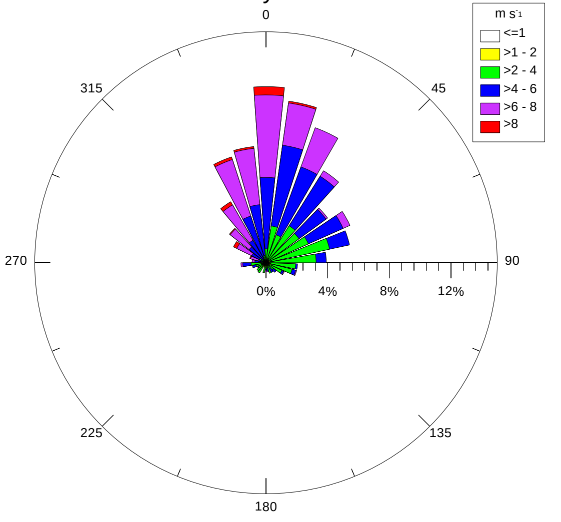












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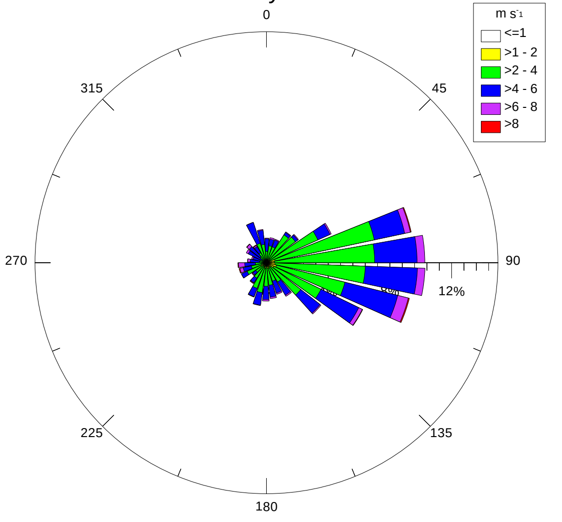

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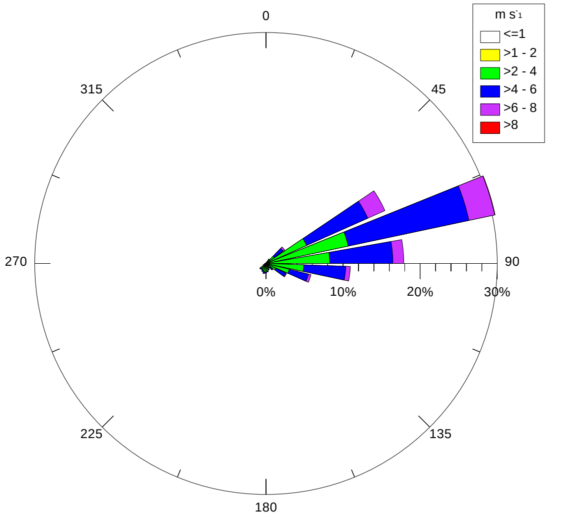

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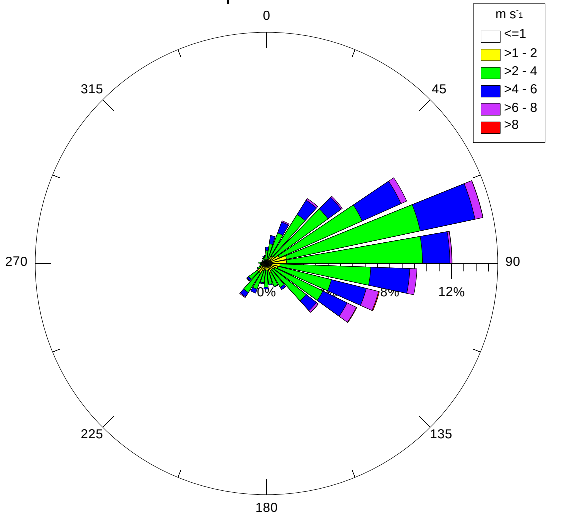

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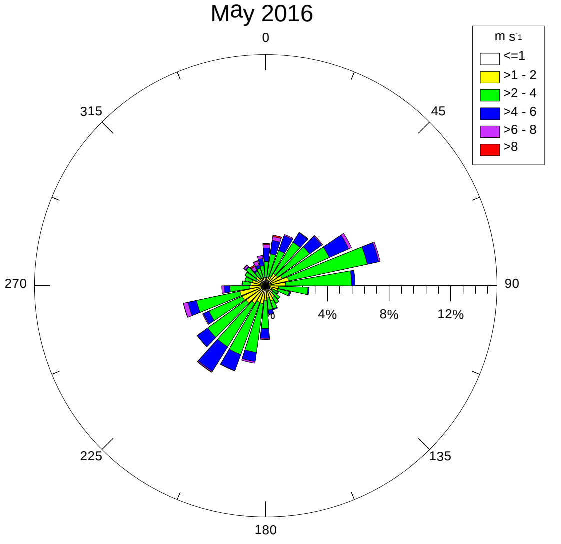

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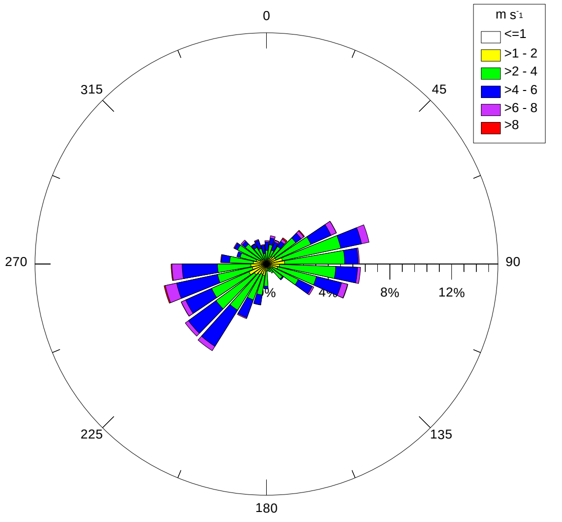
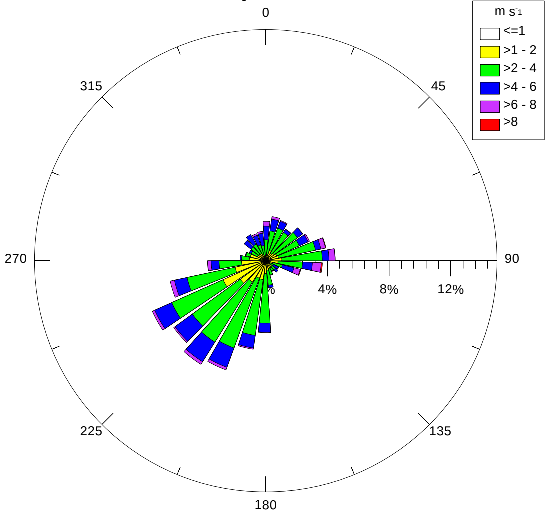


Miles wind obs
June 2016

Miles wind obs
July 2016



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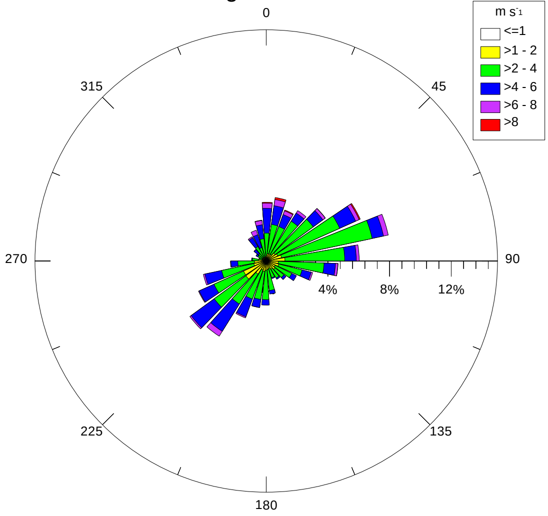

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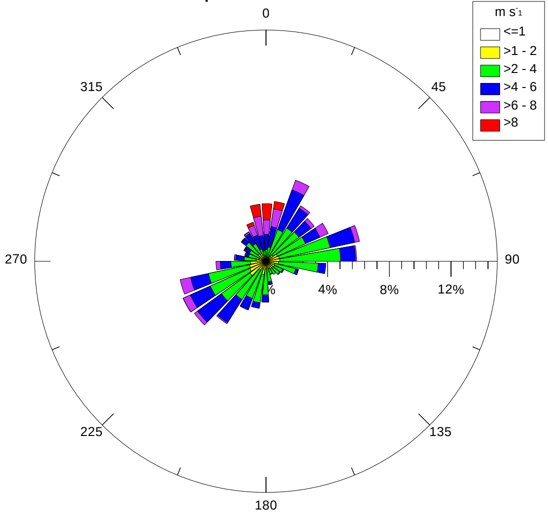

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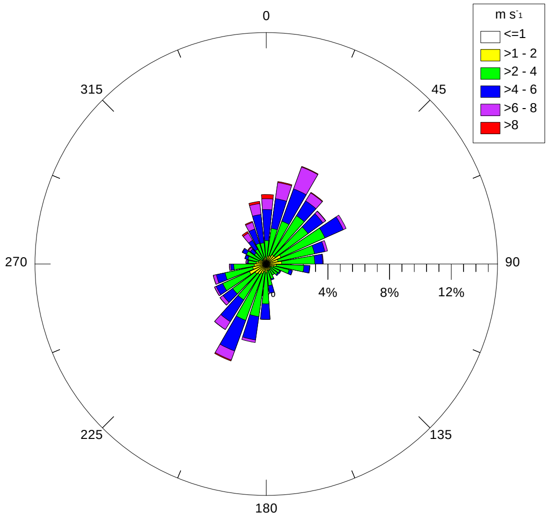

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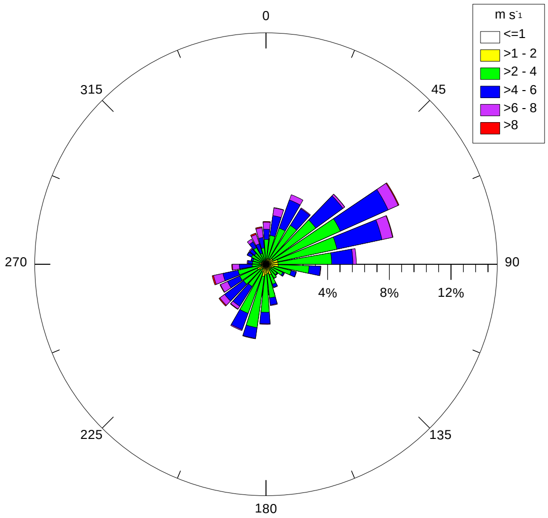

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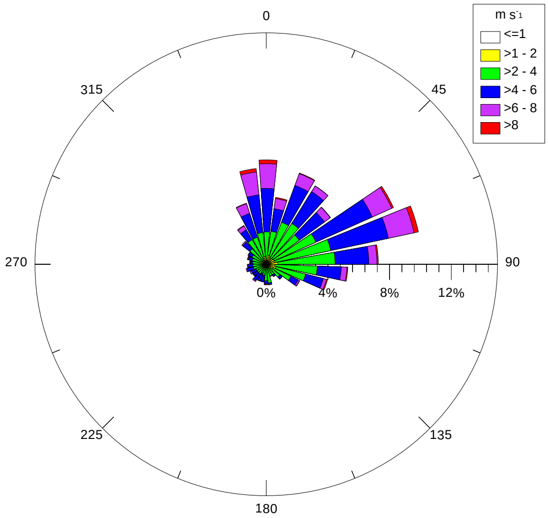
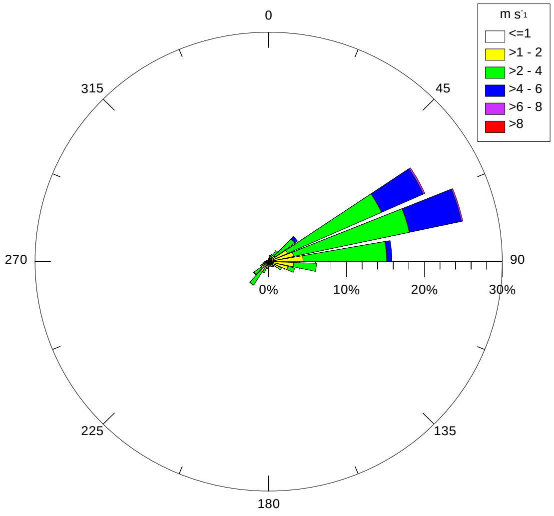


A.3.3 Condamine

Condamine wind obs
March 2016



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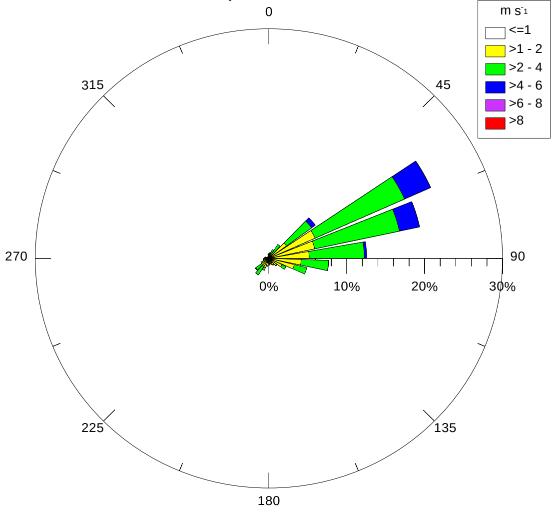
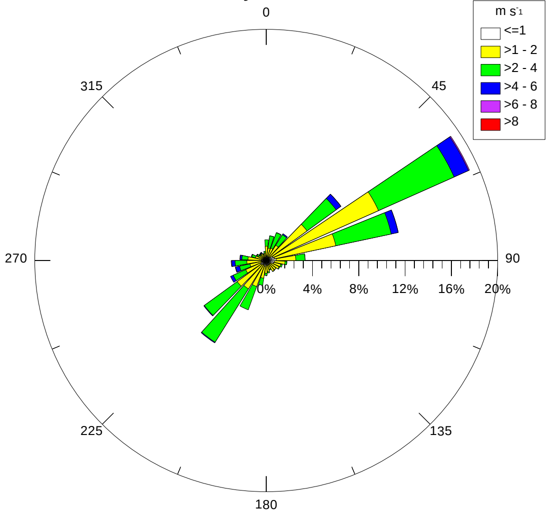
April 2016



Condamine wind obs
May 2016



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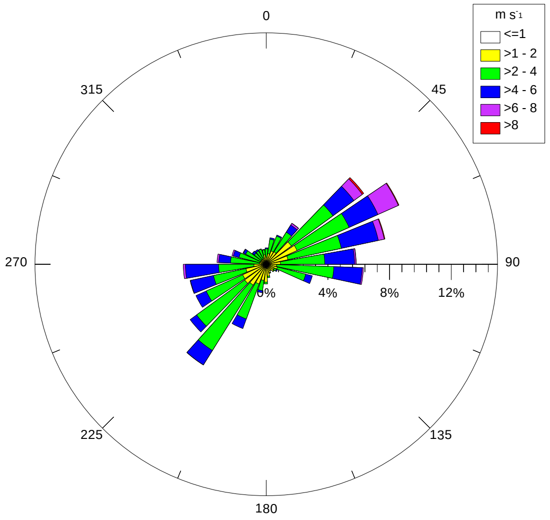

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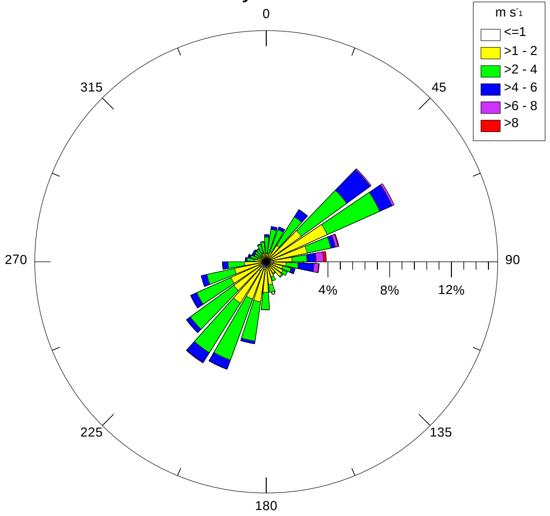
July 2016



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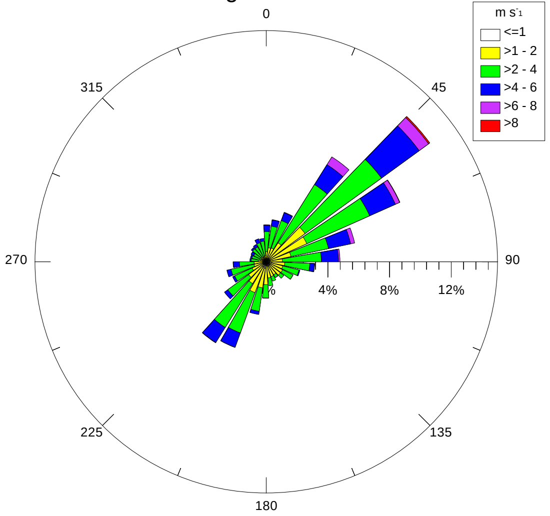
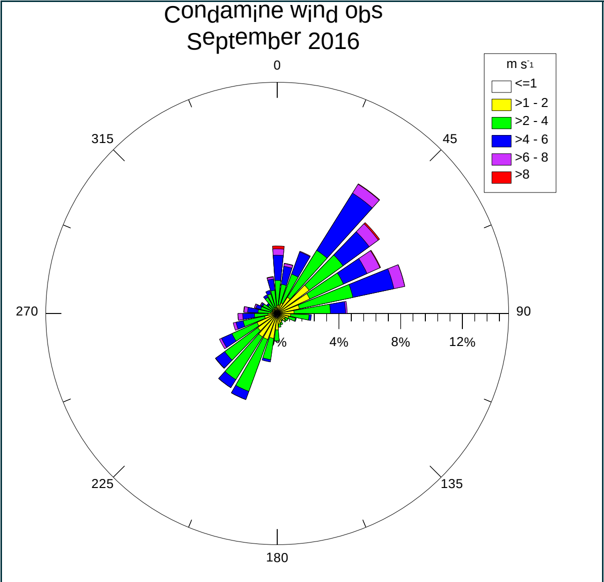
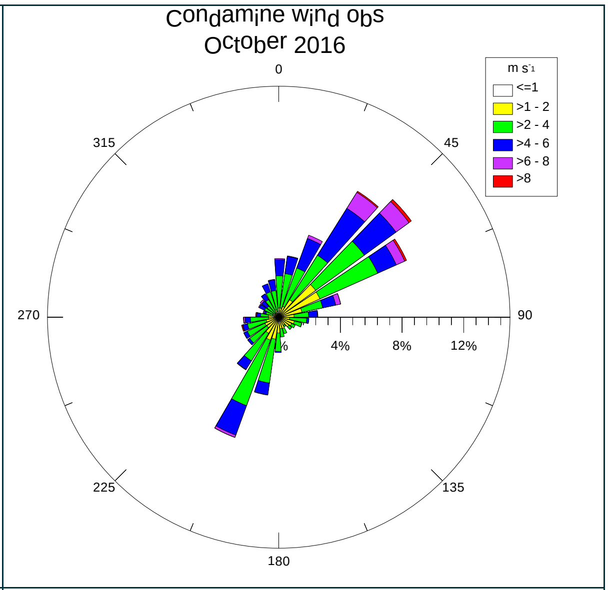
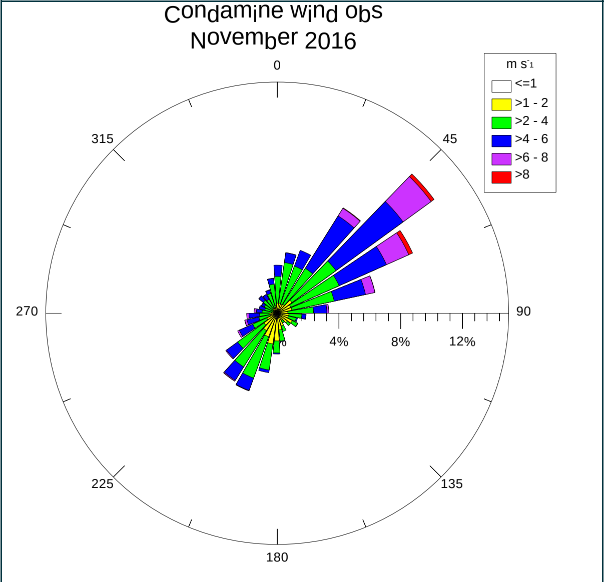
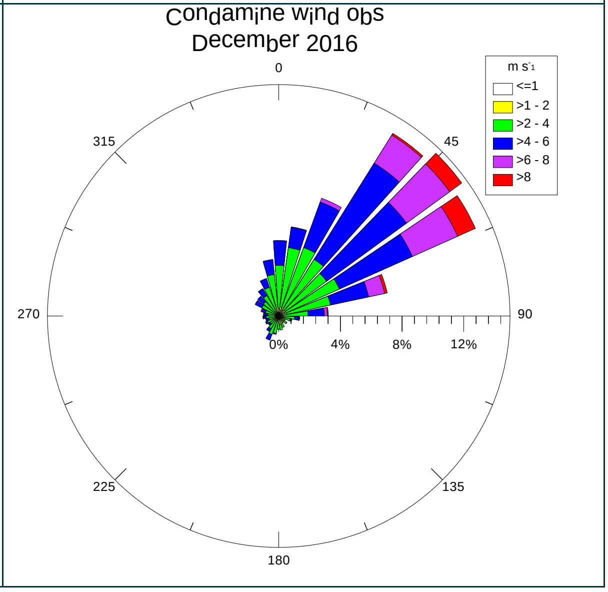
August 2016



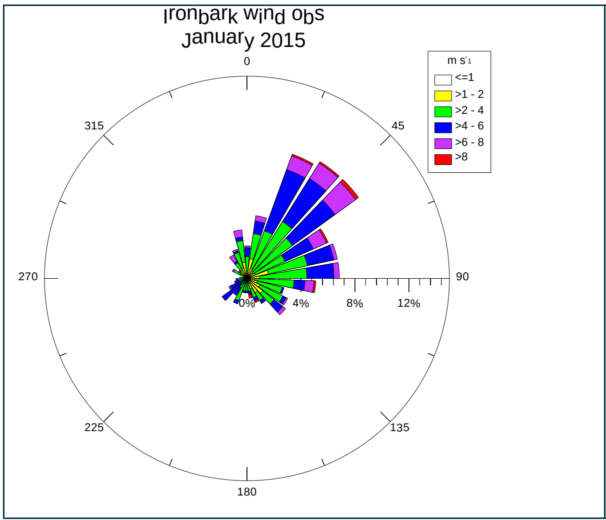


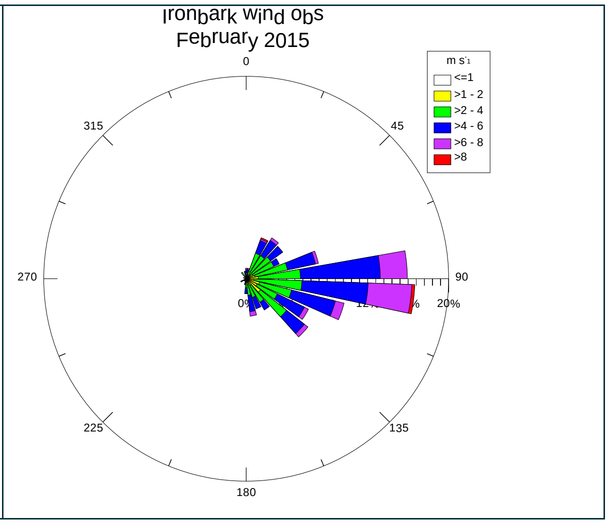






A.3.4 Tara Region/Ironbark





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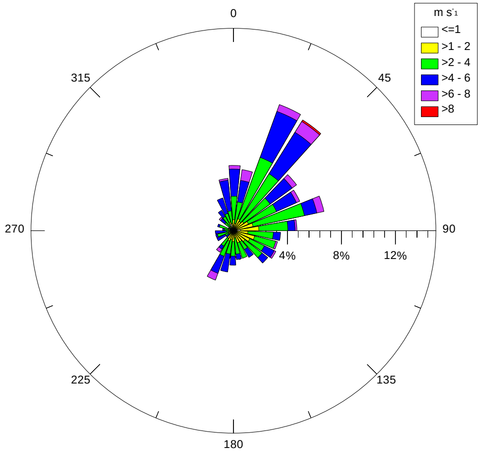

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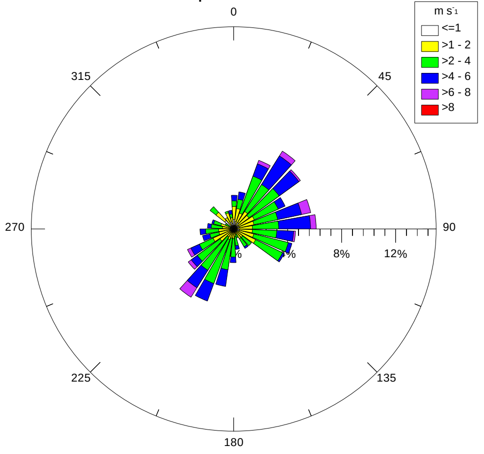

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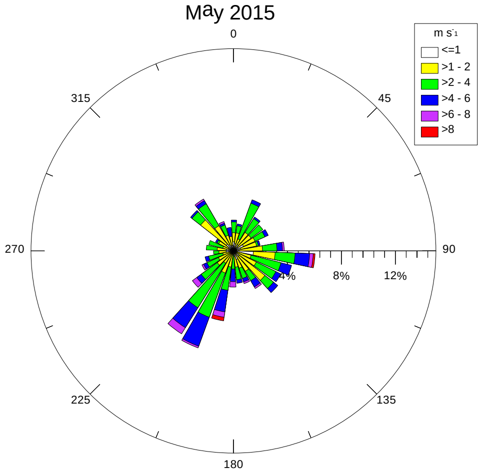

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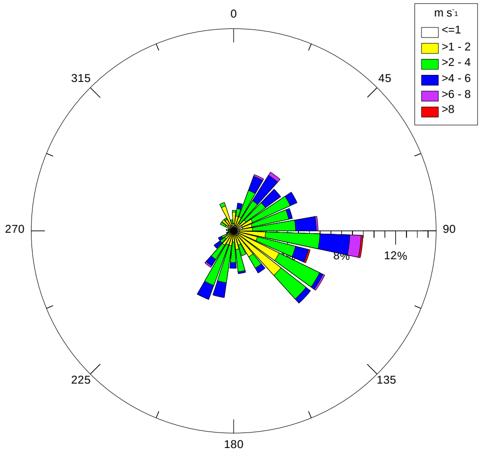

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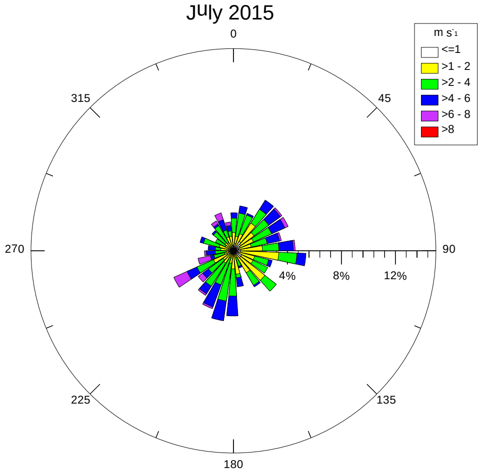

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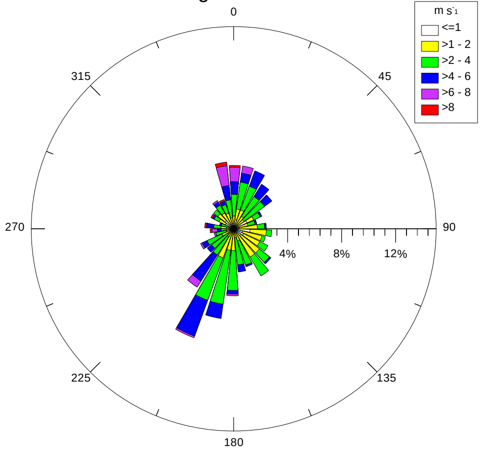

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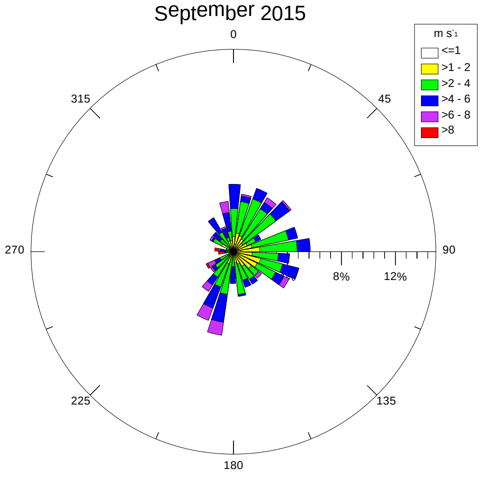

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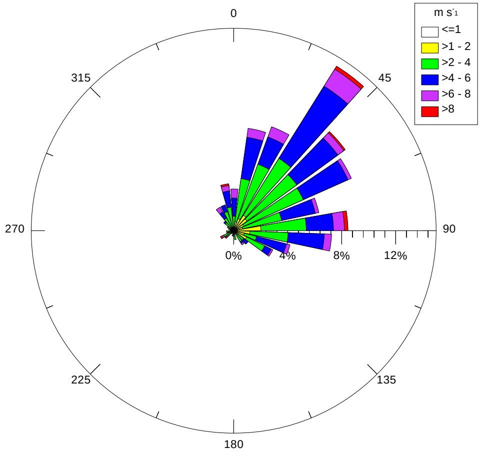

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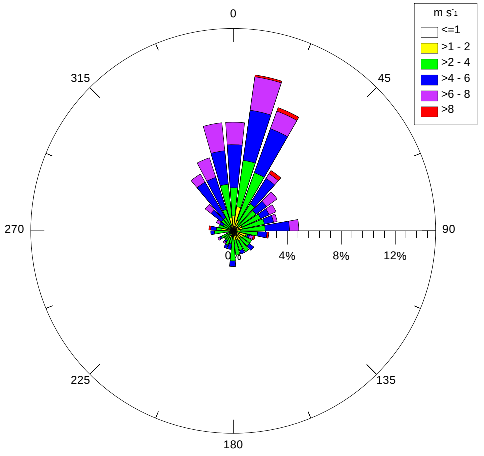

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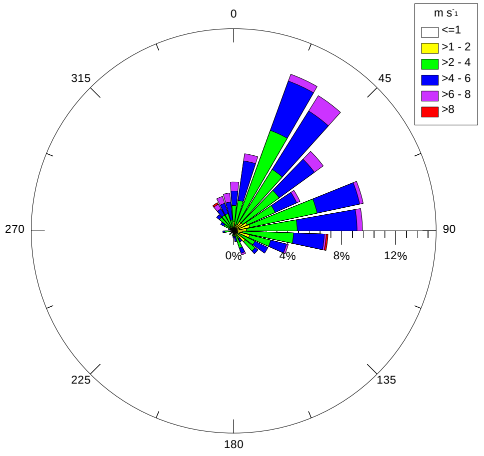

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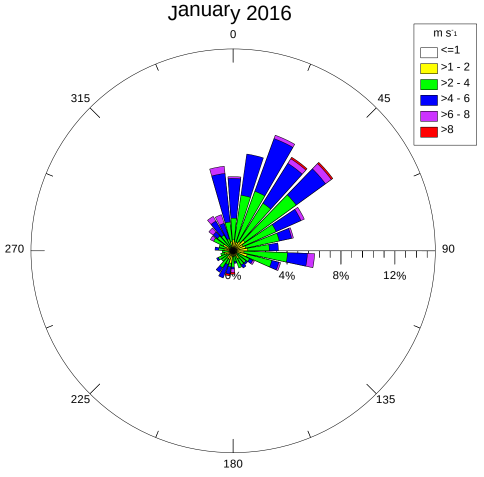

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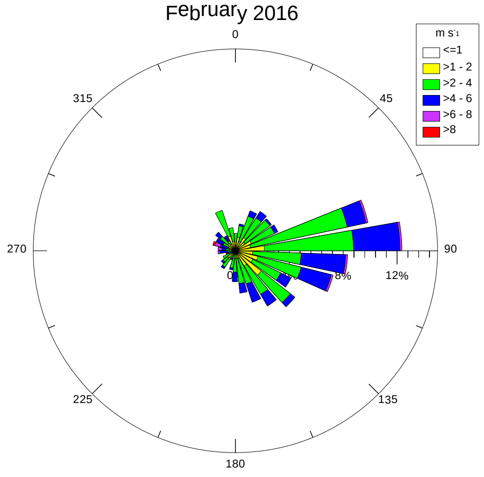

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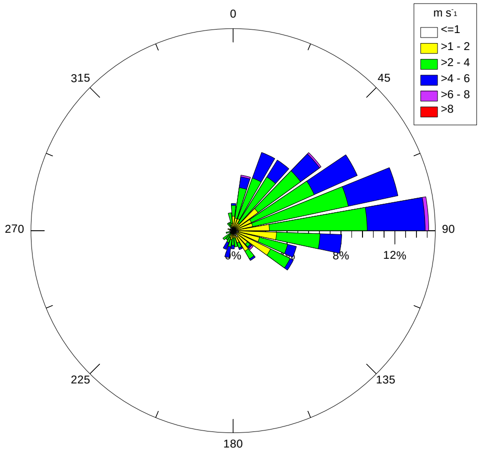

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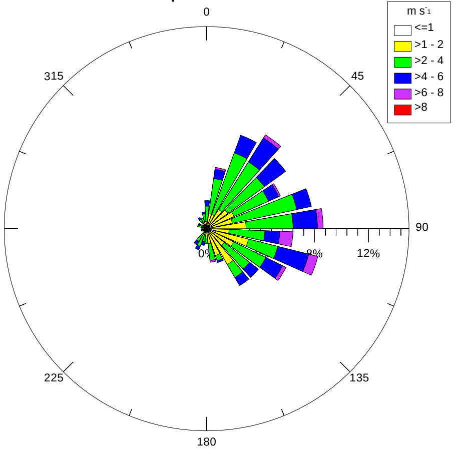
April 2016



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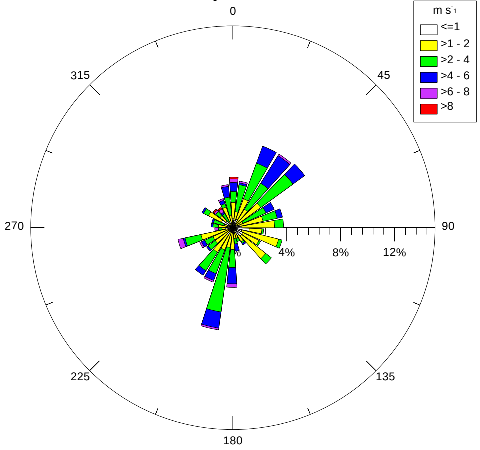

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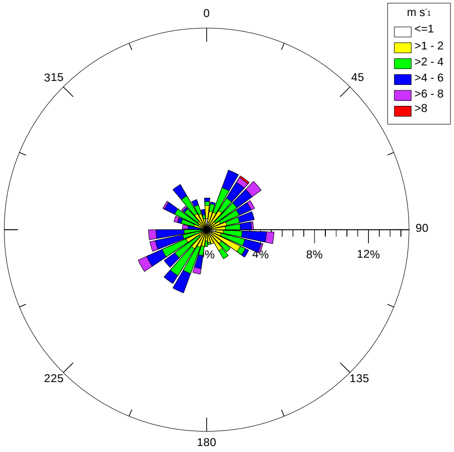

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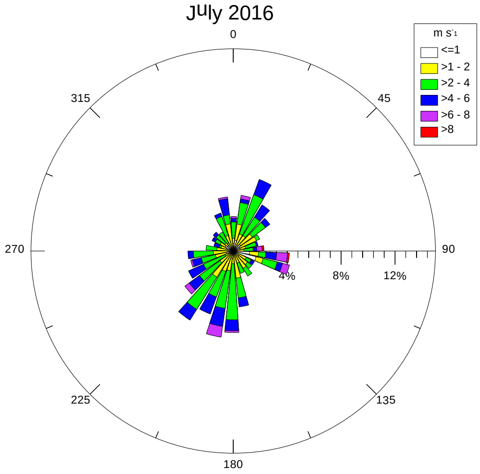

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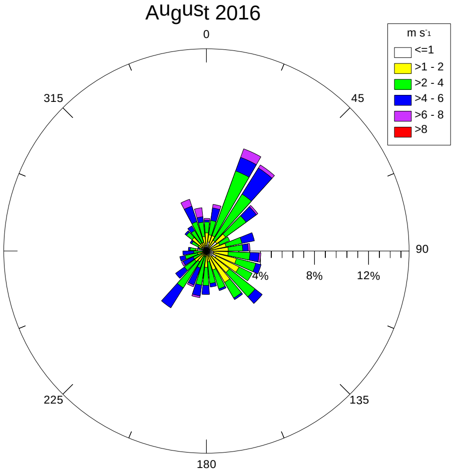

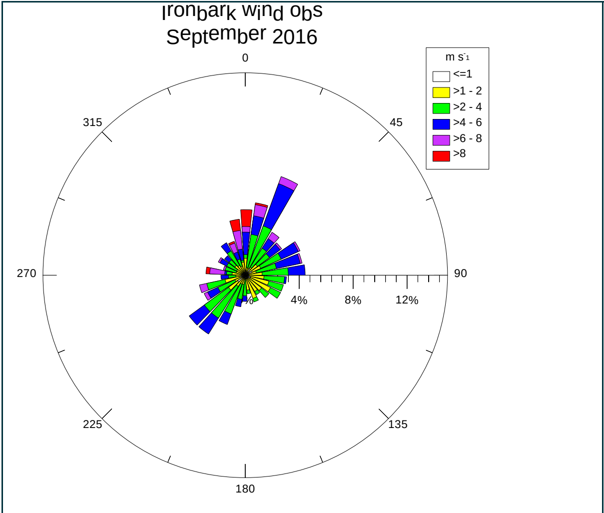
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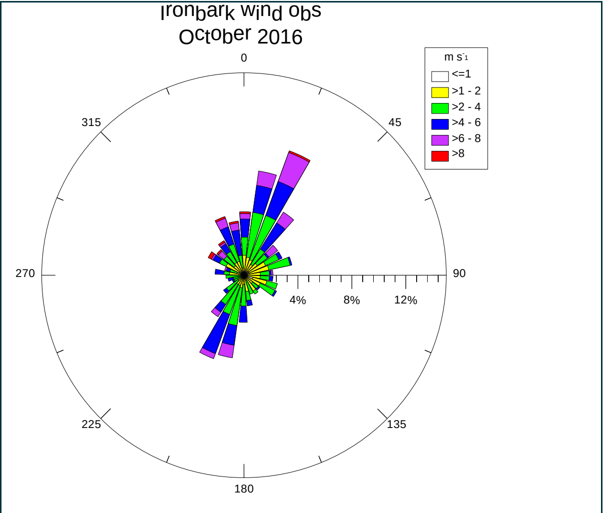
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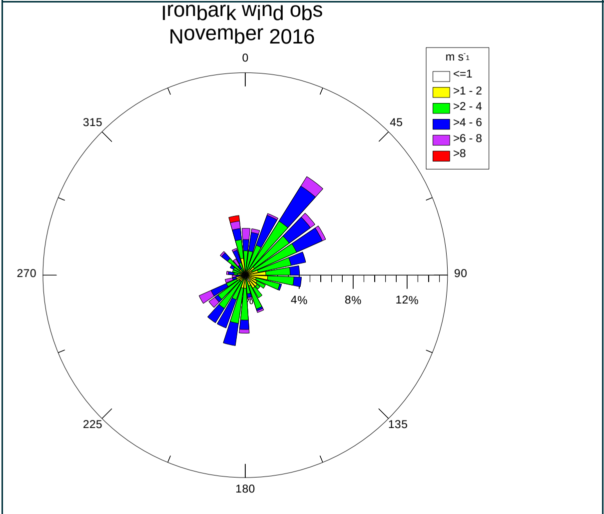
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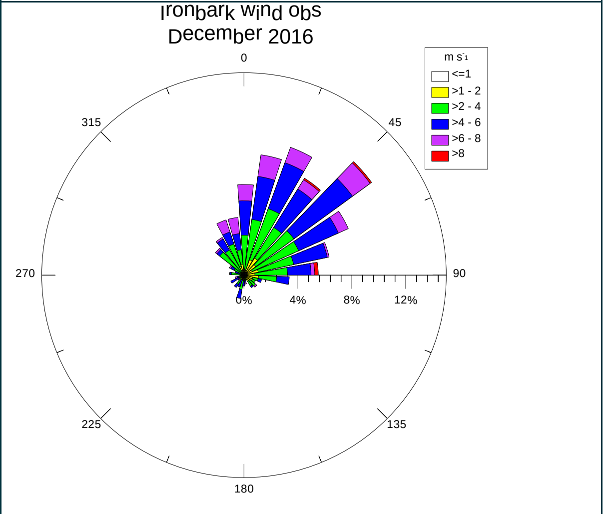
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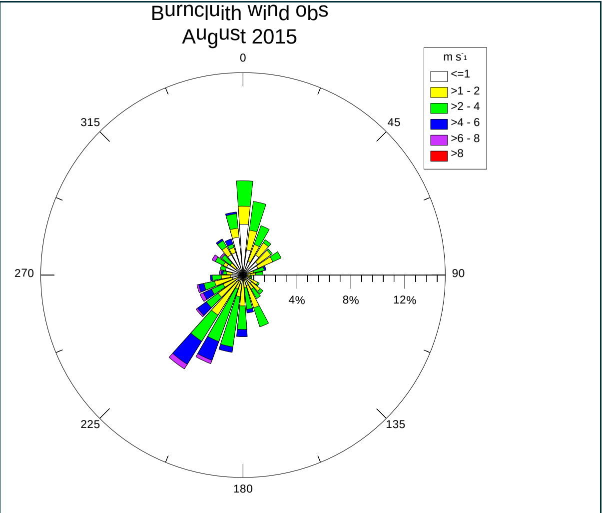
December 2016

A.3.5 Burncluith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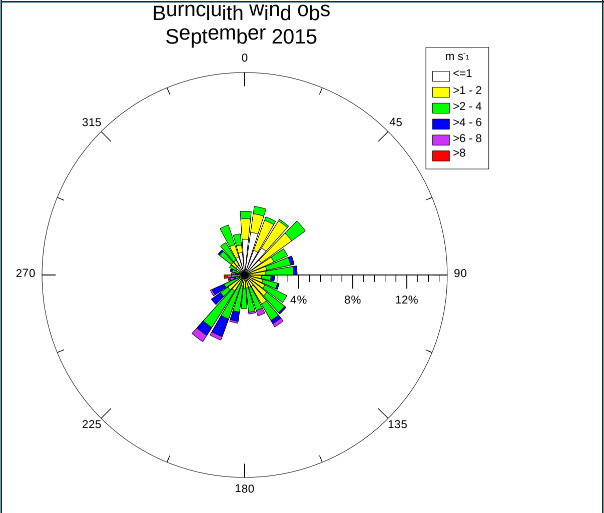
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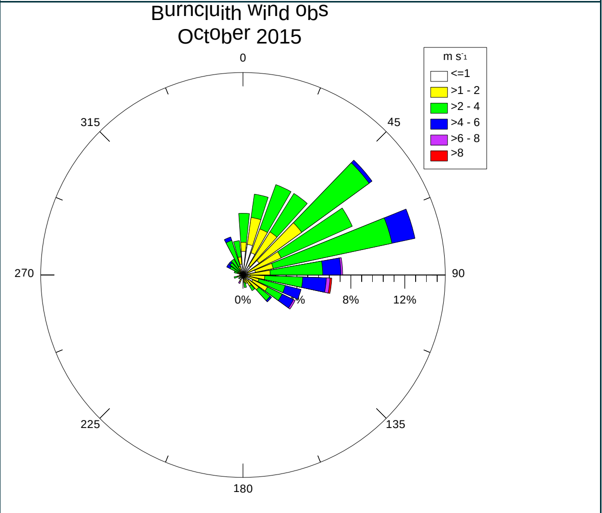
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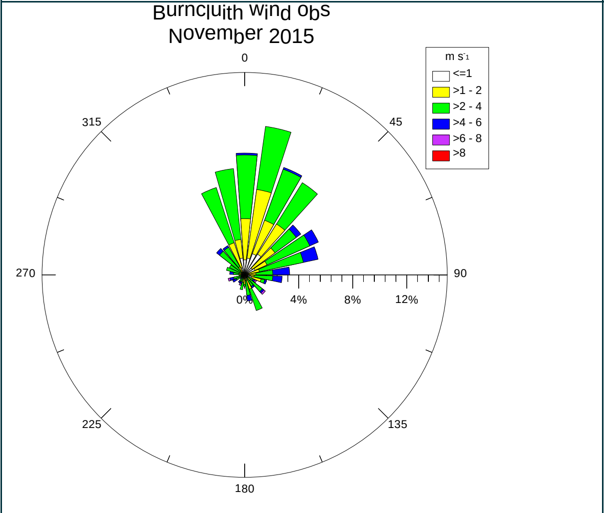
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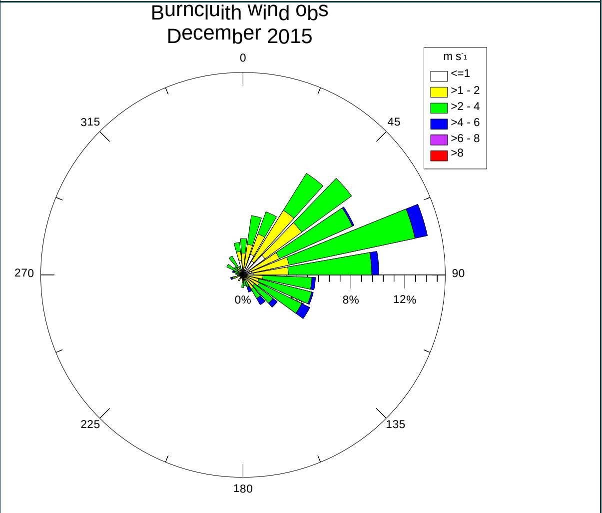
Burncluith Wind Obs
December 2015

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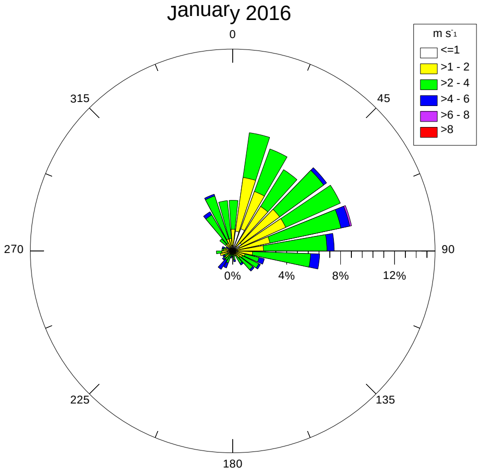
January 2016



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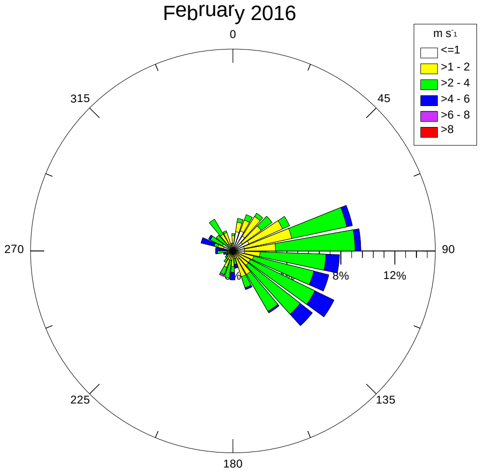

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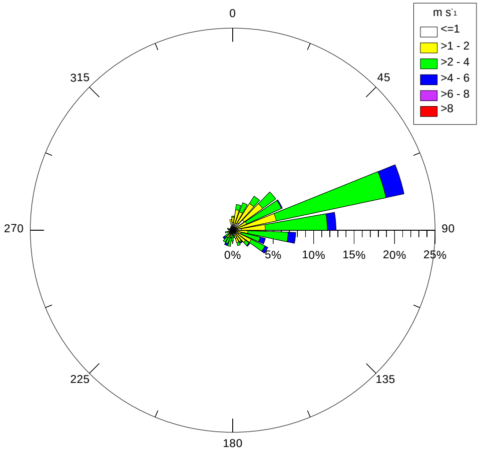

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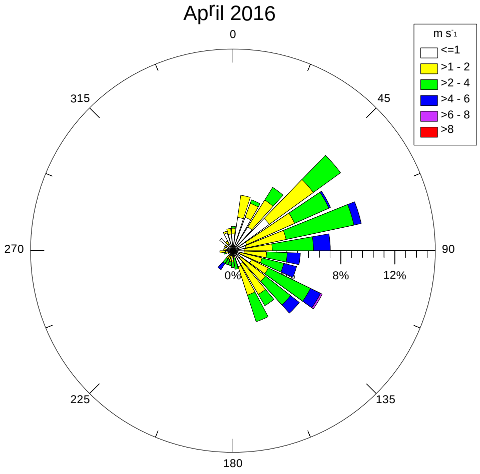

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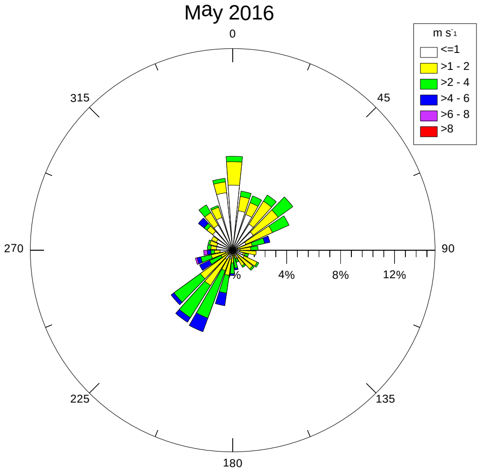

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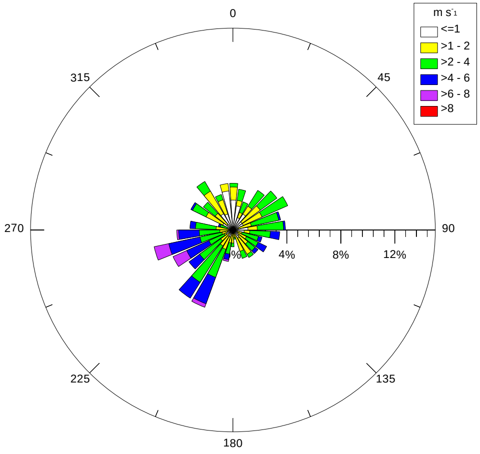

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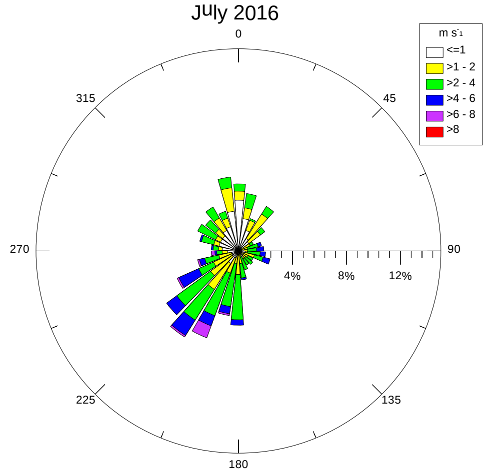

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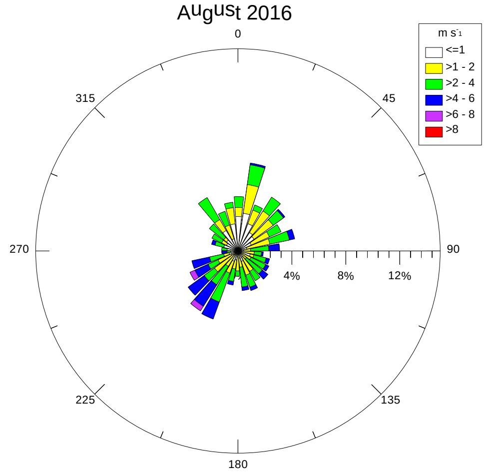

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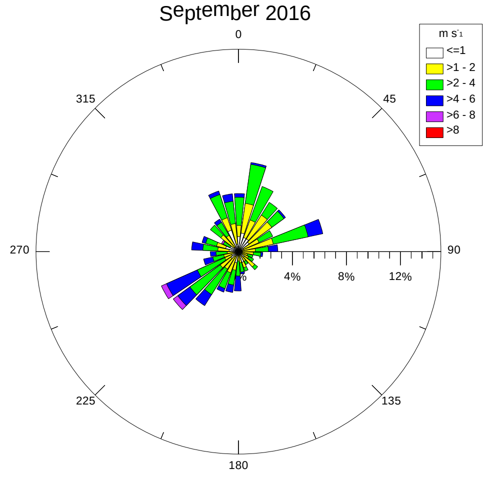

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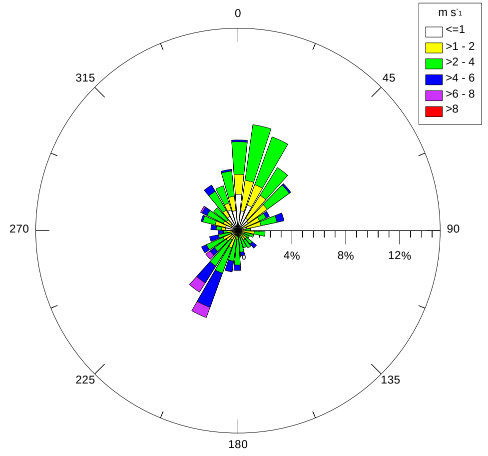

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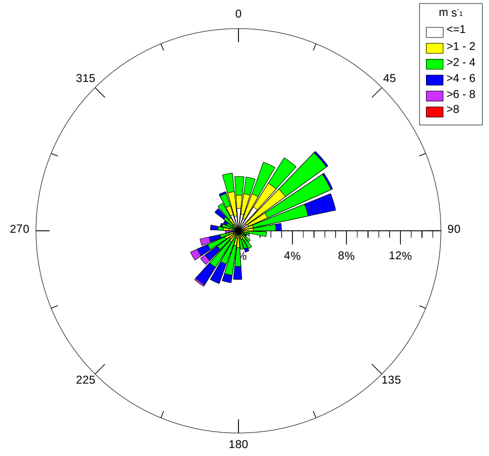

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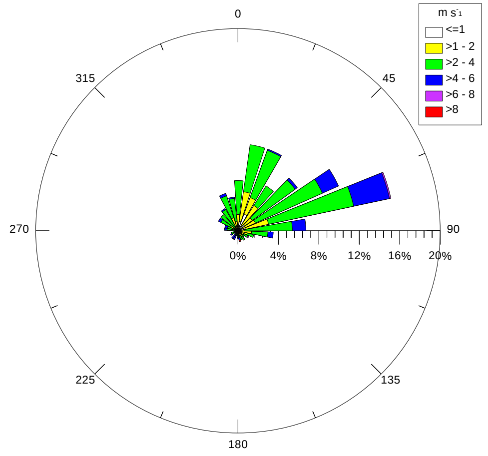
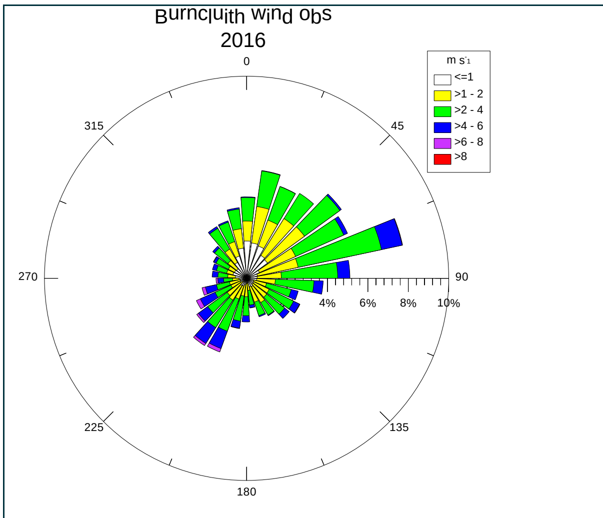



Burncluith wind obs
2016
0
45
90
135
180
225
270
315
4%
6%
8%
10%
m s-1
<=1
>1 - 2
>2 - 4
>4 - 6
>6 - 8
>8

A.4 Reasons for data removal/low data capture and use of indicative data

A.4.1 Reasons for data capture <75%

Data capture rates of <75% for a month are due to missing data, or because some of the data collected have been assessed as being invalid. Data which has been assessed as invalid are not presented in this report.

Reasons for missing data has been divided into 6 categories. Table A.1 below shows the categories, a description of the issue and actions taken to resolve issues and maximise data capture.

Due to the remoteness of the sites, and adverse weather, there were sometimes delays in accessing the sites to assess and resolve the issues listed below. Two of the sites are also on private landholder property which required additional permissions prior to accessing the sites.

Table A. 1 Description of invalid data categories

Category	**Description of issue**	**Actions taken to resolve issue and maximise data capture**
a) Power outage	Instruments cannot run without power. Due to the remoteness of this sites, power was sometimes unreliable, particularly in the summer.	Electricity supplier contacted; local technicians contacted to visit site and investigate issue. Due to the remoteness of the sites, there were sometimes delays in accessing the sites for assessment, diagnosing the cause of the power outage and resolving the issue.
b) Instrument fault	Fault – failure of a component, performance outside of specifications, unrealistic readings as instrument stabilising following a power outage, calibration or service	Diagnosing and resolving the instrument fault was initially performed remotely. If the problem couldn't be identified or resolved, a technician was sent to the site. Servicing was mostly performed on site; occasionally instruments had to be removed and sent to the manufacturer for repair.
c) Instrument commissioned during month	Data capture for month is low when instrument was initially installed/commissioned mid-way through one month	N/A
d) Air conditioning failure	Enclosure gets too hot which can result in instrument failure and damage	Instruments are shutdown automatically (via safety switch) or manually to avoid heat damage to instruments. A local technician was contacted to visit site and reset or repair the air conditioner unit. Servicing of heat damaged instruments was mostly performed on site; occasionally instruments had to be removed and sent to the manufacturer for repair.
e) Calibration out of tolerance	Overnight zeroes and spans not within acceptable tolerance; the calibration system itself fails; multipoint calibrations fail.	Diagnosing and resolving the calibration issue was initially performed remotely. If the problem couldn't be identified or resolved, a technician was sent to the site. Servicing was mostly performed on site; occasionally instruments had to be removed and sent to the manufacturer for repair.
f) Communication/logger failure	Data from instrument can be noisy, corrupt or lost	Diagnosing and resolving the instrument fault was initially performed remotely. If the logger couldn't be remotely access, a technician was sent to the site to regain communications. If logger was faulty, it replaced. Where possible data not able to be remotely collected was able to be recovered from the logger or instrument during the site visit.

A.4.2 Indicative data

Some data which has been used in this report does not comply with Australian standard measurement methods. This indicative data has been assessed as being of acceptable quality for use in this report using instrument checks, calibrations, and comparing data obtained with other co-located or nearby instruments.

While ozone, oxides of nitrogen and carbon monoxide methods used in this study are compliant with Australian standards, there are some occasions during the study period when the data was not compliant, due to all requirements of the Australian Standard method not being met. Examples are provided in Table A2.

The $PM_{2.5}$ and PM_{10} method used in this study is a European certified method but not an Australian standard method. This instrument has been run according to the manufacturer's operating procedures. CSIRO deployed a system based on beta attenuation which produces data equivalent to Australian Standard Methods (AS/NZS 3580.9.11.2008 (PM10) and AS/NZS 3580.9.12:2013 ($PM_{2.5}$)). A comparison of $PM_{2.5}$ and PM_{10} data obtained using the different methods will be provided in the final report, and any implications discussed.

The methane and carbon dioxide measurements using cavity ring down technique were not run using an Australian Standard method, which became available in 2016. This instrument has been run according to the manufacturer's operating procedures.

A summary of the specific reasons why data was indicative/not compliant with Australian Standards is given below, as well as indicators used to assess that indicative data was of acceptable quality (Table A. 2.)

Table A. 2 Reasons that some data did not meet requirements of Australian Standards, and indicators used to assess whether data was acceptable quality for use in this study

	Reasons for indicative data/data not meeting Australian standard requirements	**Indicators of acceptable data quality (where applicable)**
Ozone	Calibrations not carried out within the specified time or at frequency required by the Australian Standard Suspected calibrator fault. Automatic span calibrations out of tolerance Shelter above 30°C (outside recommended range)	Daily and spans and zeros are within scope Data correlates with other nearby sites
$PM_{2.5}$, PM_{10}	Method not covered by an Australian Standard Calibration out of tolerance (isolated event)	Instrument operation follows manufactures instructions including recommended zero and span checks Method comparison for PM2.5 and PM10 between this technique and another technique which produces data equivalent to Australian Standard Methods (AS/NZS 3580.9.11.2008 (PM10) and AS/NZS 3580.9.12:2013 (PM2.5)) will be presented in final report (see A.2)
Methane and carbon dioxide	Cell pressure outside tolerance Overnight span was not triggered/did not occur (isolated events) Calibrations not undertaken at required frequency	Methane data correlates with co-located instrument (TVOC/CH4 monitor) and methane data from nearby sites
Oxides of nitrogen	No valid overnight calibrations for several nights Multipoint calibration failed (isolated event) Overdue proficiency audit or converter efficiency check Shelter above 30°C (outside recommended range)	

Carbon monoxide	Chassis temperature out of tolerance (isolated event) Suspected calibrator fault. Automatic span calibrations out of tolerance (isolated event) Overdue proficiency audit Shelter above 30°C (outside recommended range)	
Total VOC	Overnight span was not triggered/did not occur Overdue proficiency audit and multipoint calibration Shelter above 30°C (outside recommended range)	

A.5 Event investigations - Fire Hotspot data

Hotspots referred to in Section 4 are derived from satellite-born instruments that detect light in the thermal wavelengths. The satellite data are processed with a specific algorithm that highlights areas with an unusually high temperature.

Two different satellite products were used to investigate the presence of fires in the study area in this report – Sentinel Hotspots and NASA Worldview.

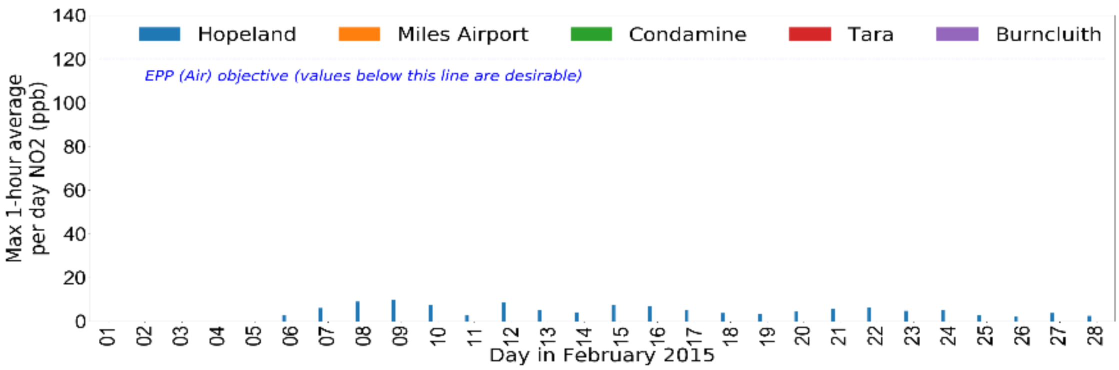
Sentinel Hotspots - Sentinel is an Australian bushfire monitoring system that provides information about fire hotspots. Sources – MODIS sensor aboard NASA Terra and Aqua satellites, AVHRR (Advanced Very High Resolution Radiometer) night time imagery from NOAA satellites, VIIR on the Suomi-NPP satellite. © Commonwealth of Australia (Geoscience Australia) 2018.

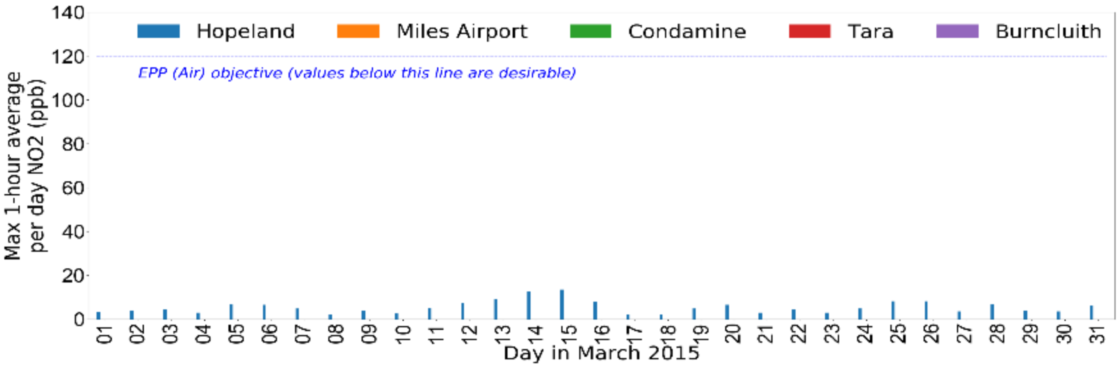
NASA Worldview is a component of the NASA Earth Observing System Data and Information System (EOSDIS). The Worldview tool from NASA's Earth Observing System Data and Information System (EOSDIS) provides the capability to interactively browse historical fire data. FIRMS (Fire Information for Resource Management System) can be used to download the historical data. NASA Worldview provides fire products from the Moderate Resolution Imaging Spectroradiometer (MODIS) (MCD14DL) and the Visible Infrared Imaging Radiometer Suite (VIIRS) 375 m (VNP14IMGTDL_NRT))

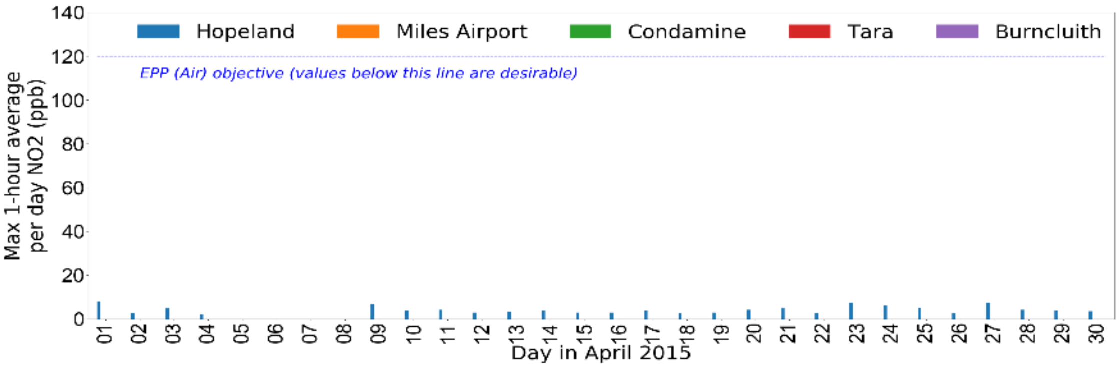
We acknowledge the use of data and imagery from LANCE FIRMS operated by the NASA/GSFC/Earth Science Data and Information System (ESDIS) with funding provided by NASA/HQ.

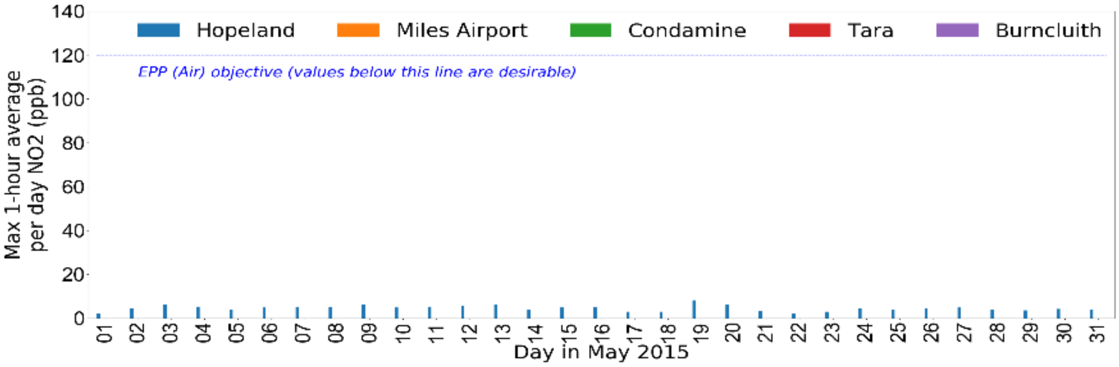
A.6 Daily summary Plots

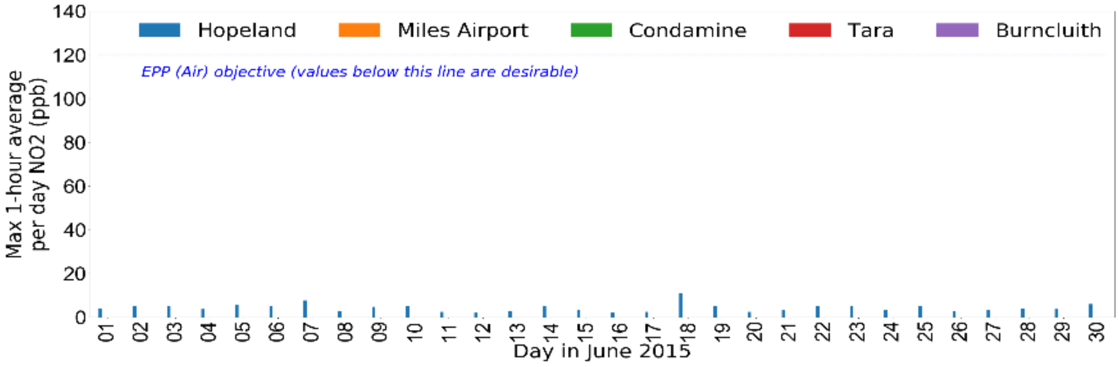
A.6.1 Nitrogen dioxide- maximum 1 hour average from February 2015 – December 2016

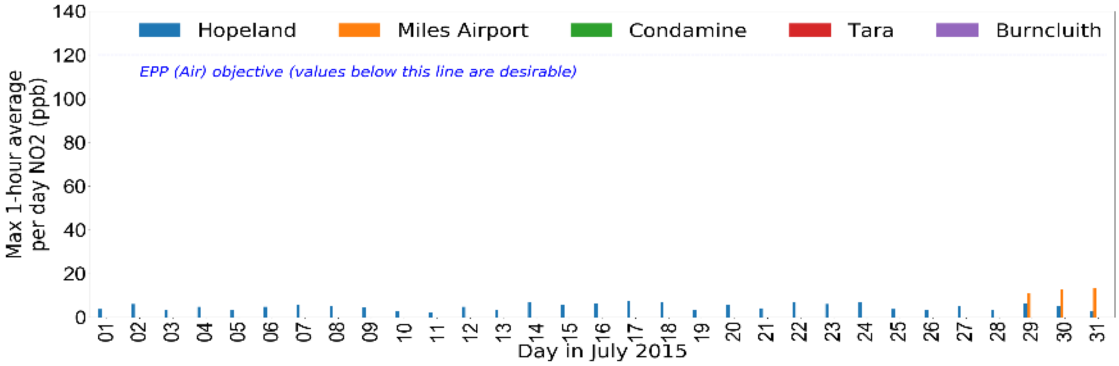


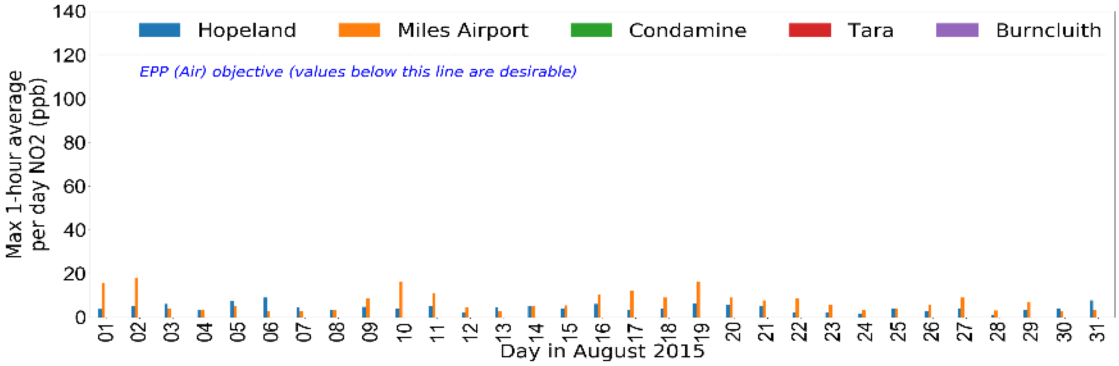




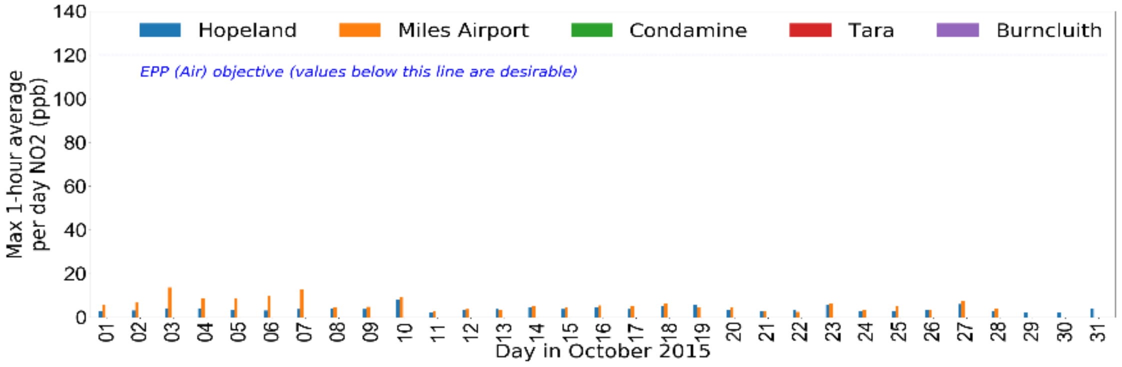


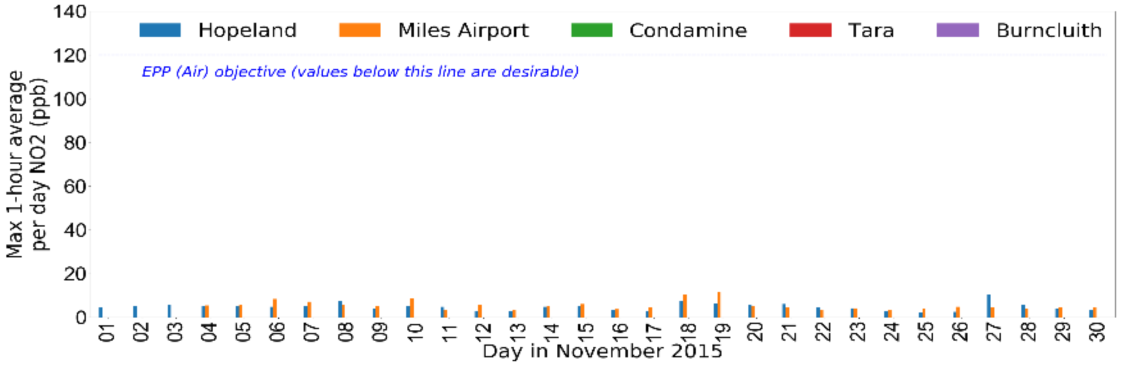

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day NO2 (ppb)
140
120
100
80
60
40
20
0
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in June 2015

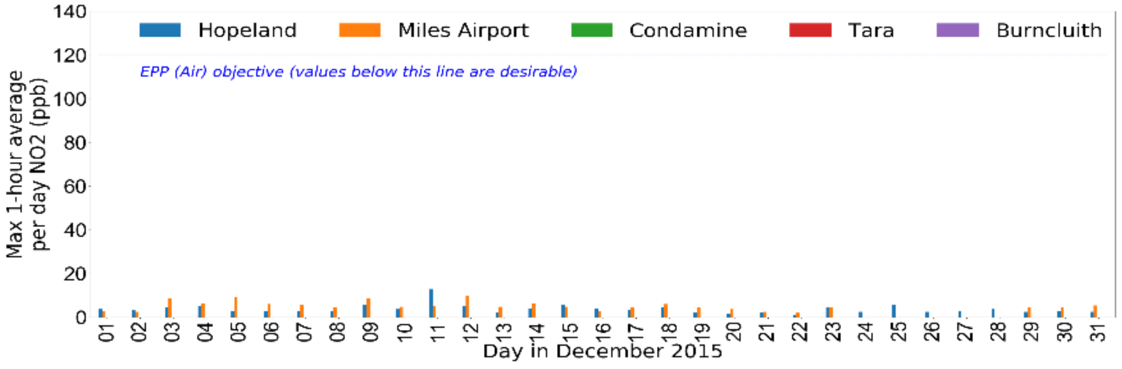

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day NO2 (ppb)
140
120
100
80
60
40
20
0
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in July 2015


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day NO2 (ppb)
140
120
100
80
60
40
20
0
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in August 2015

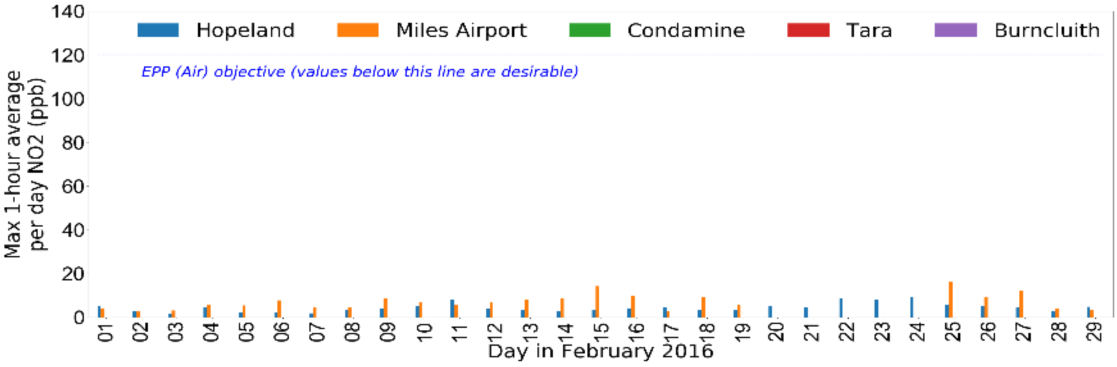

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day NO2 (ppb)
140
120
100
80
60
40
20
0
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in September 2015

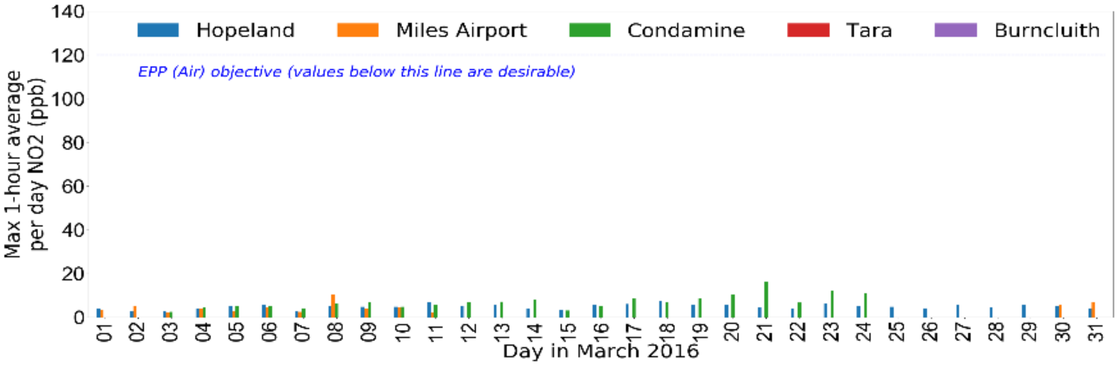

Max 1-hour average per day NO2 (ppb)
140
120
100
80
60
40
20
0
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in October 2015

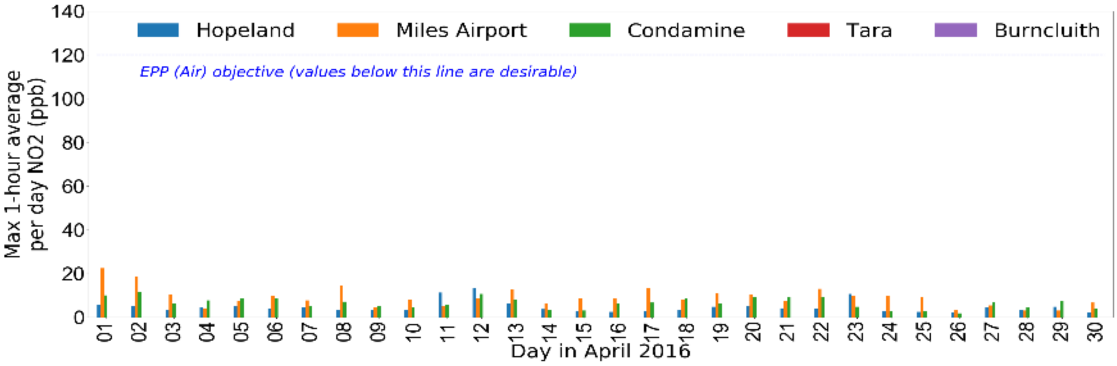

Max 1-hour average per day NO2 (ppb)
140
120
100
80
60
40
20
0
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in November 2015

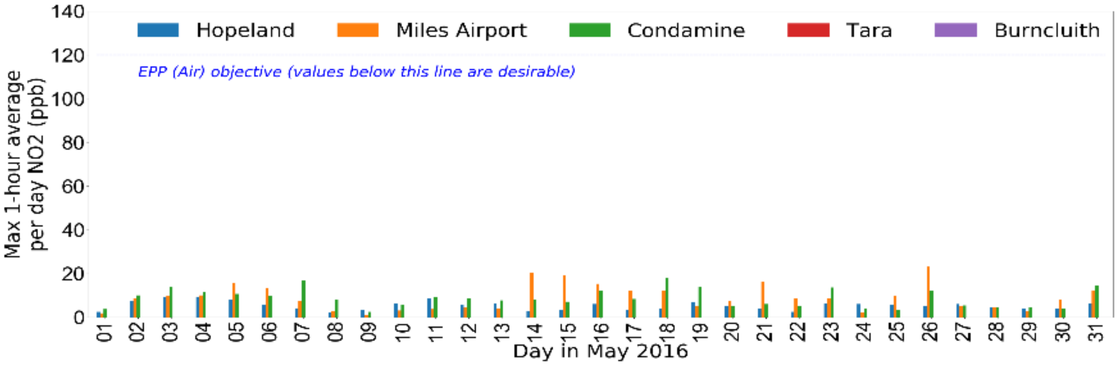

Max 1-hour average per day NO2 (ppb)
140
120
100
80
60
40
20
0
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in December 2015

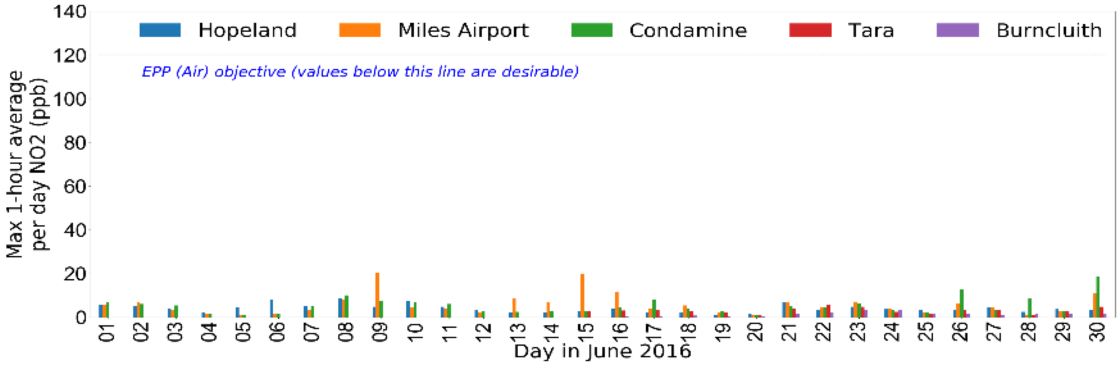

Max 1-hour average per day NO2 (ppb)
140
120
100
80
60
40
20
0
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in January 2016

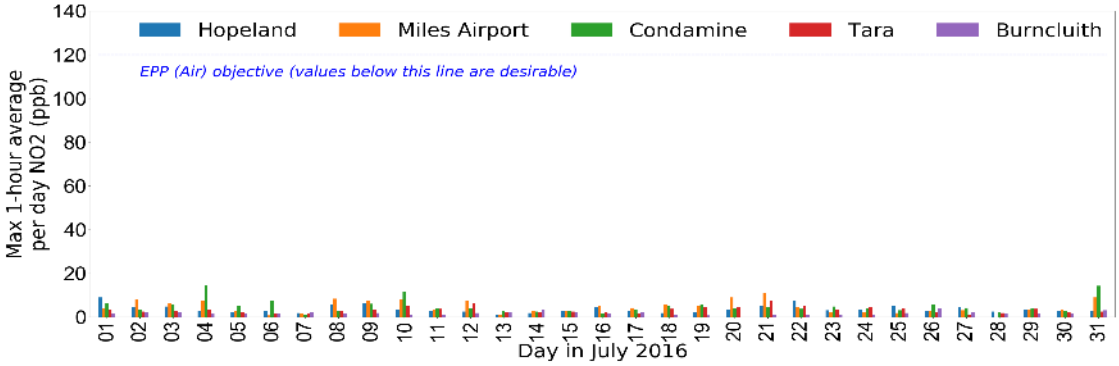

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day NO2 (ppb)
140
120
100
80
60
40
20
0
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
Day in February 2016

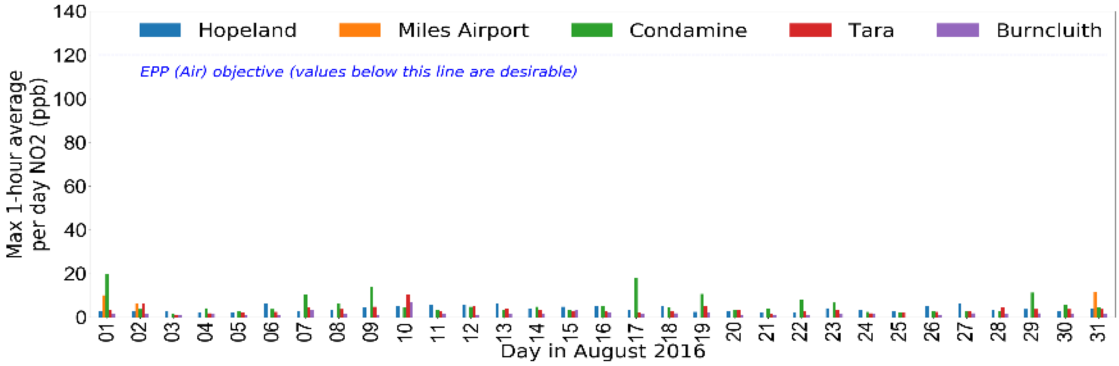

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day NO2 (ppb)
140
120
100
80
60
40
20
0
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in March 2016

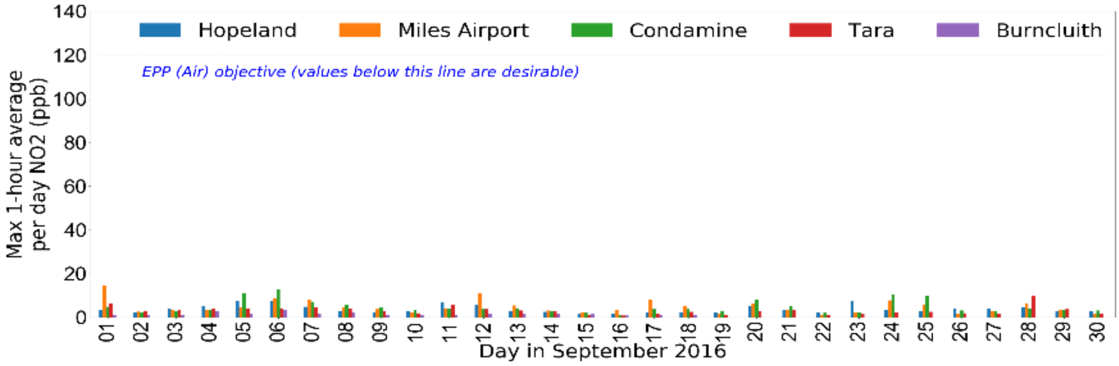

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day NO2 (ppb)
140
120
100
80
60
40
20
0
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in April 2016

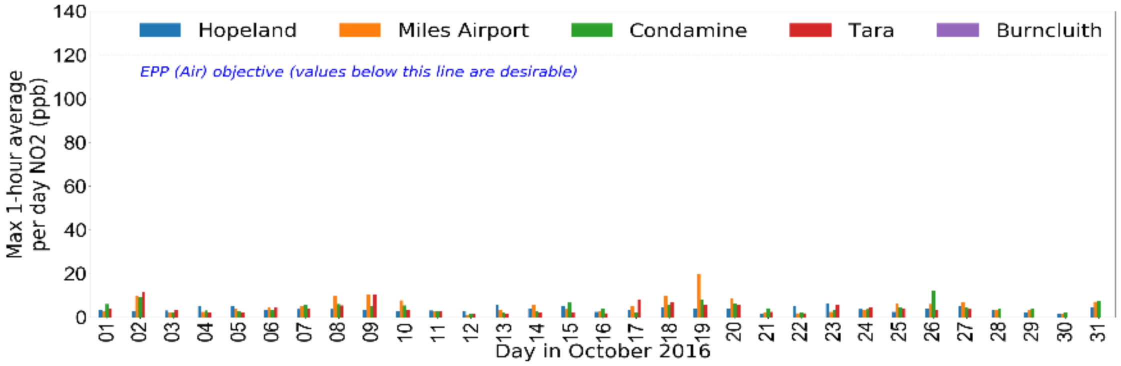

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day NO2 (ppb)
140
120
100
80
60
40
20
0
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in May 2016

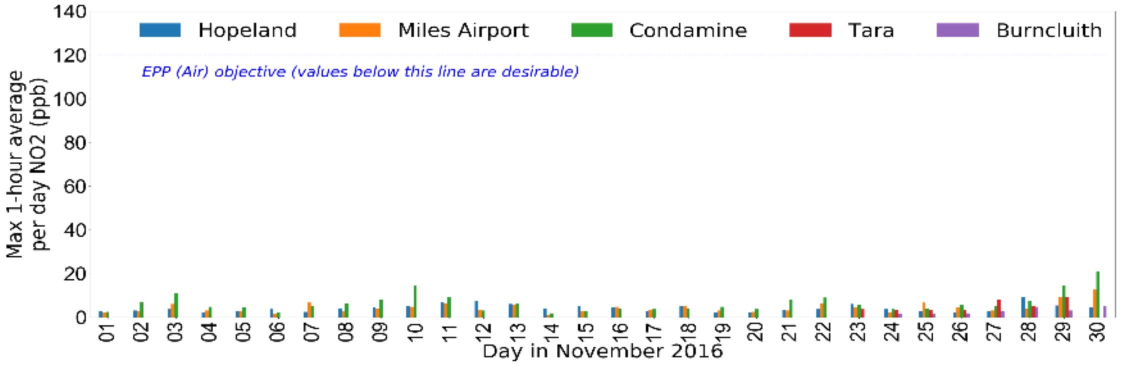

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day NO2 (ppb)
0
20
40
60
80
100
120
140
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in June 2016

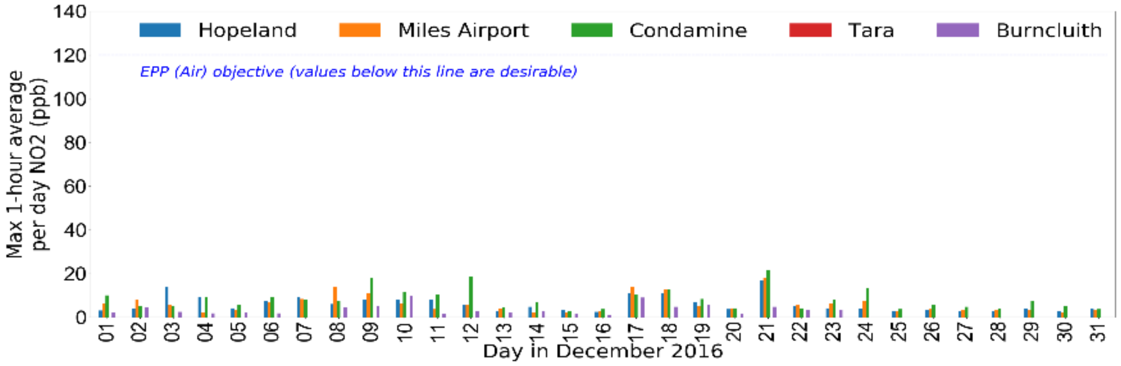

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day NO2 (ppb)
0
20
40
60
80
100
120
140
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in July 2016


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day NO2 (ppb)
0
20
40
60
80
100
120
140
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in August 2016

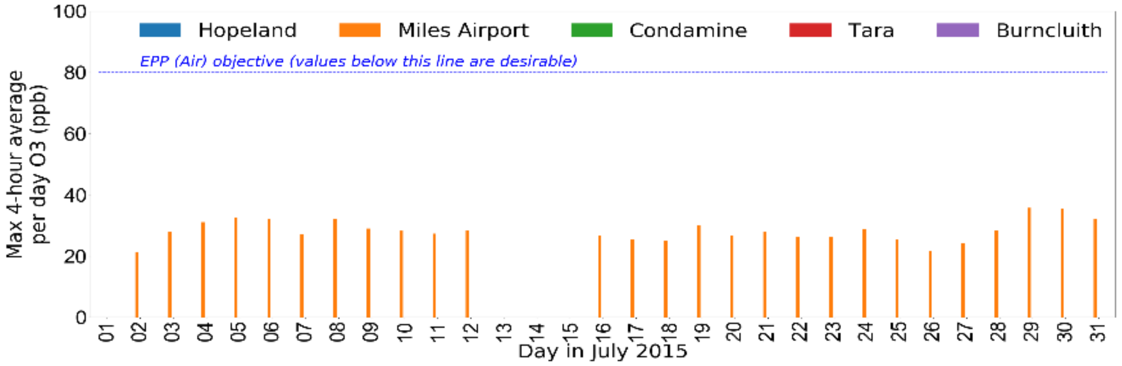

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day NO2 (ppb)
0
20
40
60
80
100
120
140
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in September 2016

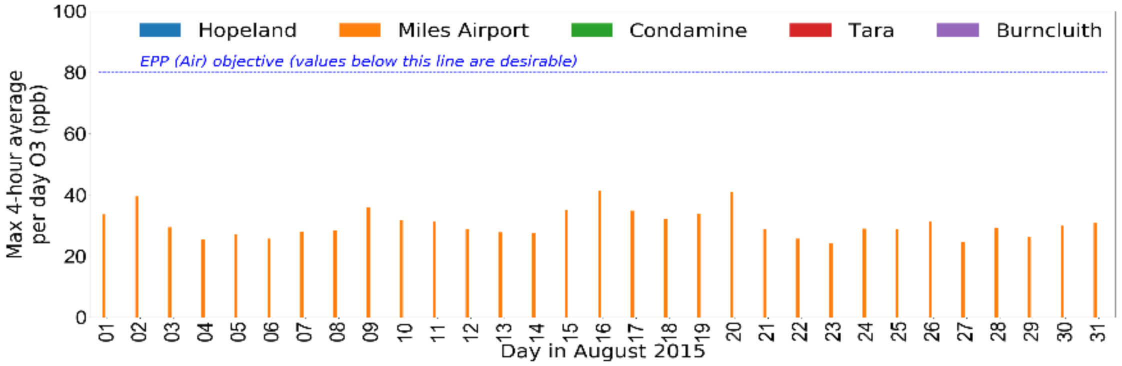

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day NO2 (ppb)
0
20
40
60
80
100
120
140
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in October 2016

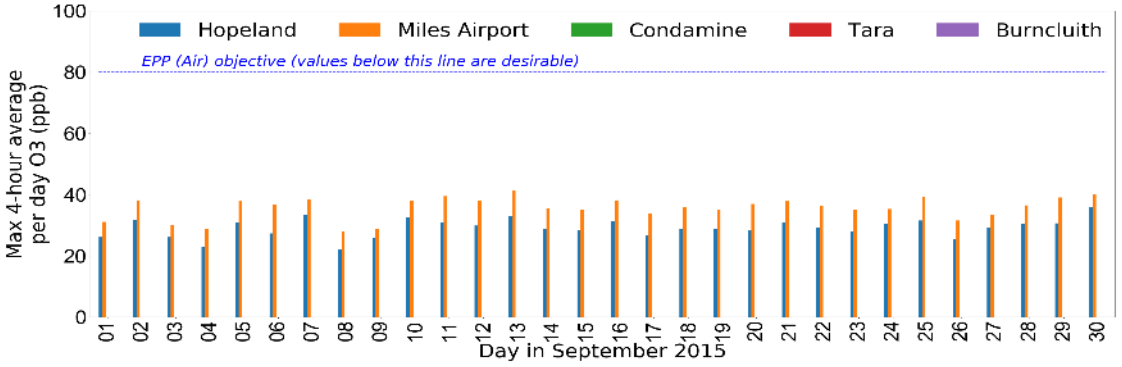

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day NO2 (ppb)
0
20
40
60
80
100
120
140
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in November 2016

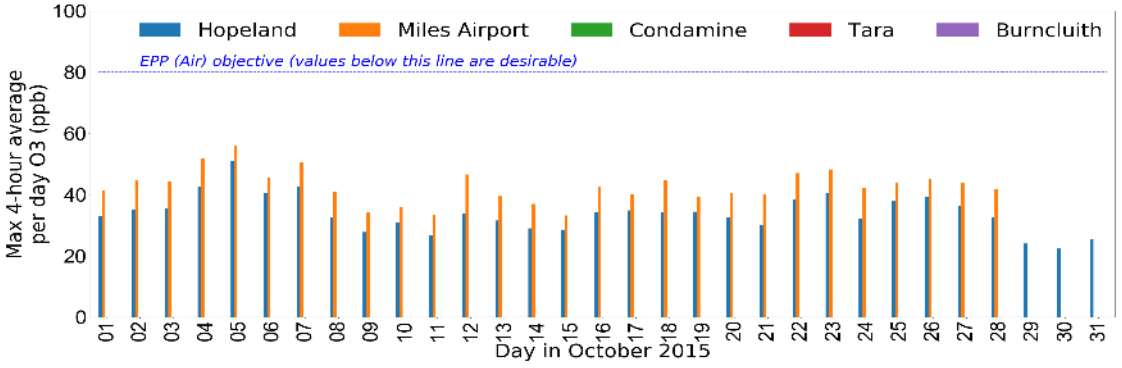

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day NO2 (ppb)
0
20
40
60
80
100
120
140
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in December 2016

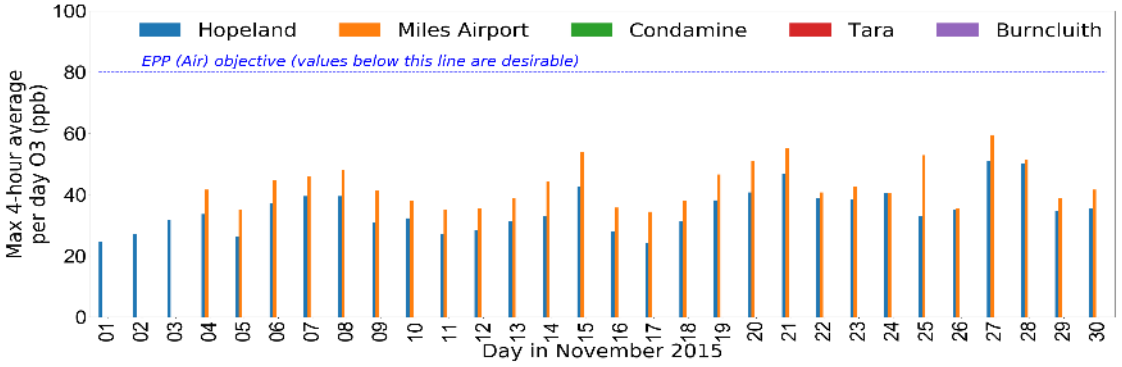
A.6.3 Ozone - maximum 4-hour concentration for all sites, for July 2015 – December 2016

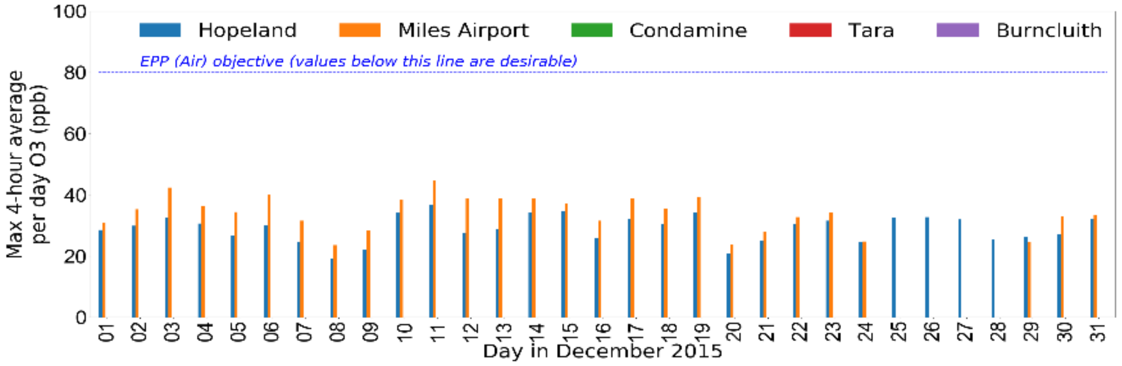


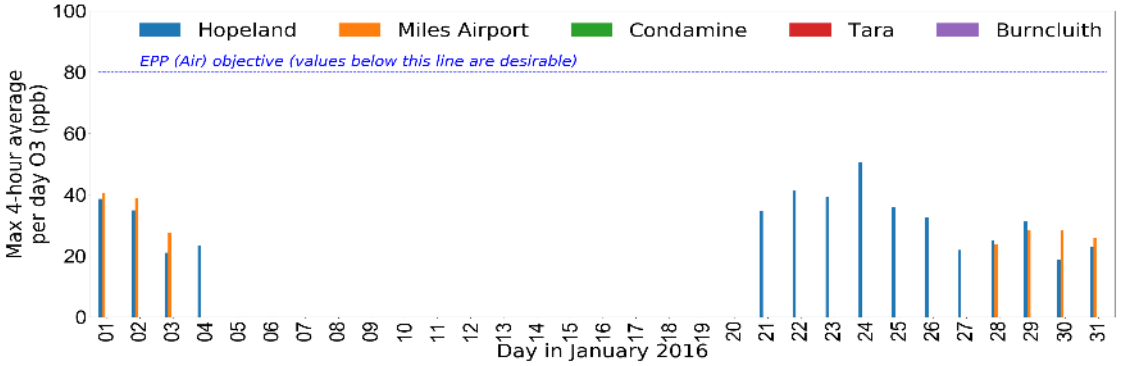


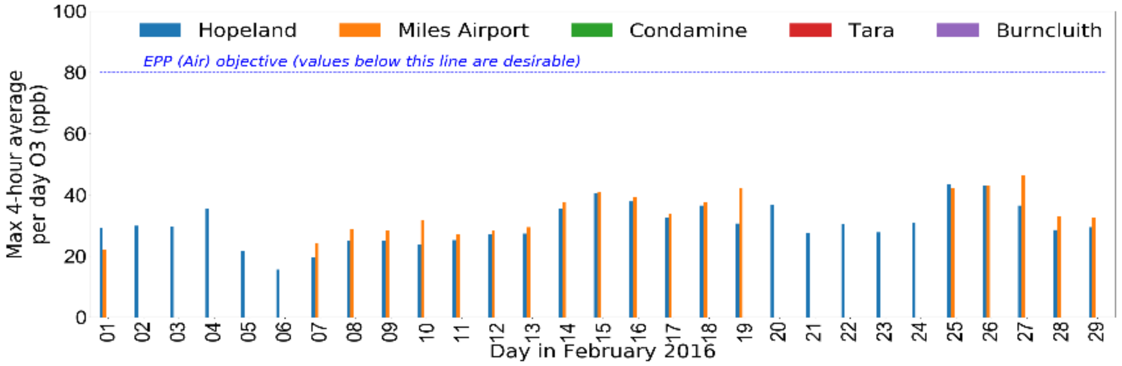


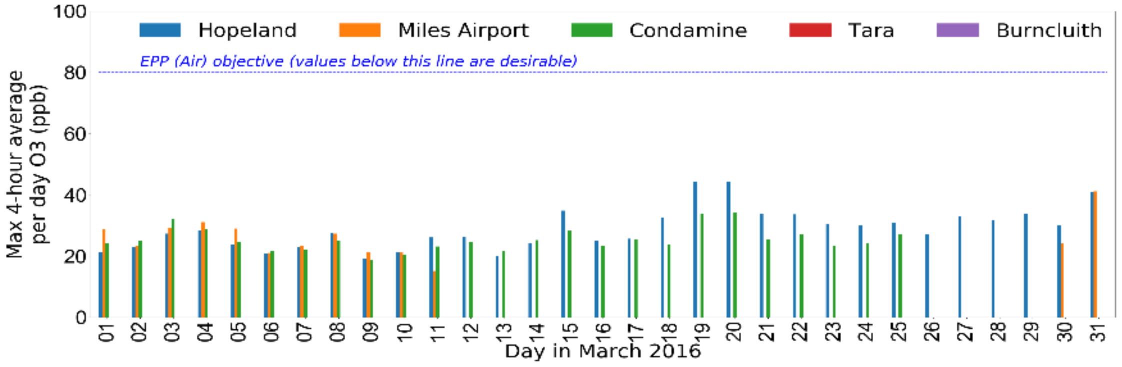


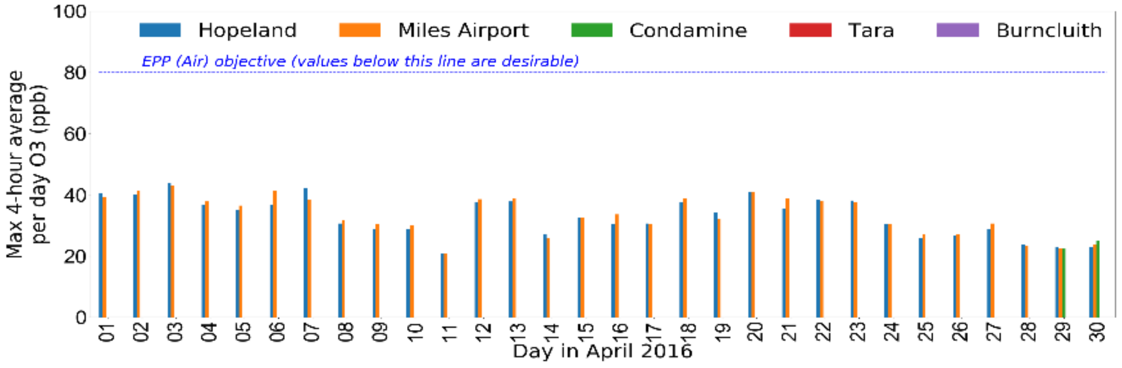

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 4-hour average per day O3 (ppb)
0
20
40
60
80
100
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in November 2015

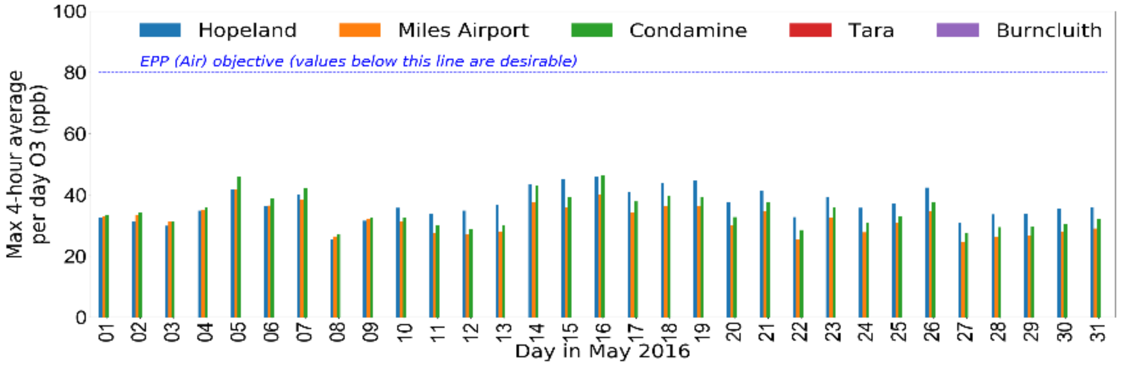

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 4-hour average per day O3 (ppb)
0
20
40
60
80
100
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in December 2015

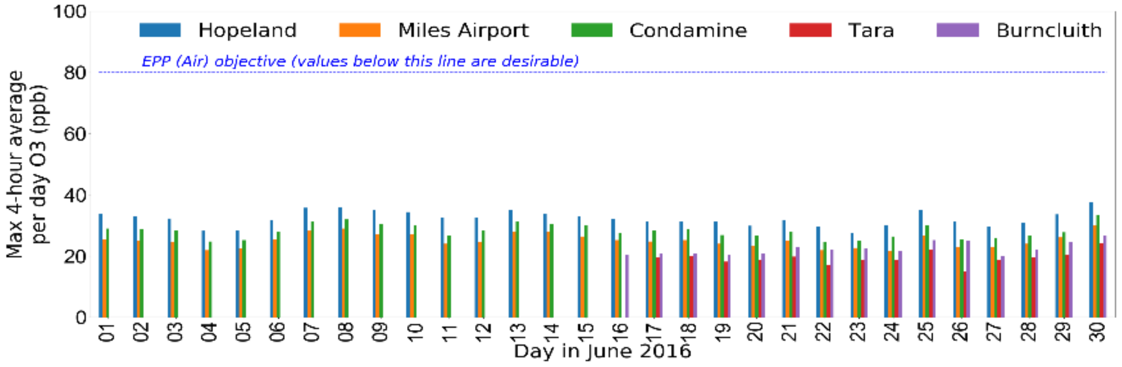

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 4-hour average per day O3 (ppb)
0
20
40
60
80
100
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in January 2016

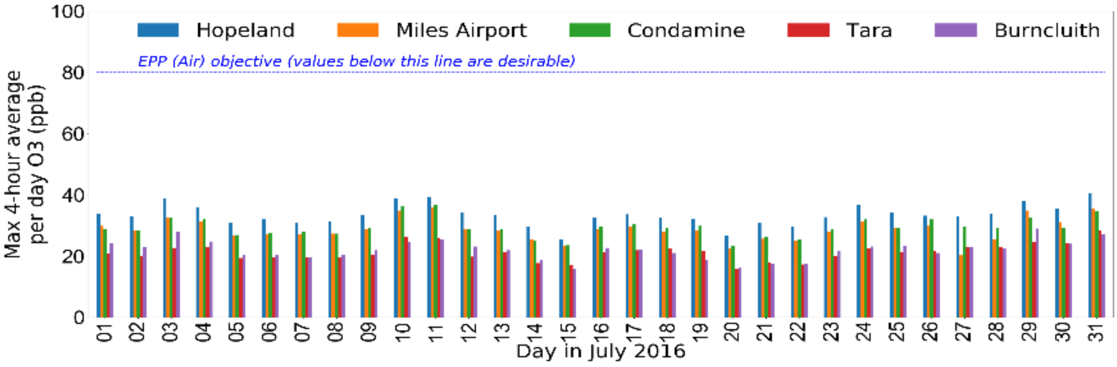

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 4-hour average per day O3 (ppb)
0
20
40
60
80
100
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
Day in February 2016

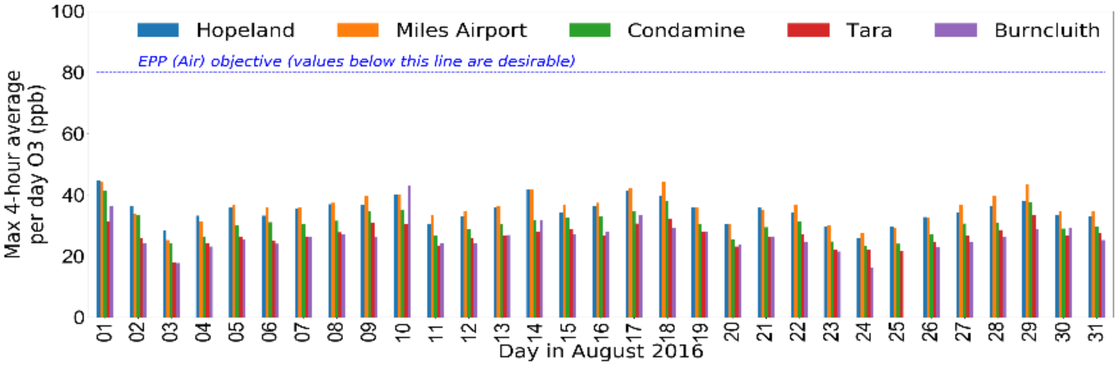

Max 4-hour average per day O3 (ppb)
100
80
60
40
20
0
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in March 2016

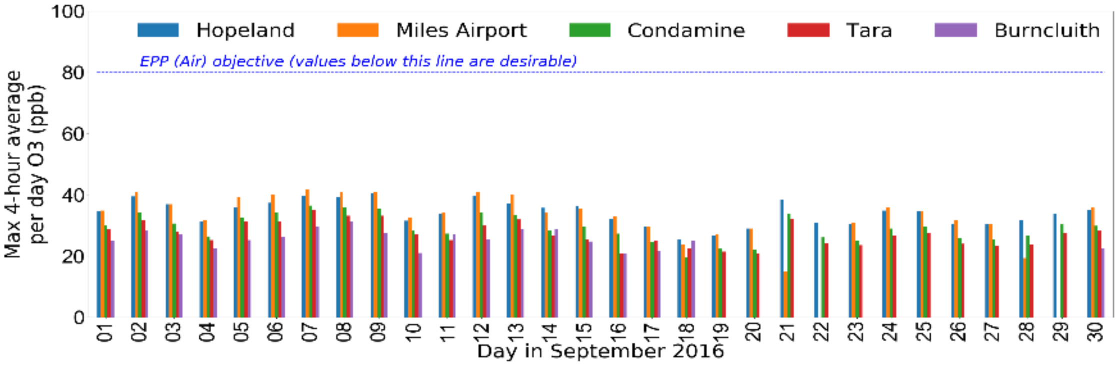

Max 4-hour average per day O3 (ppb)
100
80
60
40
20
0
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in April 2016

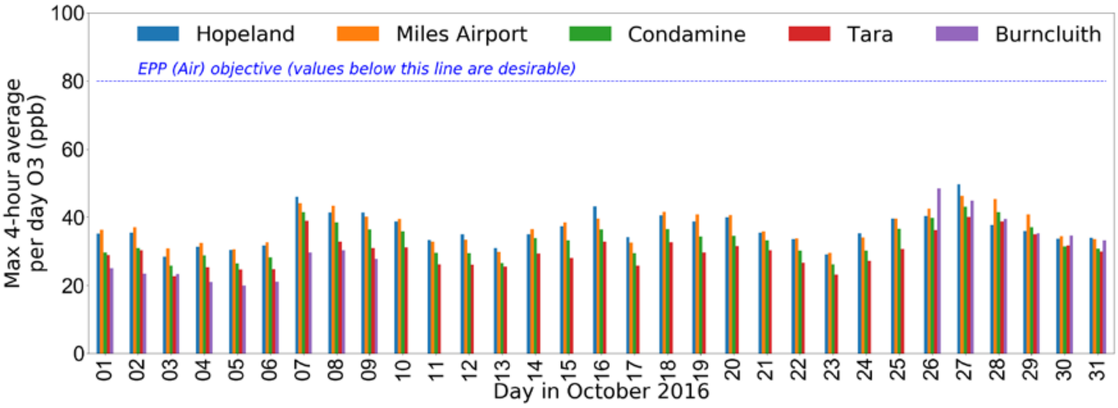

Max 4-hour average per day O3 (ppb)
100
80
60
40
20
0
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in May 2016

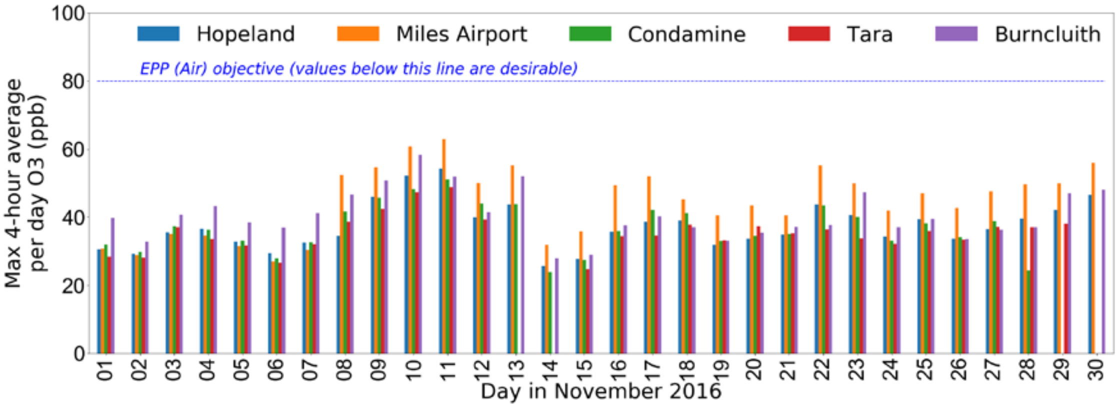

Max 4-hour average per day O3 (ppb)
100
80
60
40
20
0
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in June 2016

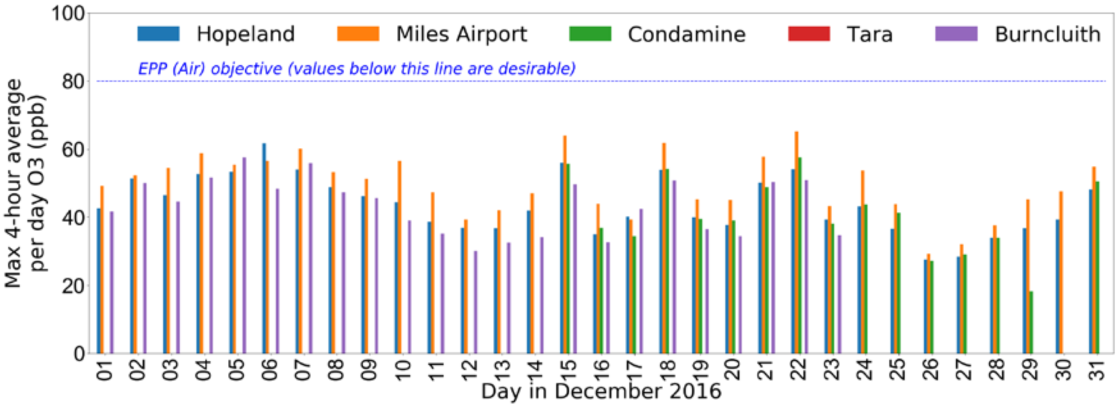

Max 4-hour average
per day O3 (ppb)
0
20
40
60
80
100
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in July 2016


Max 4-hour average
per day O3 (ppb)
0
20
40
60
80
100
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in August 2016

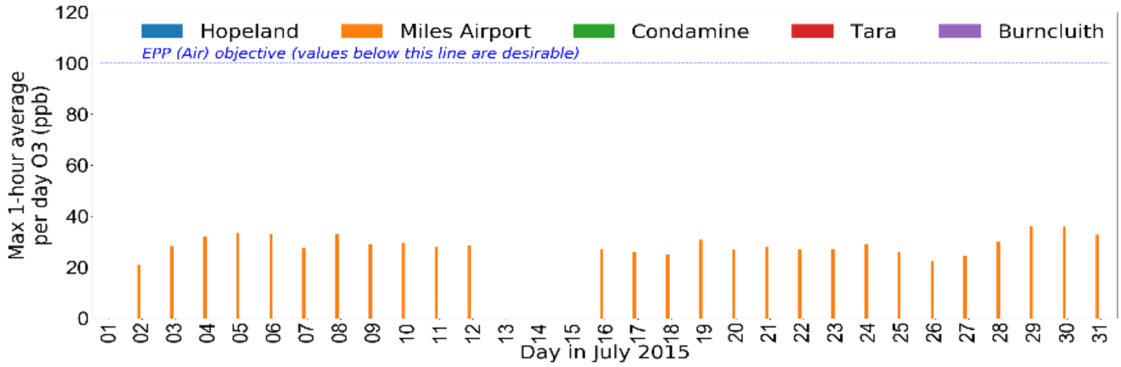

Max 4-hour average
per day O3 (ppb)
0
20
40
60
80
100
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in September 2016

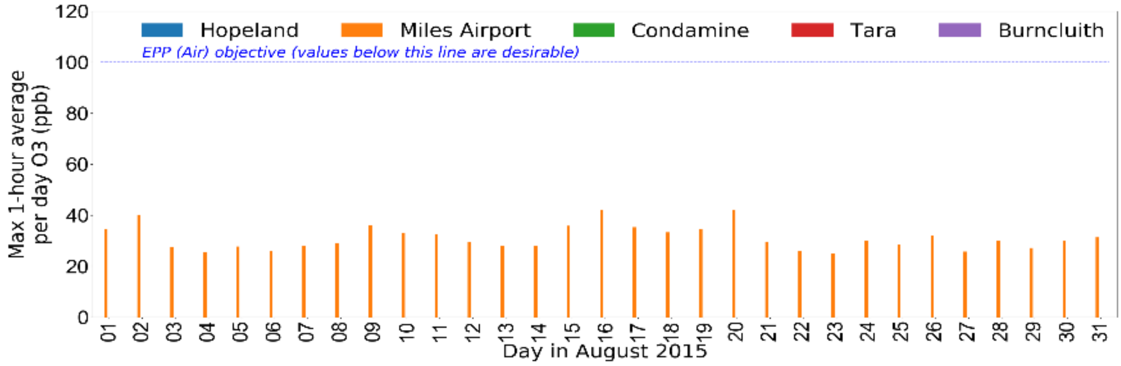

Max 4-hour average
per day O3 (ppb)
0
20
40
60
80
100
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in October 2016

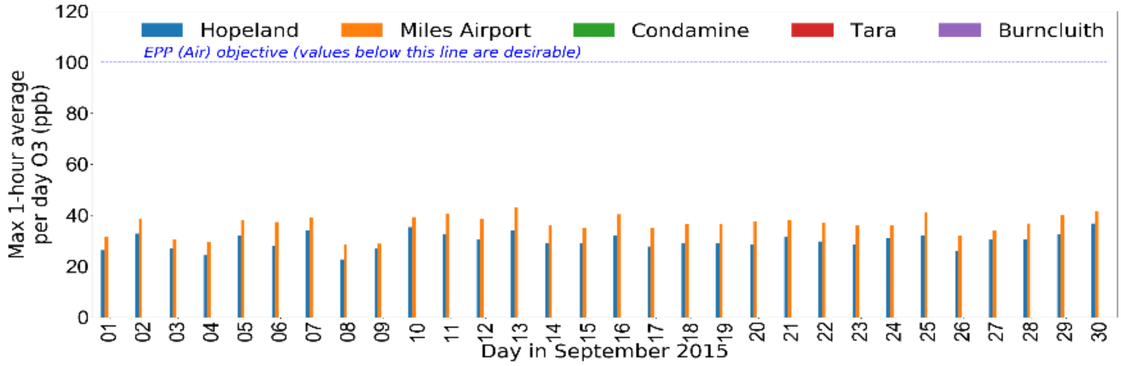

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 4-hour average per day O3 (ppb)
0
20
40
60
80
100
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in November 2016

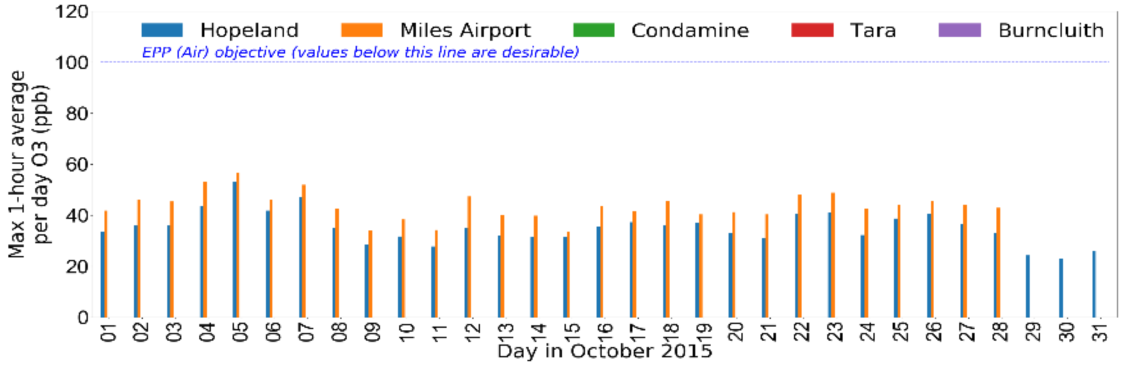

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 4-hour average per day O3 (ppb)
0
20
40
60
80
100
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in December 2016

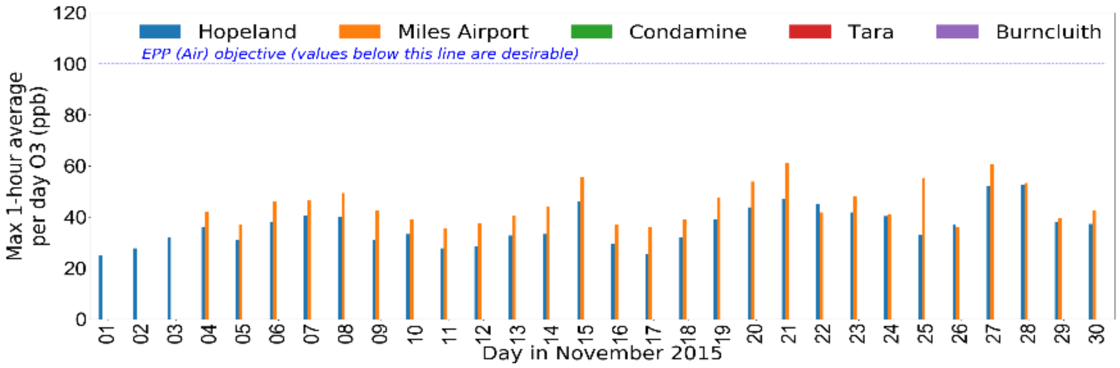
A.6.4 Ozone – maximum 1 hour average for July 2015 – December 2016

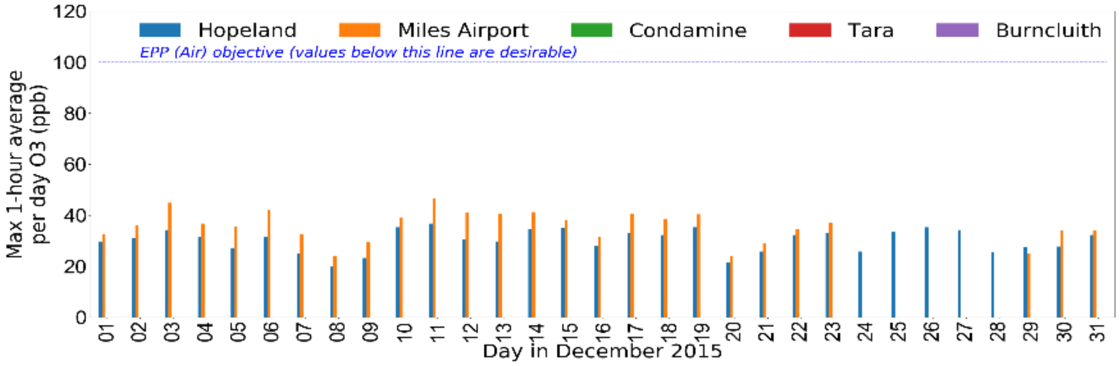









Max 1-hour average per day O3 (ppb)
0
20
40
60
80
100
120
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in November 2015


Max 1-hour average per day O3 (ppb)
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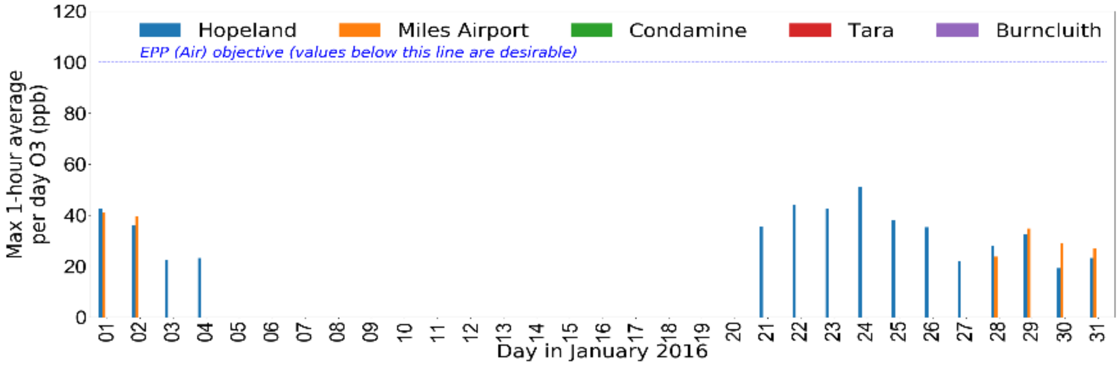
20
40
60
80
100
120
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in December 2015


Max 1-hour average per day O3 (ppb)
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20
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60
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100
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Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
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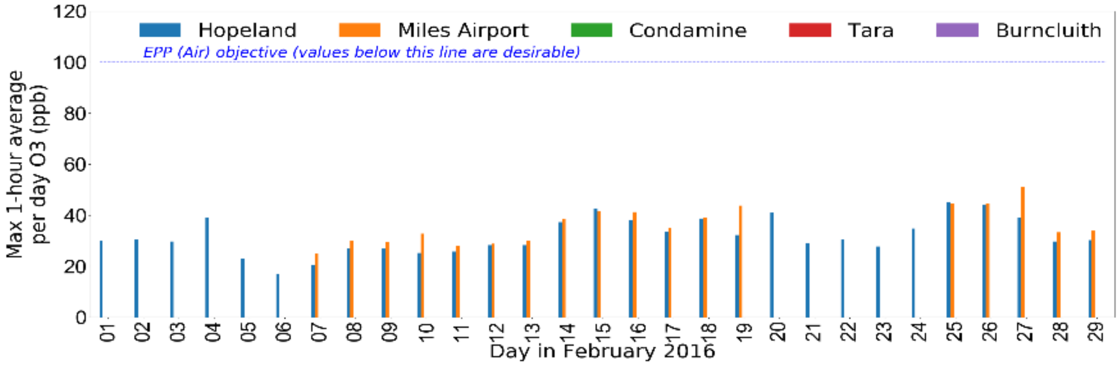
Day in January 2016


Max 1-hour average per day O3 (ppb)
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100
120
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
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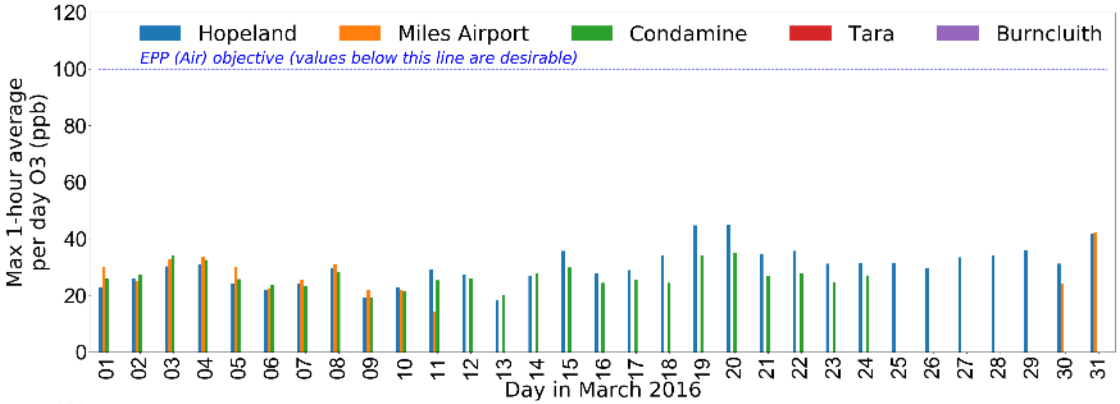
Day in February 2016


Max 1-hour average per day O3 (ppb)
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20
40
60
80
100
120
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
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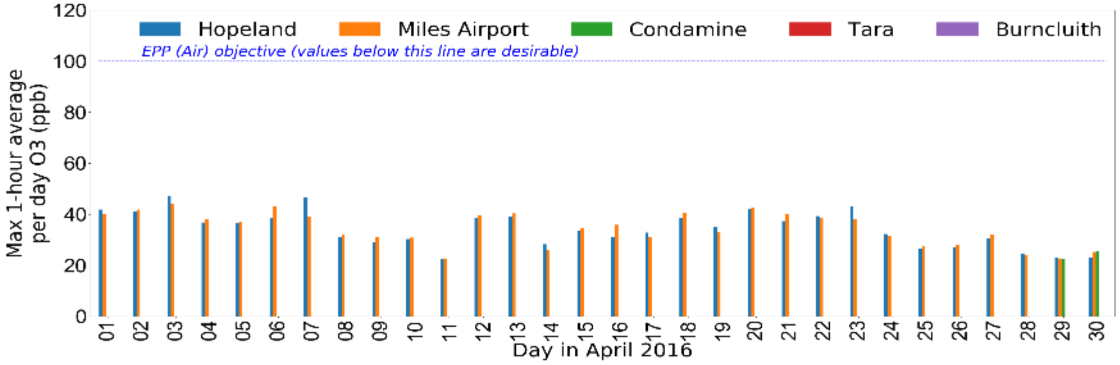
Day in March 2016


Max 1-hour average per day O3 (ppb)
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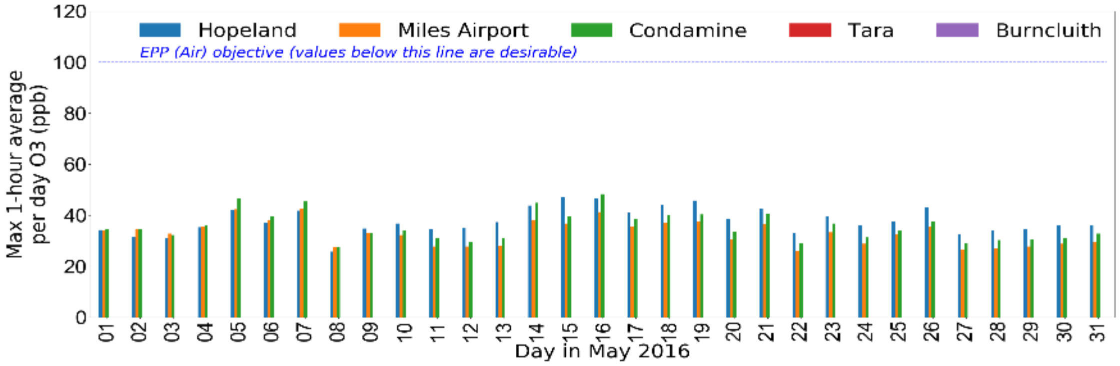
20
40
60
80
100
120
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in April 2016


Max 1-hour average per day O3 (ppb)
0
20
40
60
80
100
120
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
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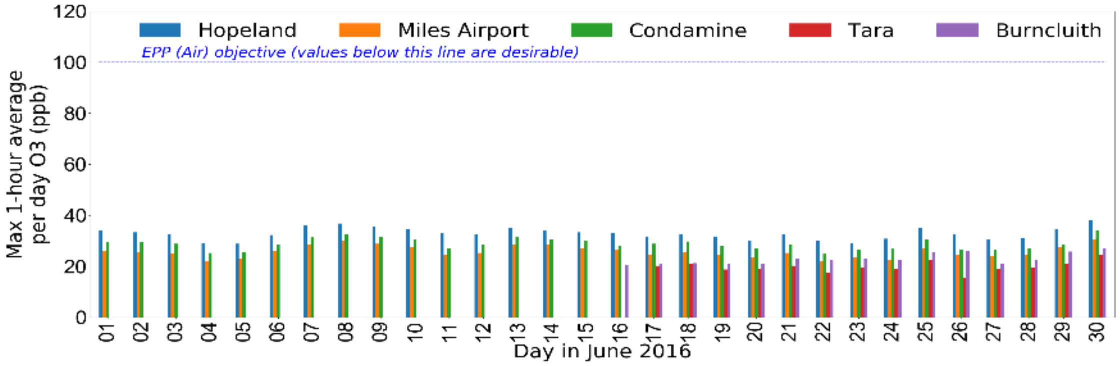
Day in May 2016


Max 1-hour average per day O3 (ppb)
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100
120
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
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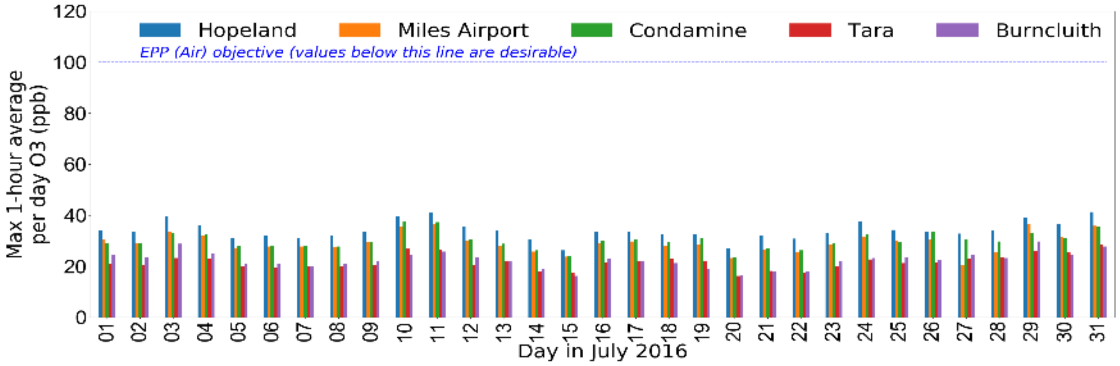
Day in June 2016


Max 1-hour average per day O3 (ppb)
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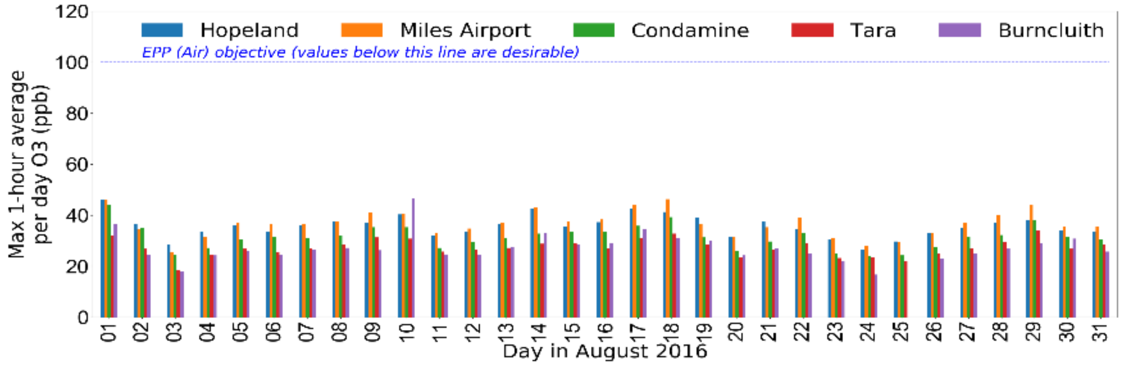
80
100
120
Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in July 2016


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day O3 (ppb)
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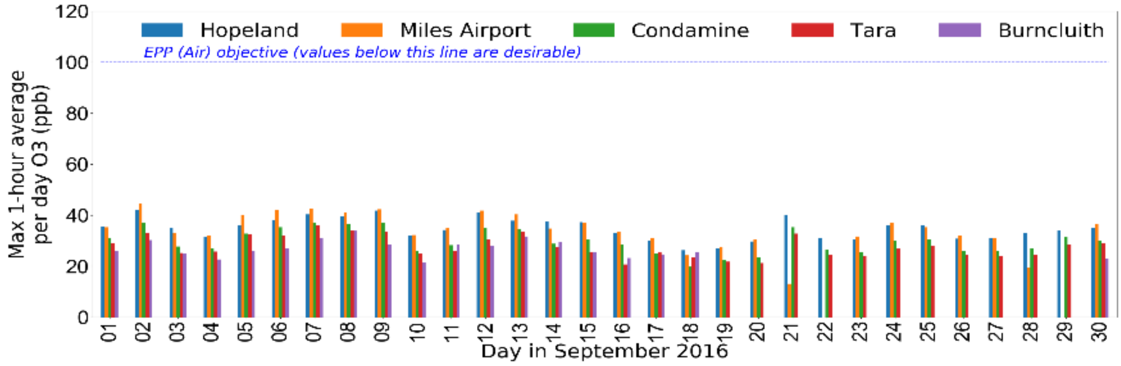
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in August 2016


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day O3 (ppb)
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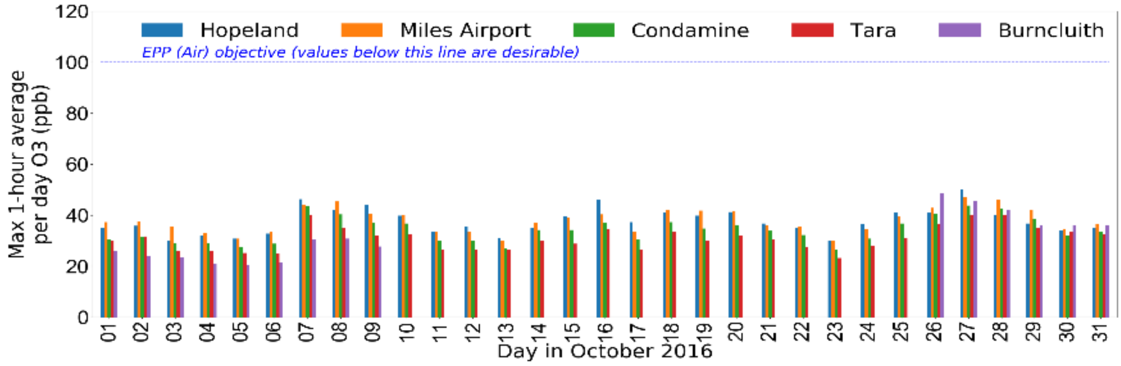
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in September 2016


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day O3 (ppb)
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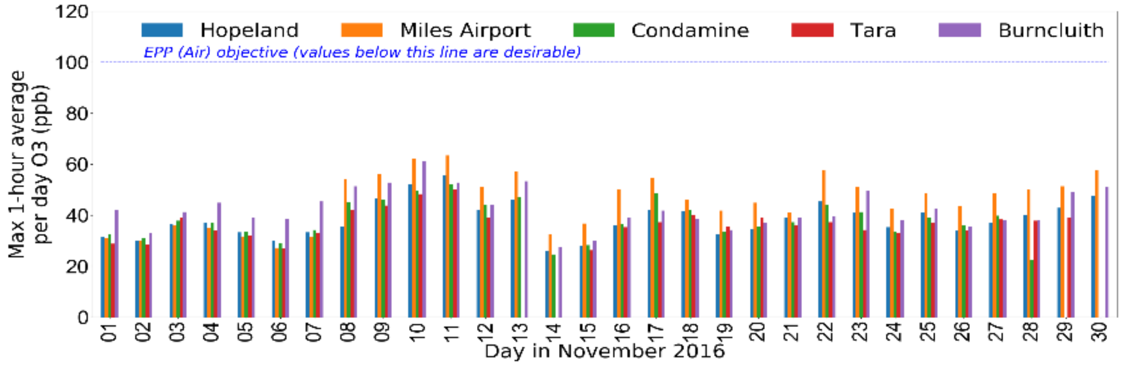
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in October 2016


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day O3 (ppb)
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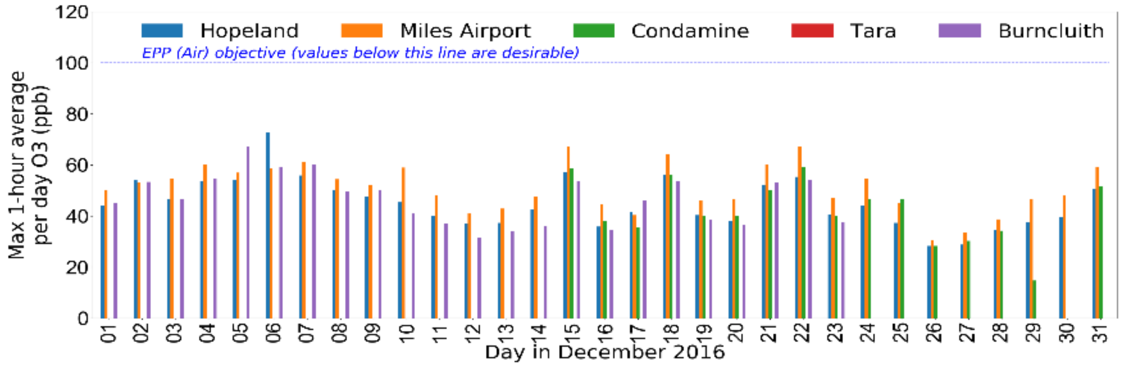
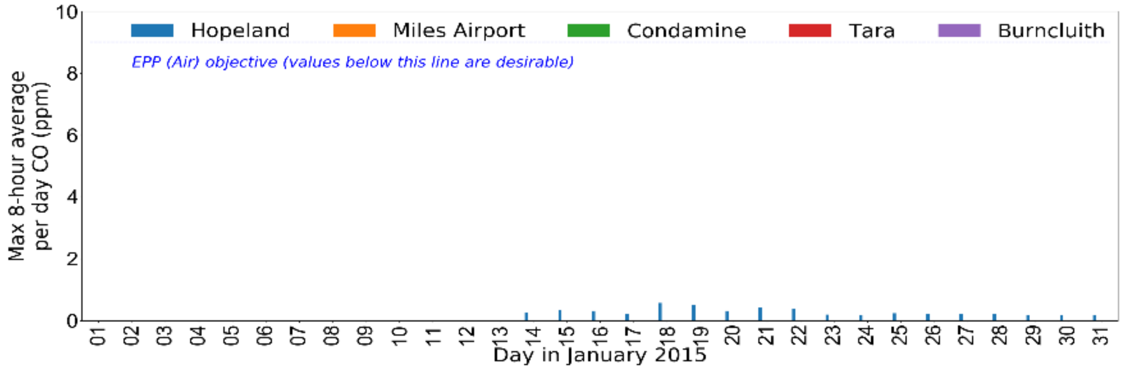
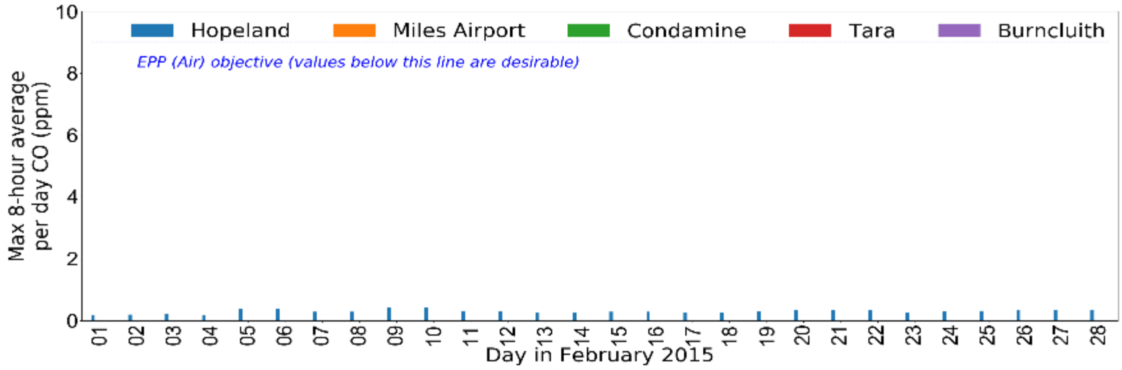
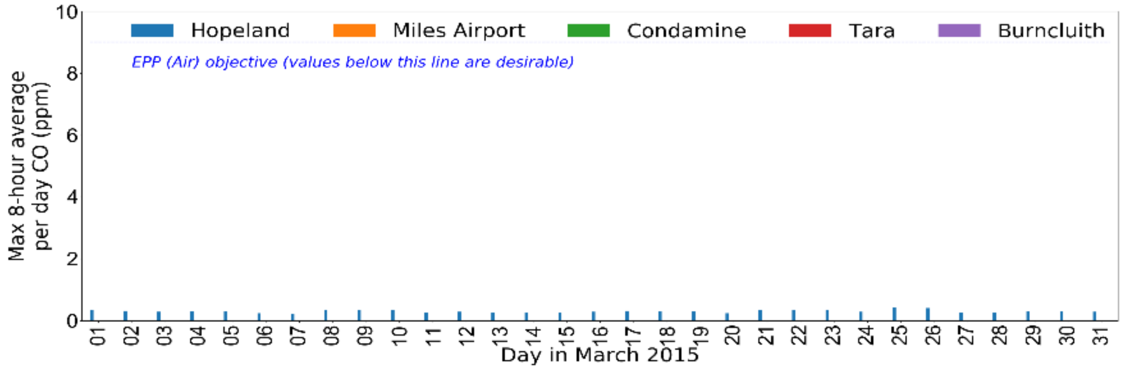
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in November 2016

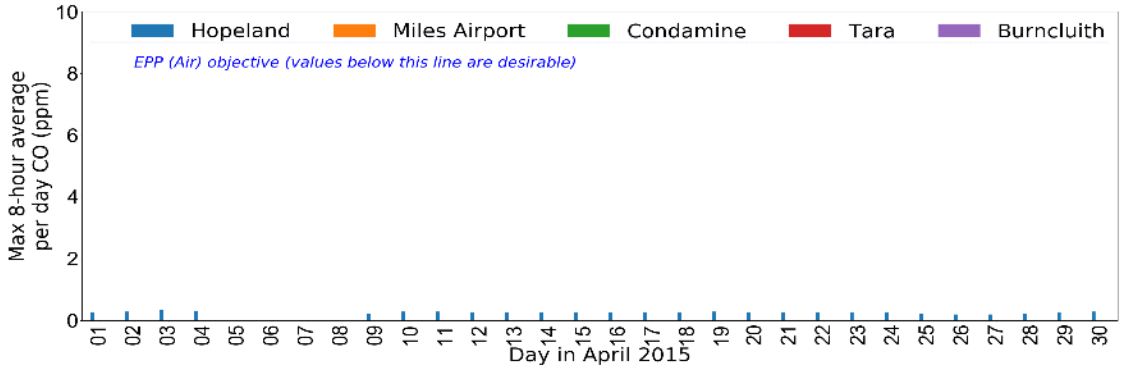

Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 1-hour average per day O3 (ppb)
0 20 40 60 80 100 120
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in December 2016

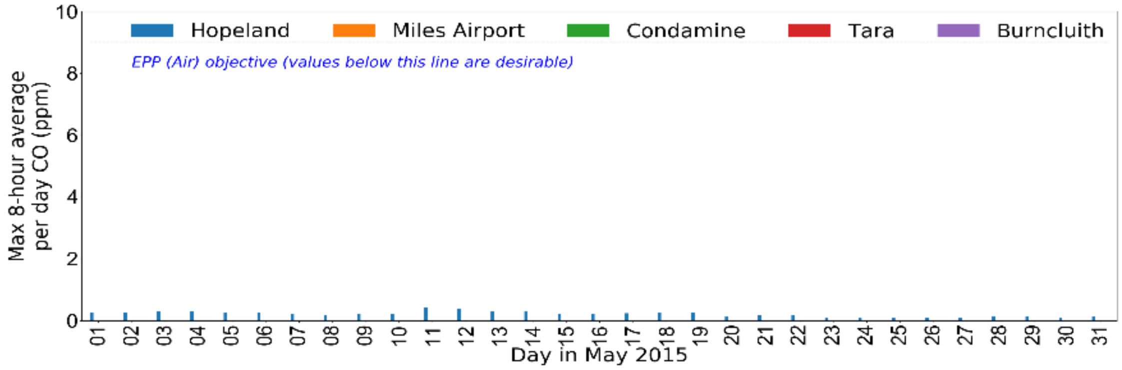
A.6.5 Carbon monoxide - maximum 8-hour concentrations, January 2015 – December 2016

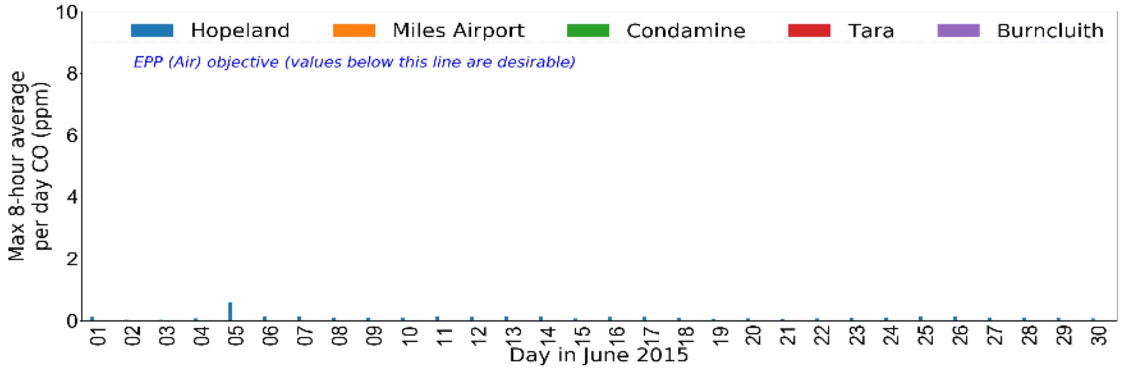









Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
0
2
4
6
8
10
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in May 2015


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
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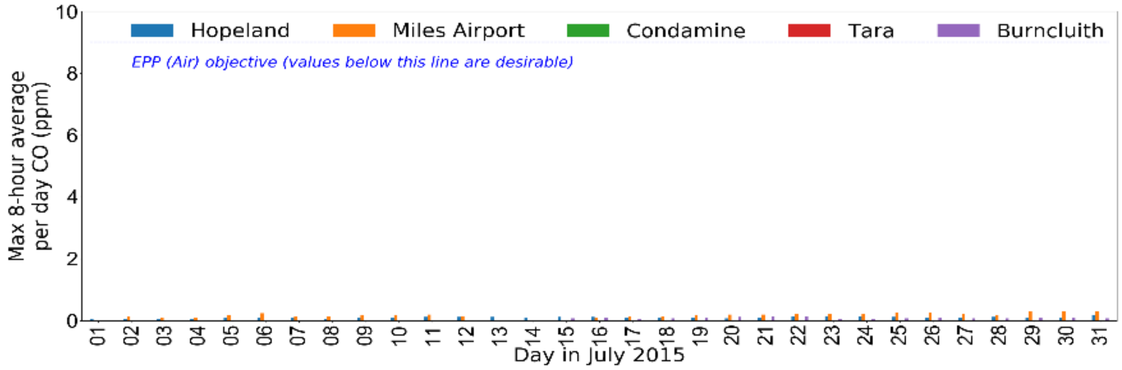
4
6
8
10
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in June 2015


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
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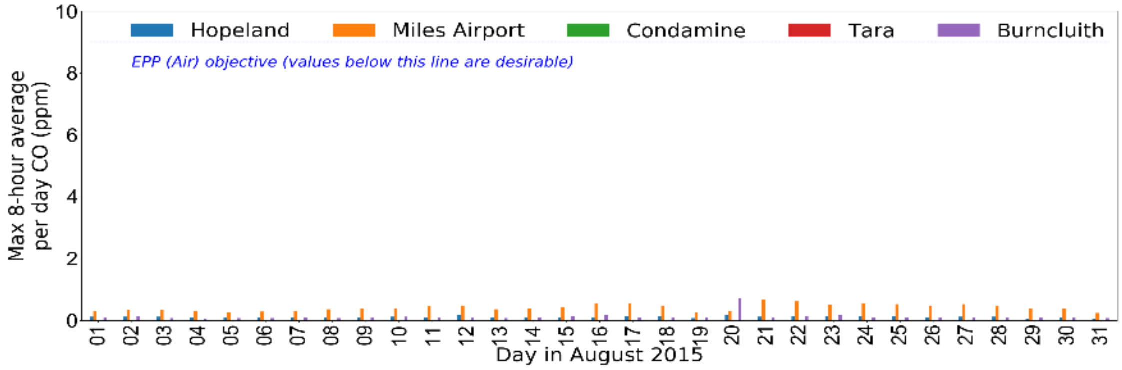
6
8
10
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in July 2015


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
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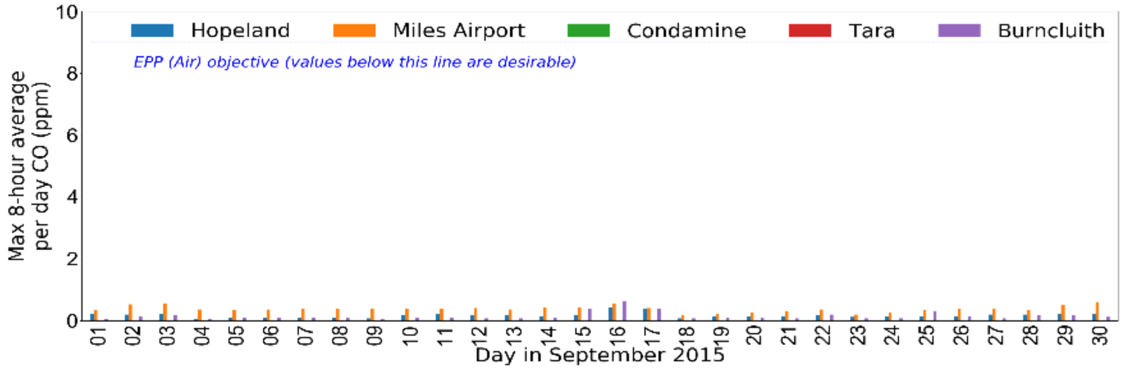
6
8
10
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in August 2015


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
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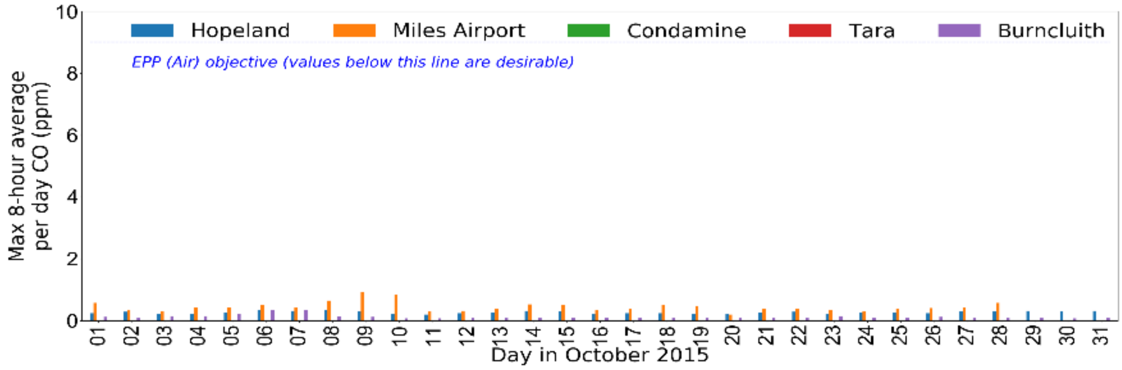
2
4
6
8
10
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in September 2015


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
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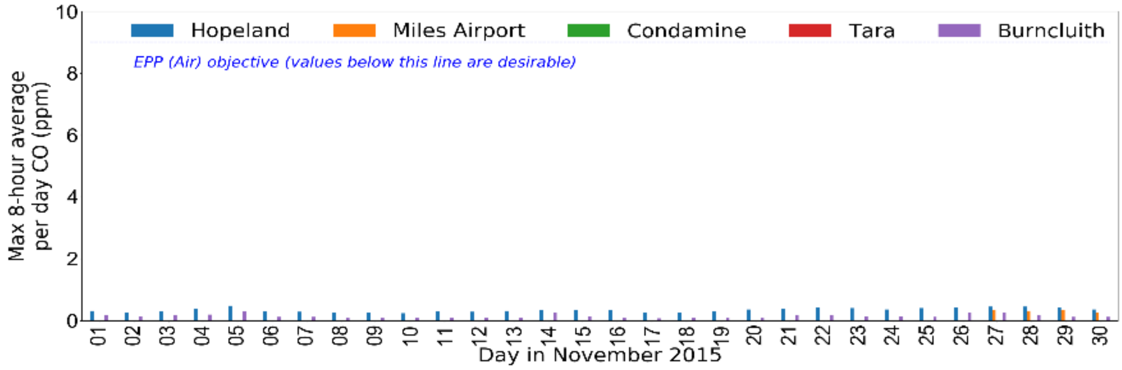
6
8
10
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in October 2015


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
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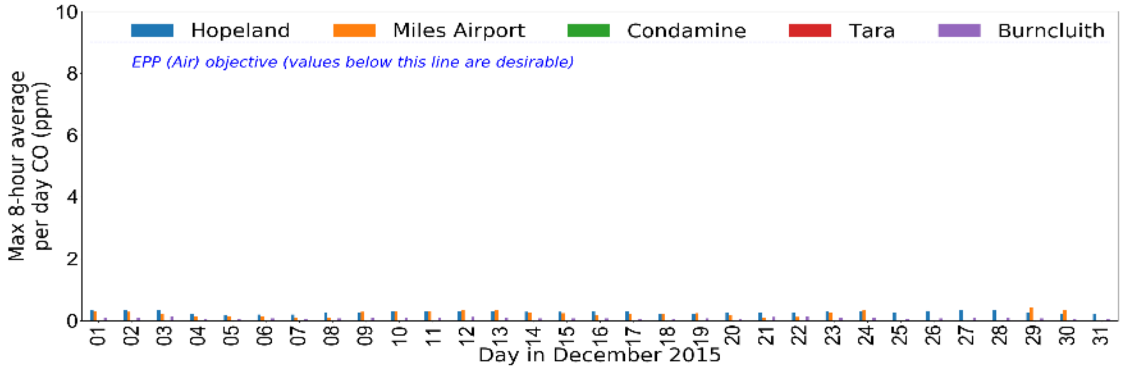
6
8
10
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in November 2015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Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
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2
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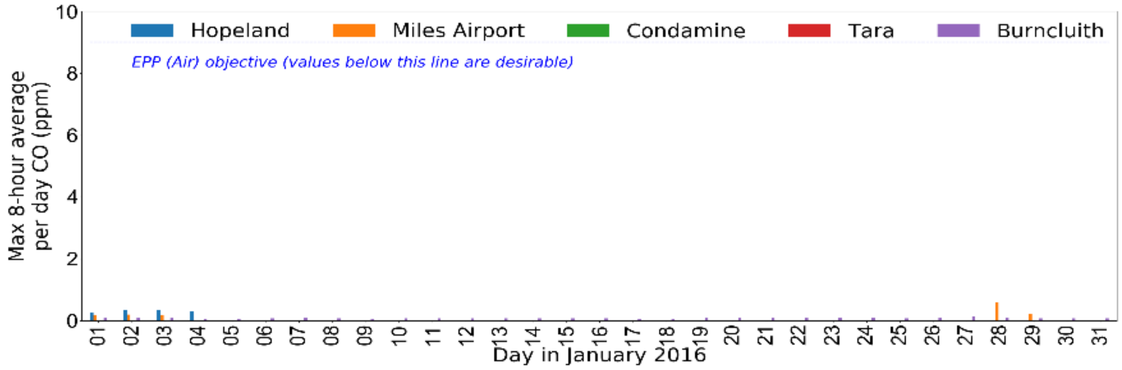
6
8
10
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in December 2015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Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
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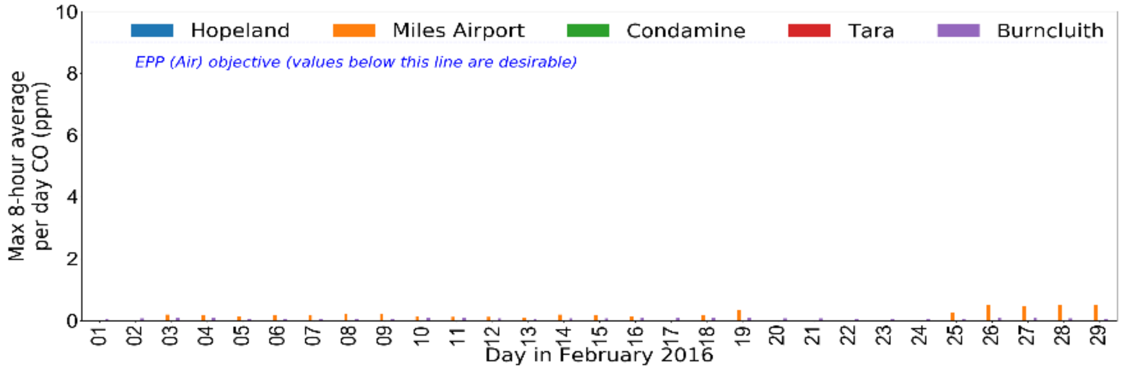
6
8
10
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in January 2016


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
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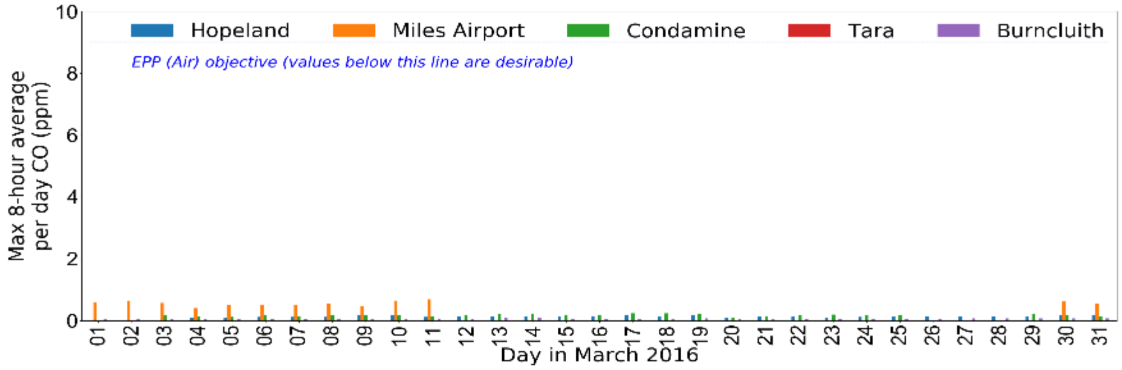
4
6
8
10
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
Day in February 2016


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
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6
8
10
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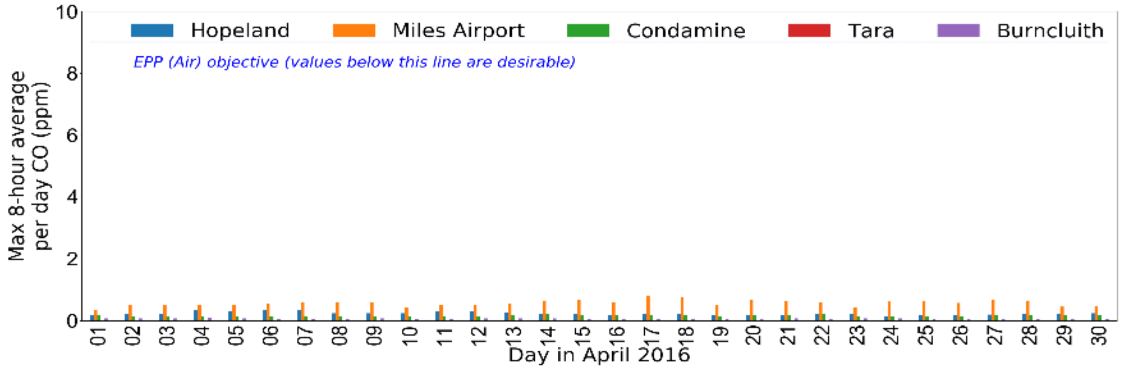
Day in March 2016


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
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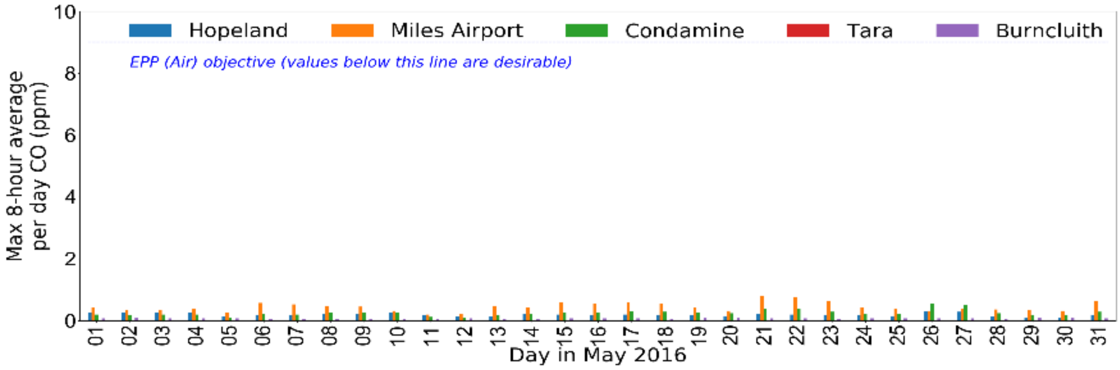
6
8
10
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in April 2016


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
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8
10
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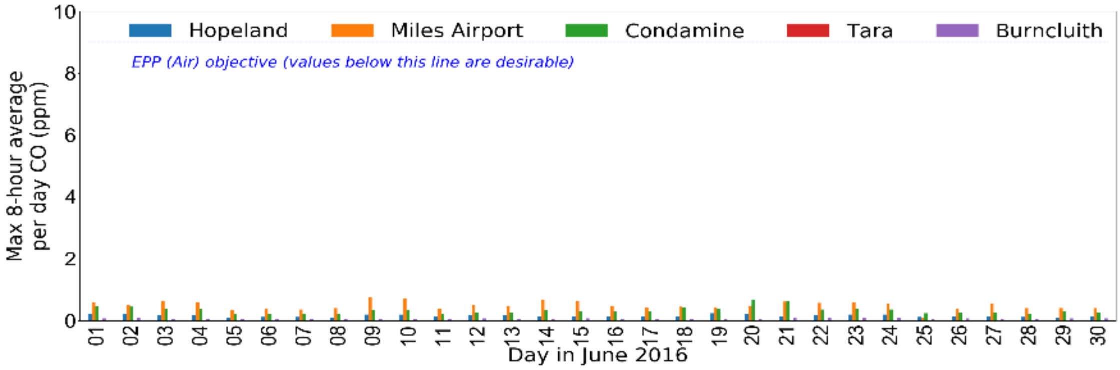
Day in May 2016


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
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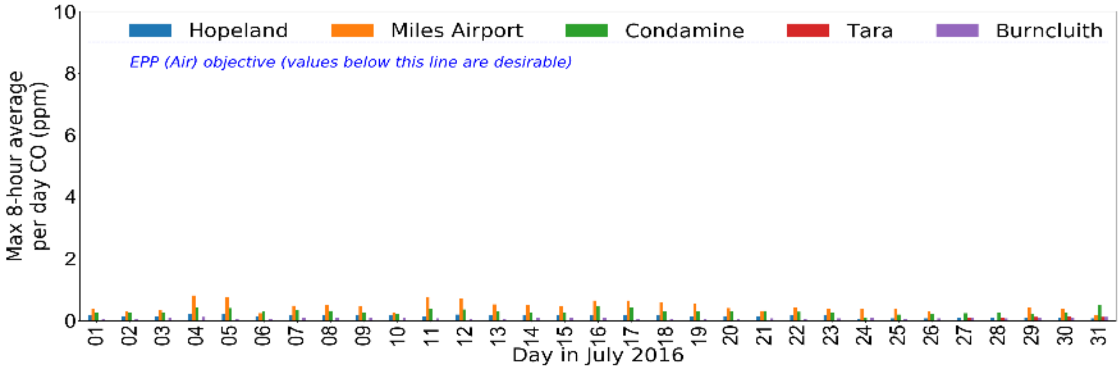
8
10
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in June 2016


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
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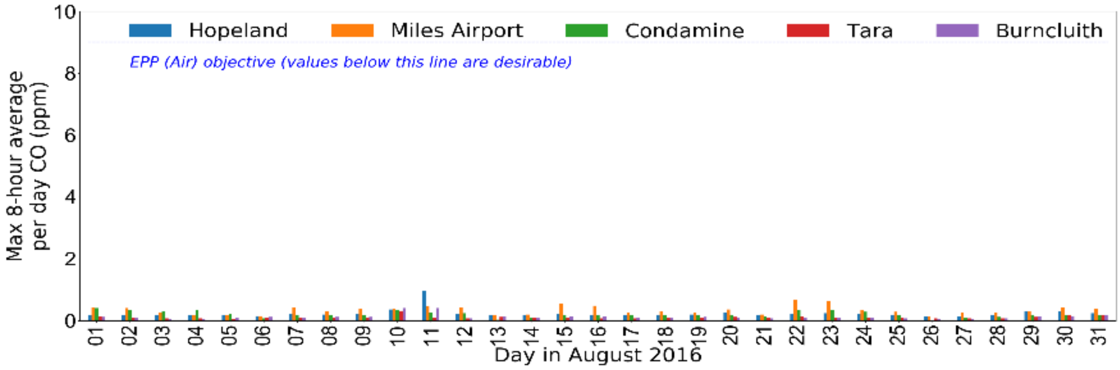
8
10
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in July 2016


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
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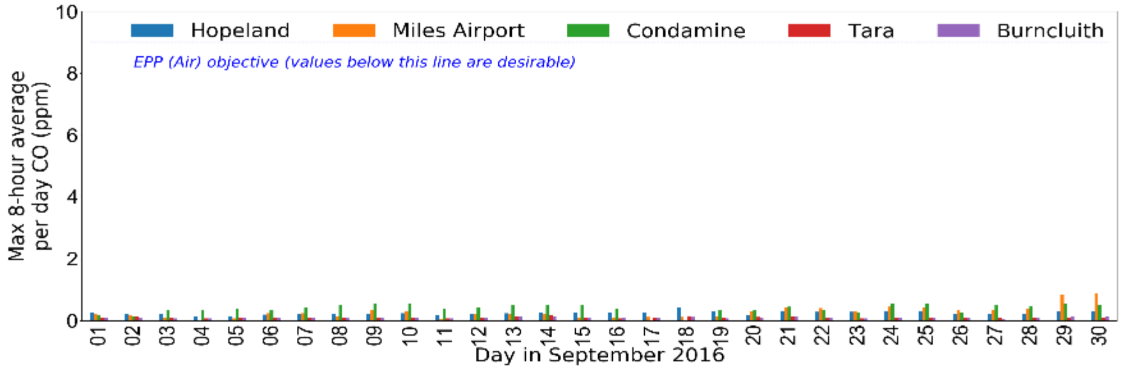
6
8
10
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in August 2016


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
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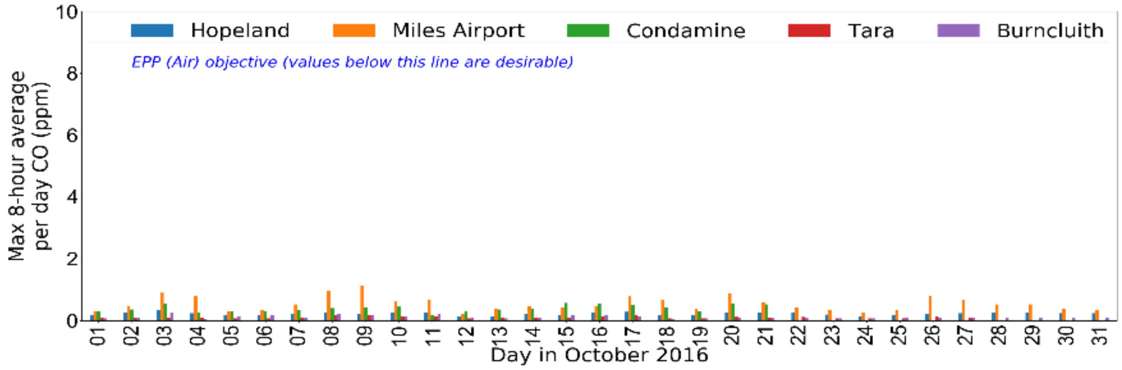
6
8
10
Day in September 2016
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
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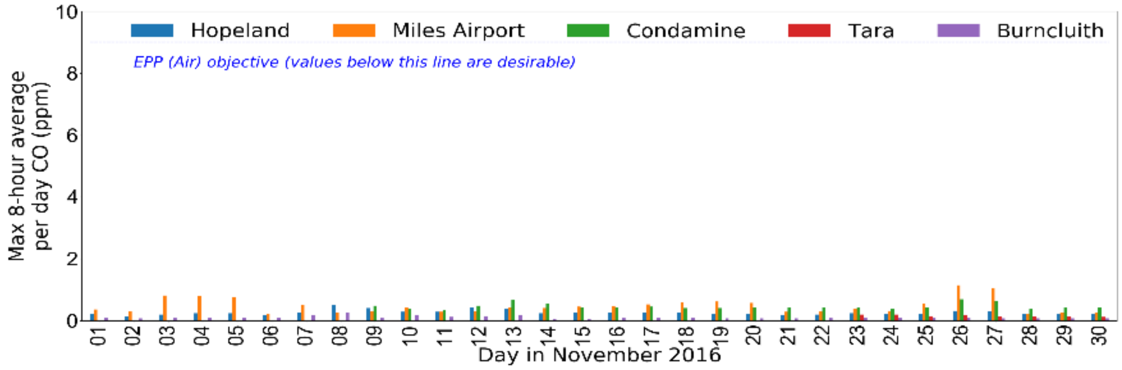
6
8
10
Day in October 2016
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
0
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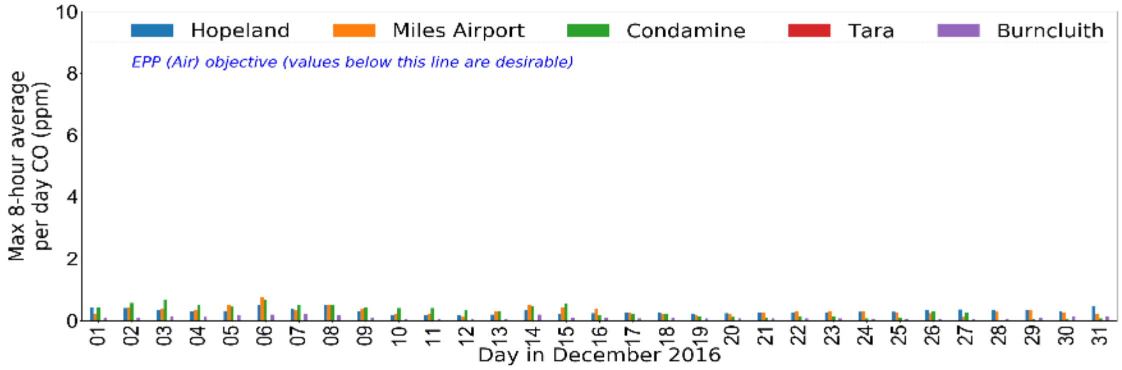
4
6
8
10
Day in November 2016
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30


Hopeland
Miles Airport
Condamine
Tara
Burncluith
EPP (Air) objective (values below this line are desirable)
Max 8-hour average per day CO (ppm)
0
2
4
6
8
10
Day in December 2016
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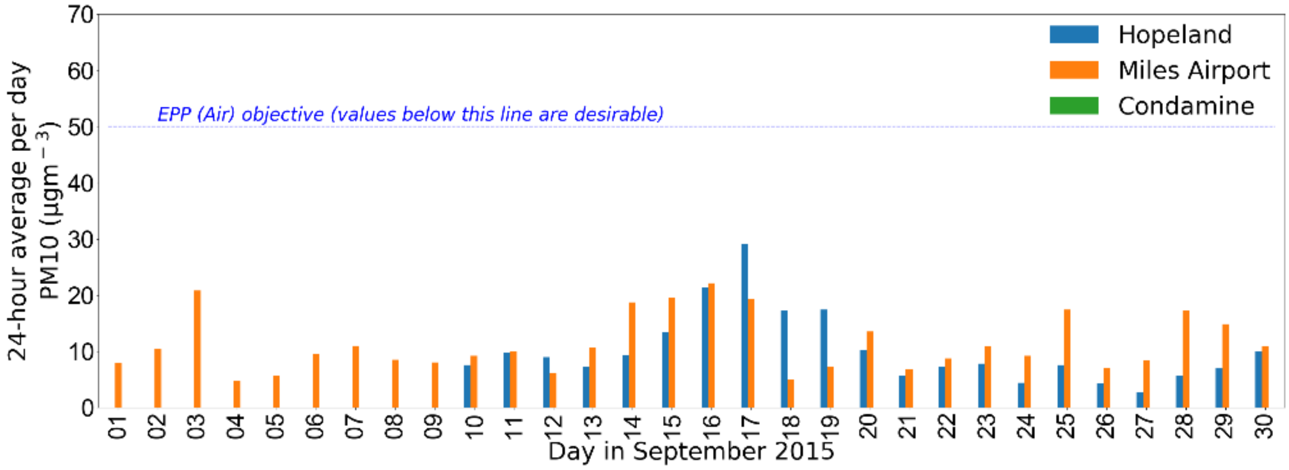
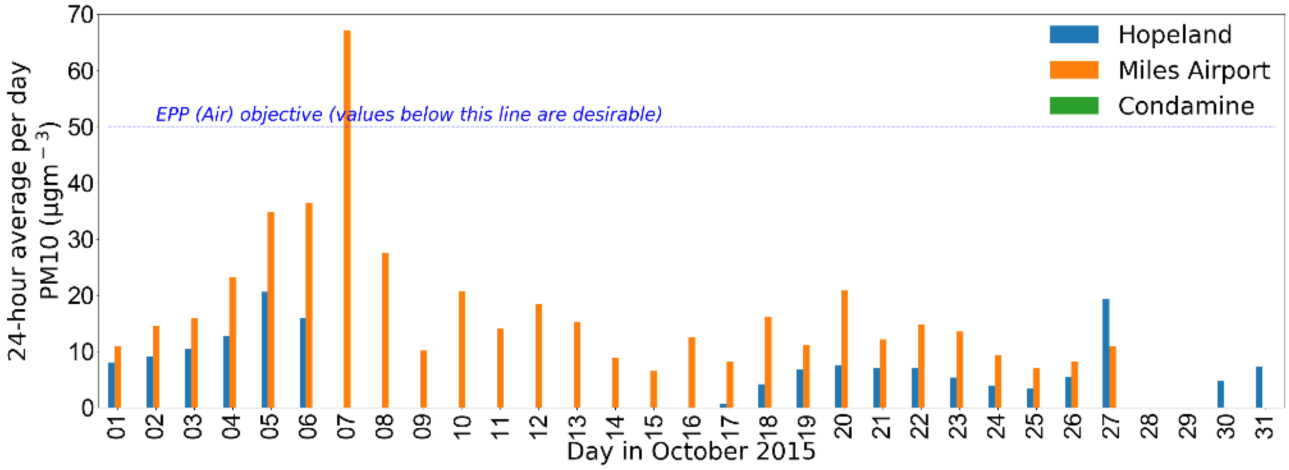
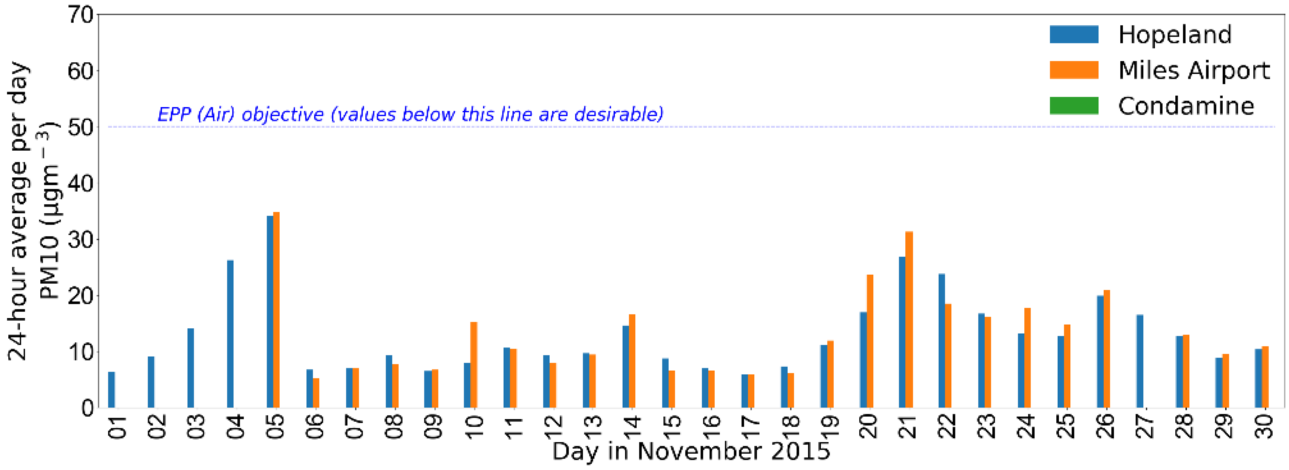
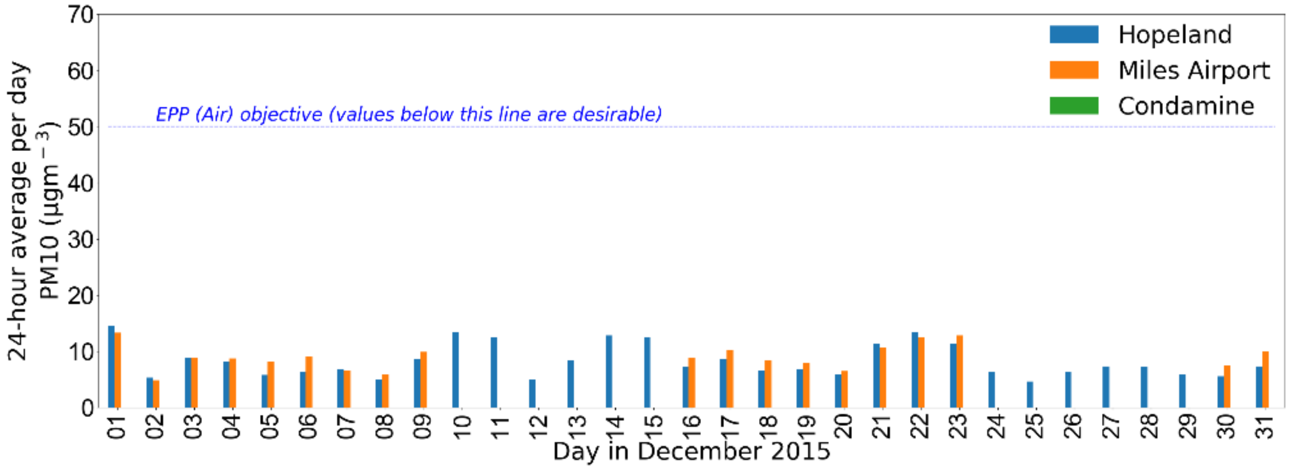
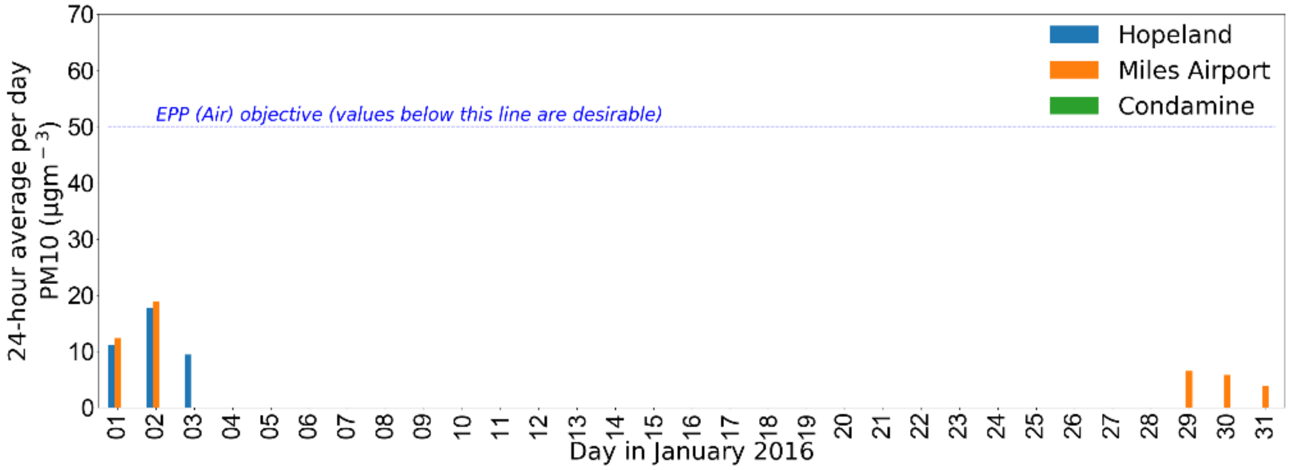
A.6.6 PM10 – 24 hour averages from September 2015 – December 2016

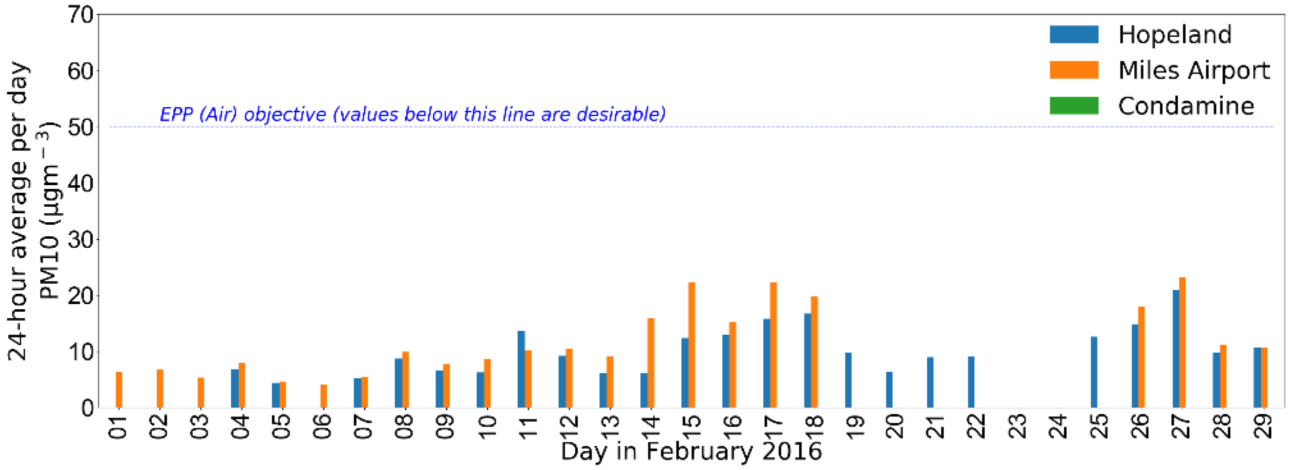


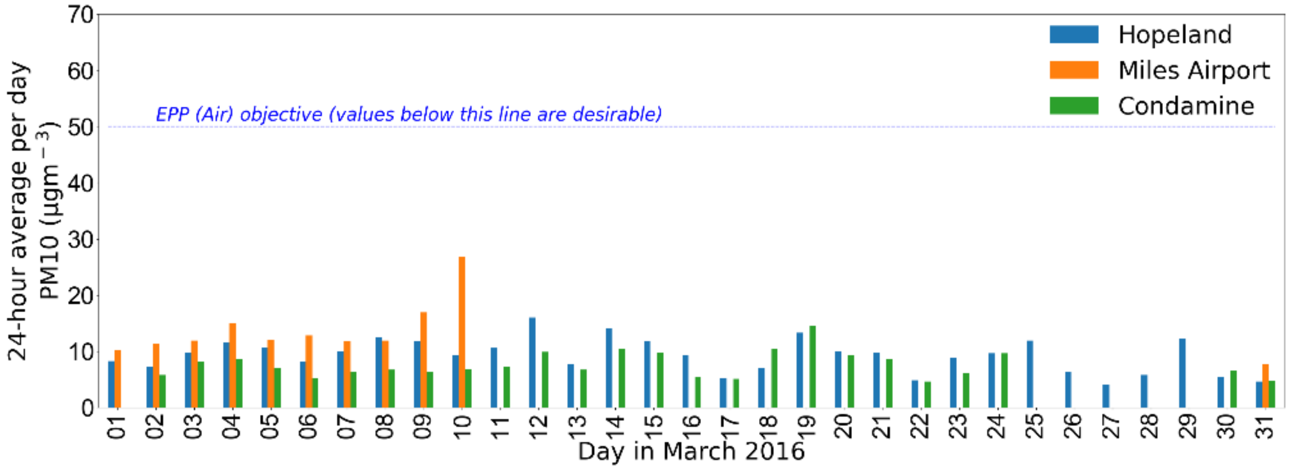


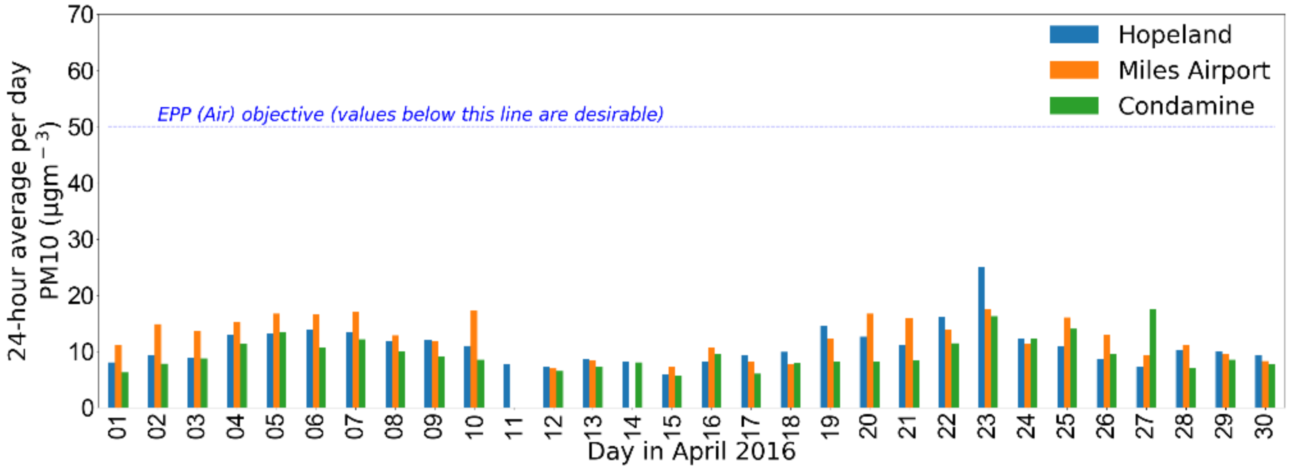


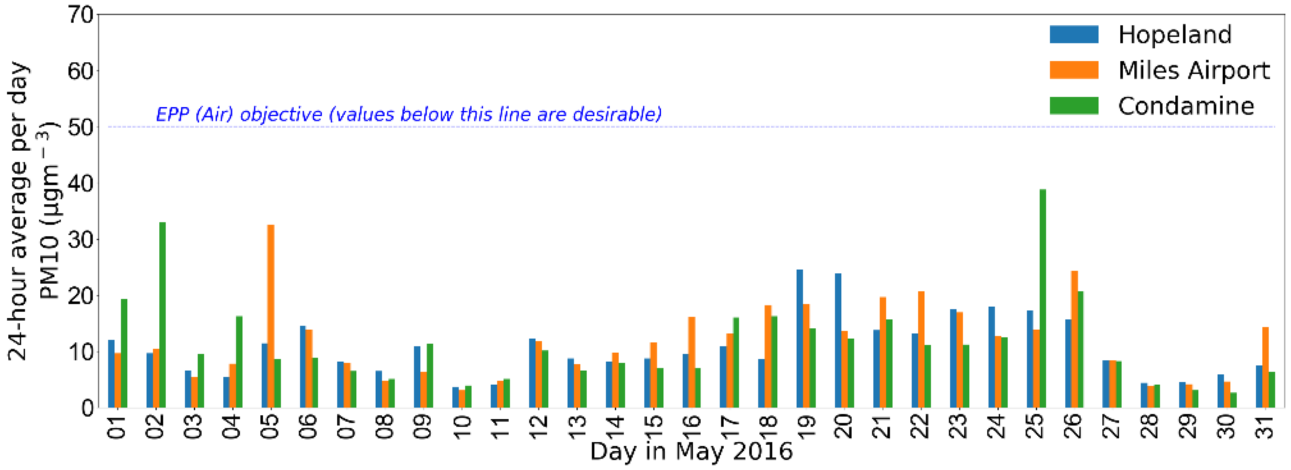

24-hour average per day PM10 (µgm^{-3})
0
10
20
30
40
50
60
70
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in December 2015

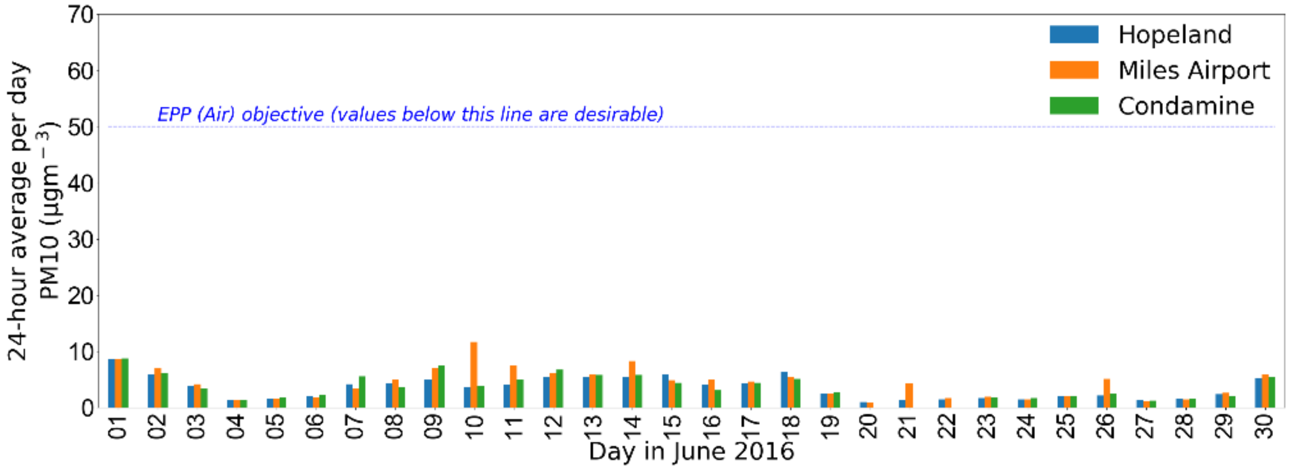

24-hour average per day PM10 (µgm^{-3})
0
10
20
30
40
50
60
70
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in January 2016

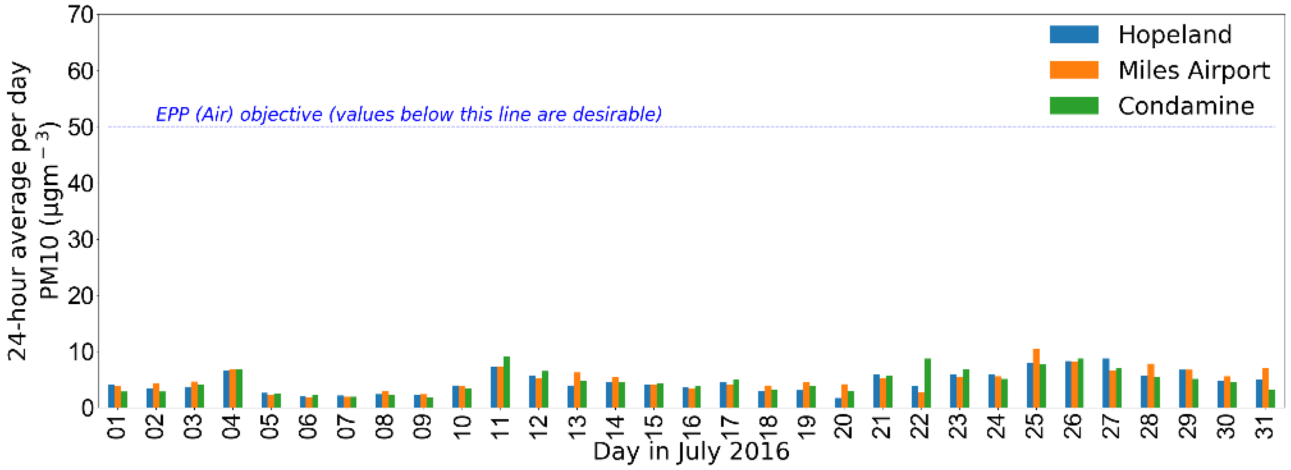

24-hour average per day PM10 (µgm^{-3})
0
10
20
30
40
50
60
70
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
Day in February 2016

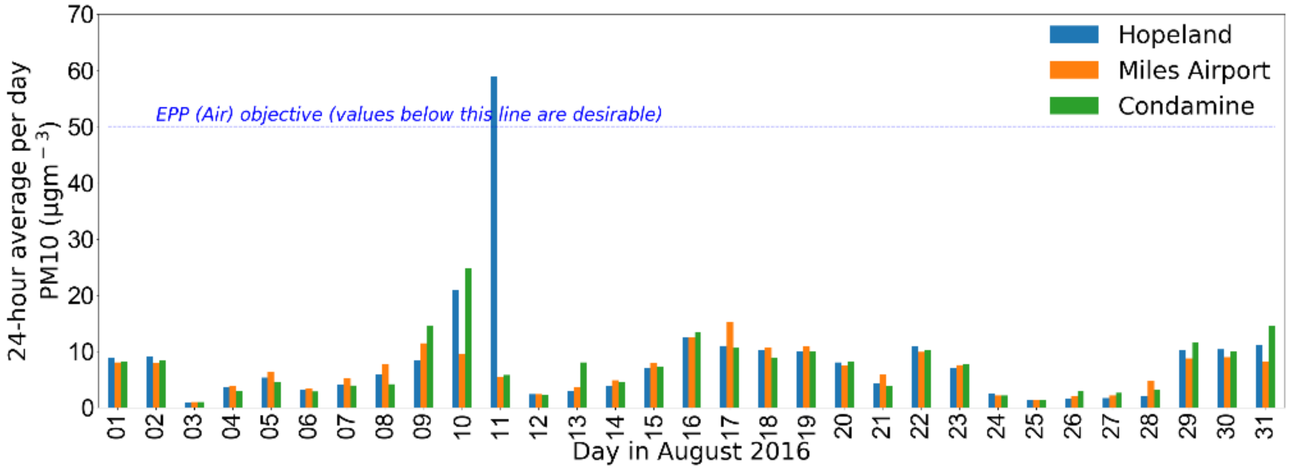

24-hour average per day PM10 (µgm^{-3})
0
10
20
30
40
50
60
70
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in March 2016

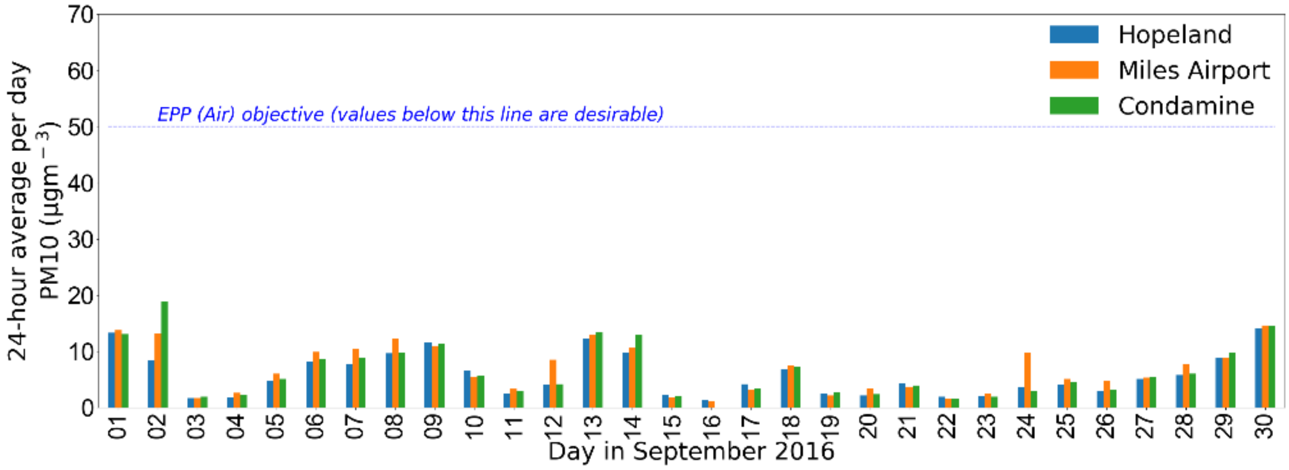

24-hour average per day
PM10 (μgm^{-3})
0
10
20
30
40
50
60
70
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in April 2016

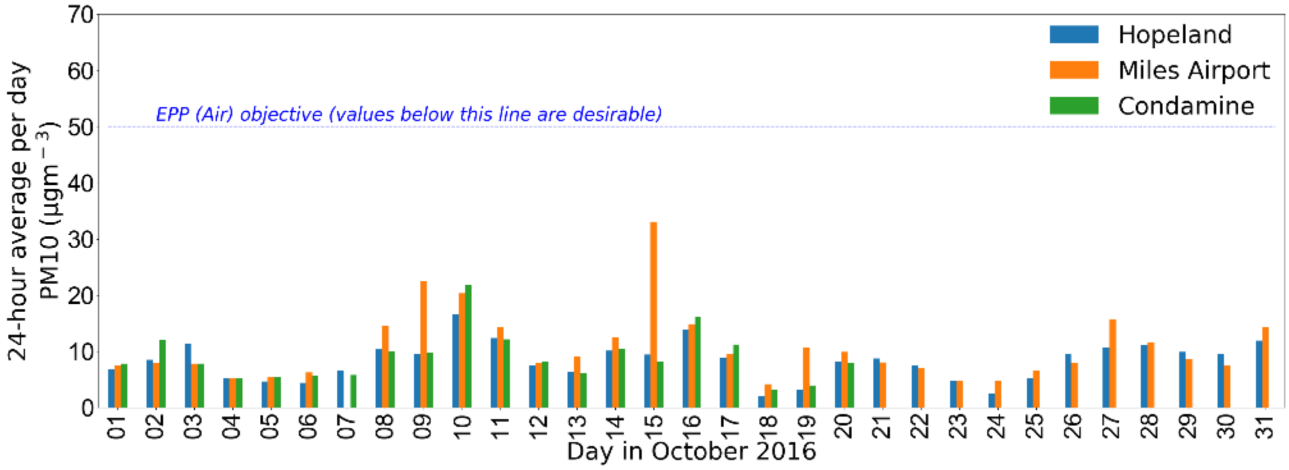

24-hour average per day
PM10 (μgm^{-3})
0
10
20
30
40
50
60
70
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in May 2016

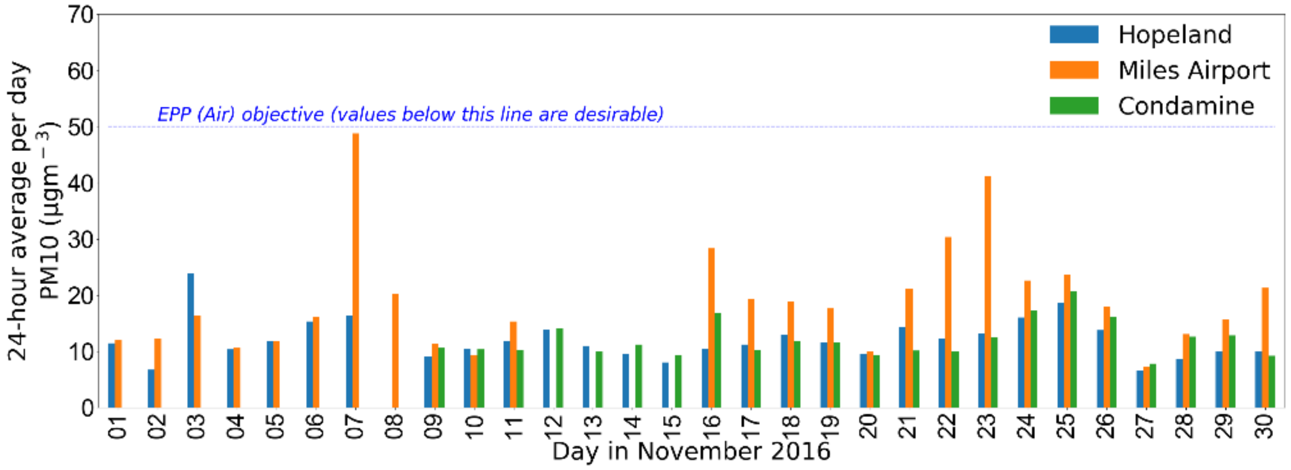

24-hour average per day
PM10 (μgm^{-3})
0
10
20
30
40
50
60
70
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in June 2016

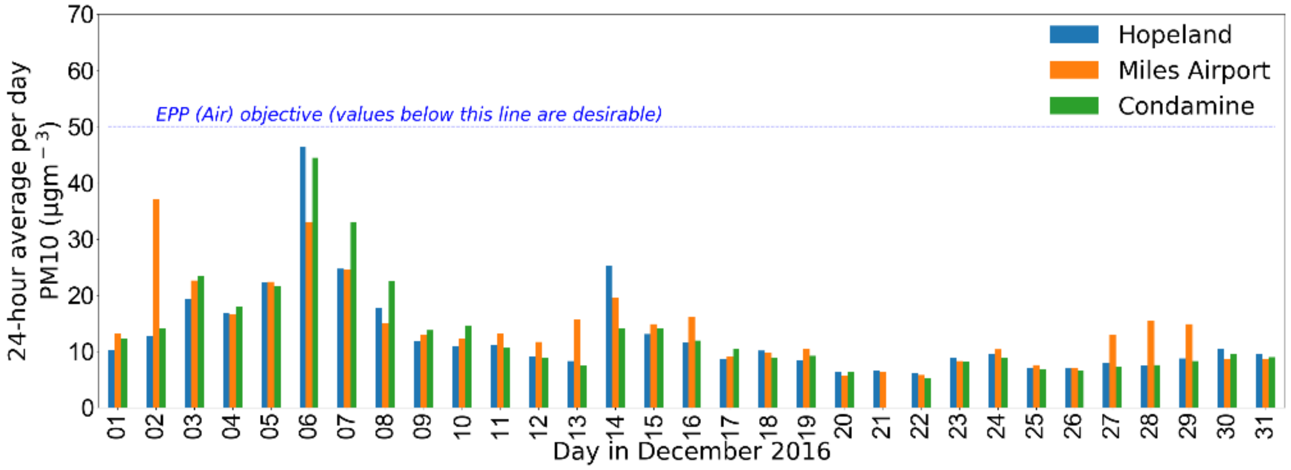

24-hour average per day
PM10 (μgm^{-3})
0
10
20
30
40
50
60
70
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in July 2016


24-hour average per day PM10 (µgm⁻³)
70
60
50
40
30
20
10
0
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in August 2016

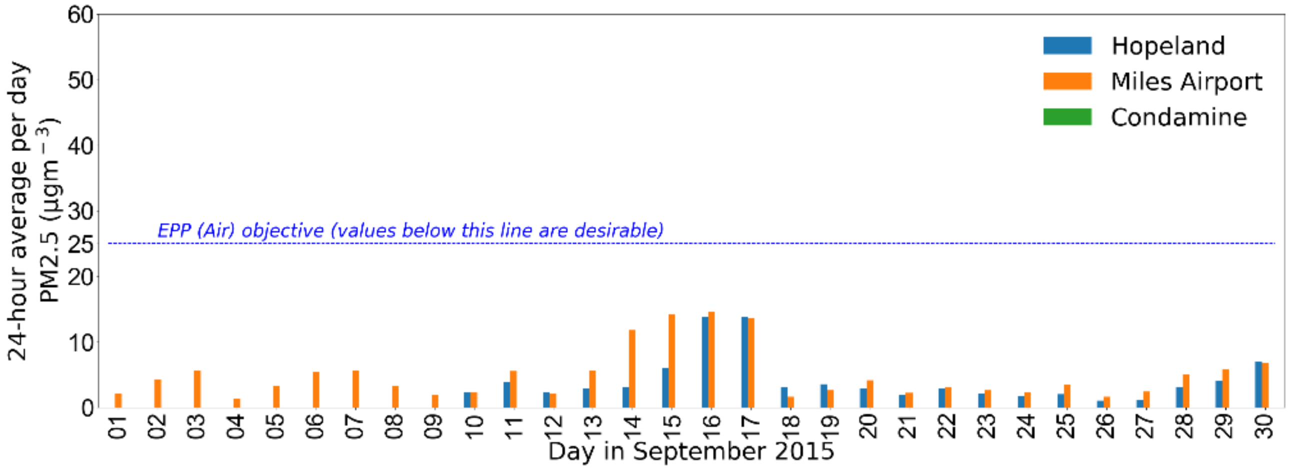

24-hour average per day PM10 (µgm⁻³)
70
60
50
40
30
20
10
0
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in September 2016

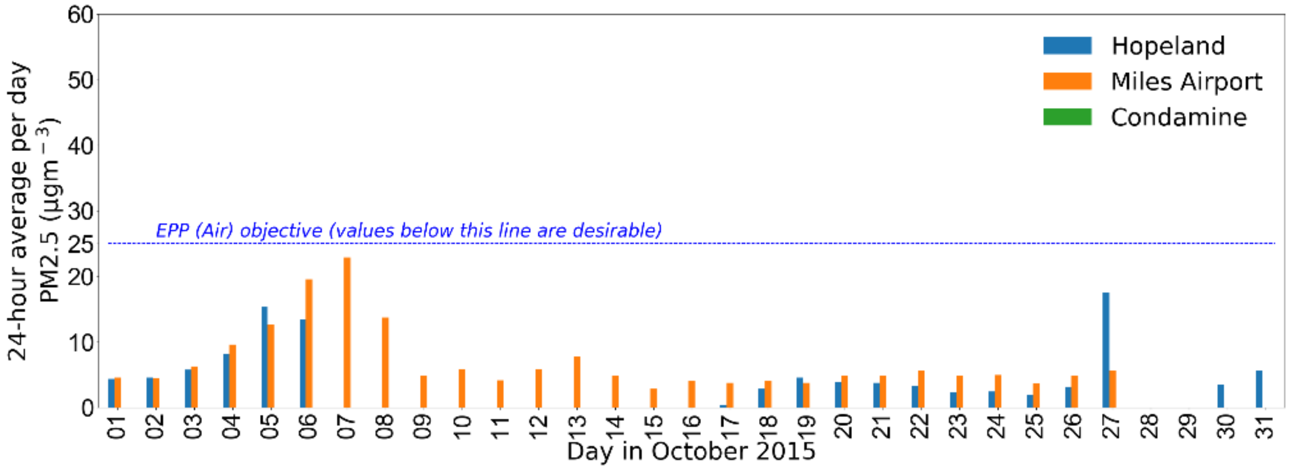

24-hour average per day PM10 (µgm⁻³)
70
60
50
40
30
20
10
0
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in October 2016

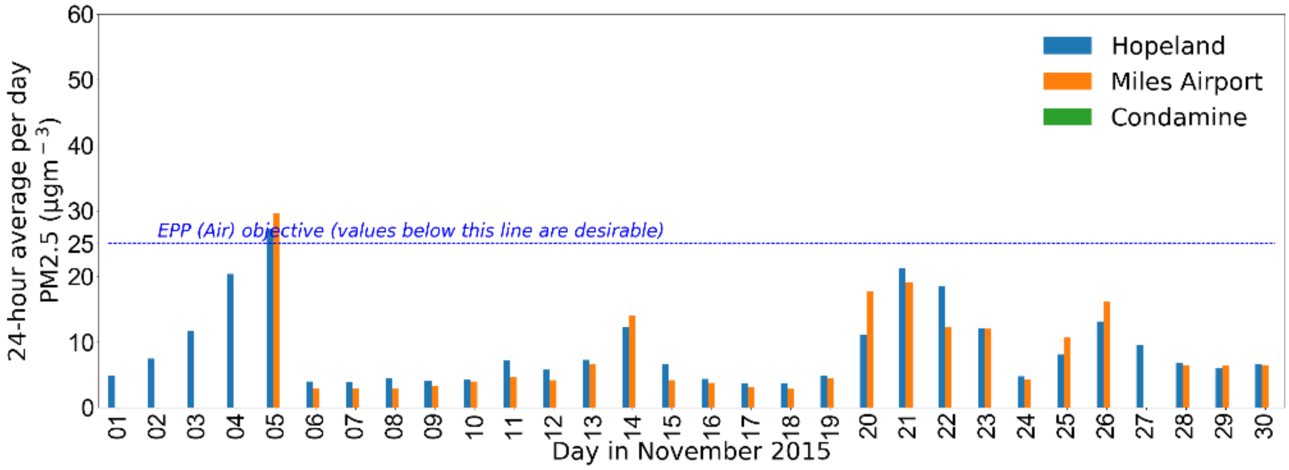

24-hour average per day
PM10 (µgm⁻³)
0
10
20
30
40
50
60
70
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in November 2016

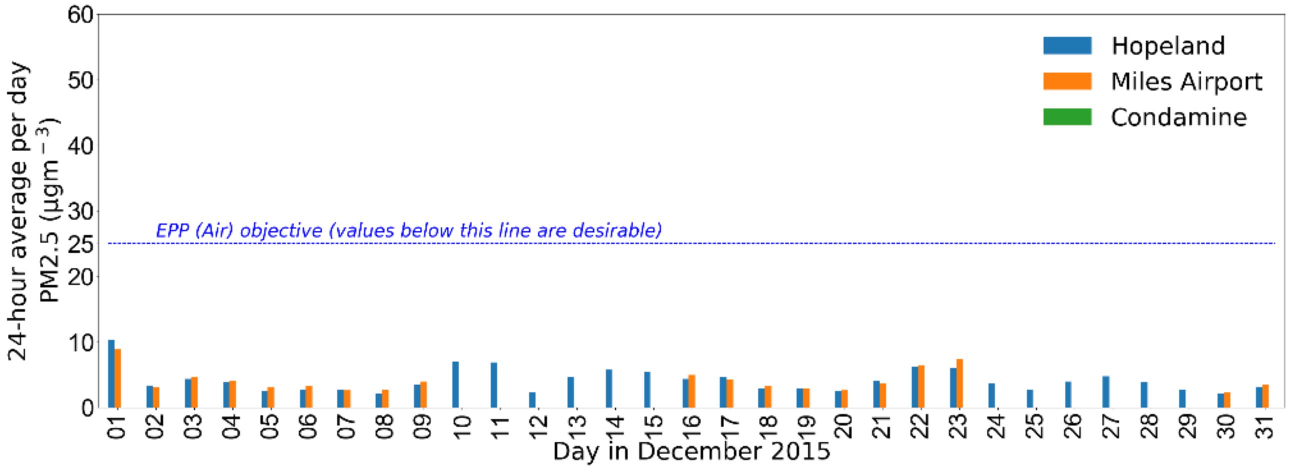

24-hour average per day
PM10 (µgm⁻³)
0
10
20
30
40
50
60
70
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in December 2016

A.6.7 PM2.5 – 24 hour averages, September 2015 – December 2016

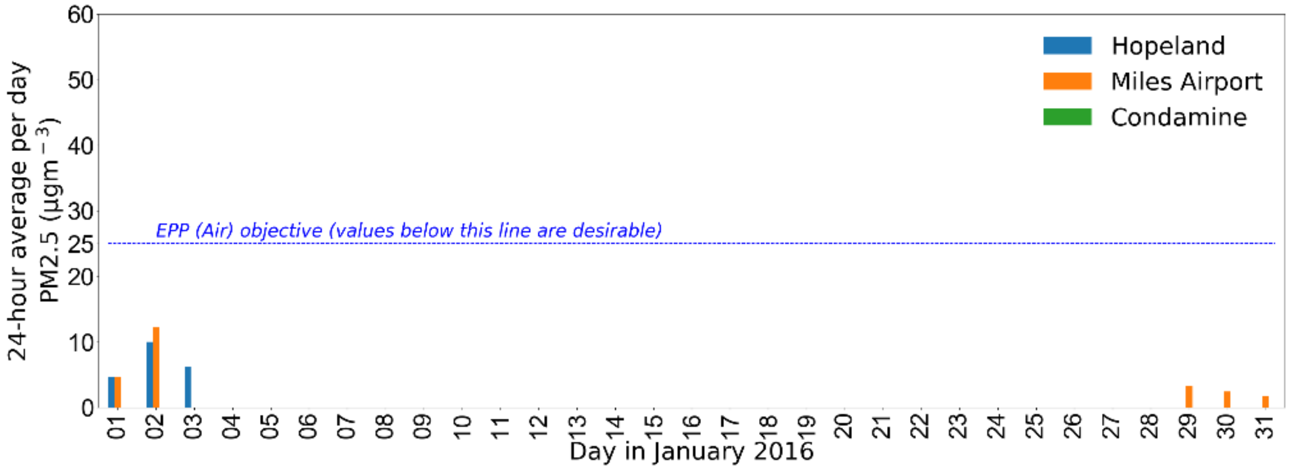




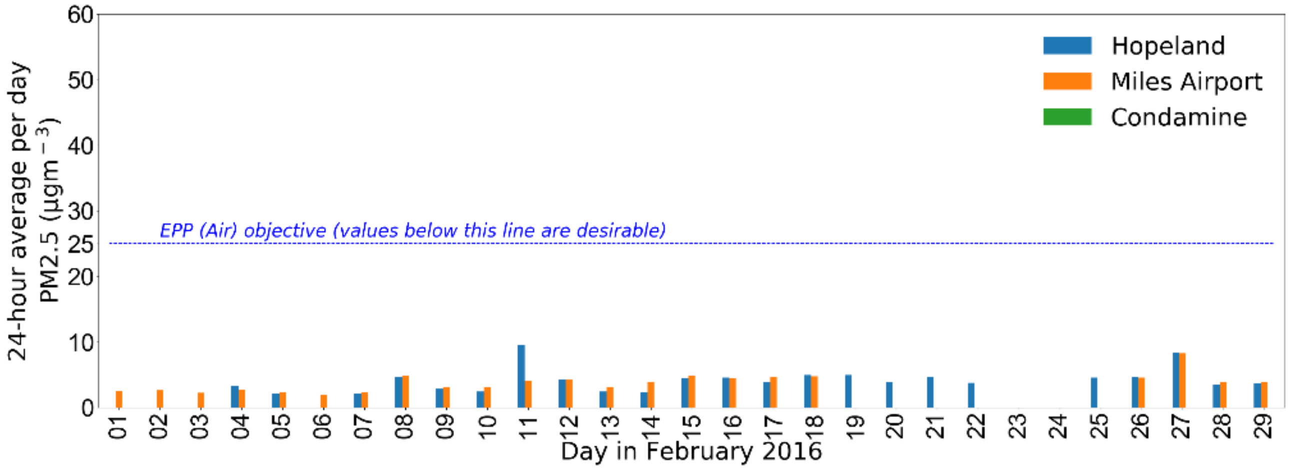




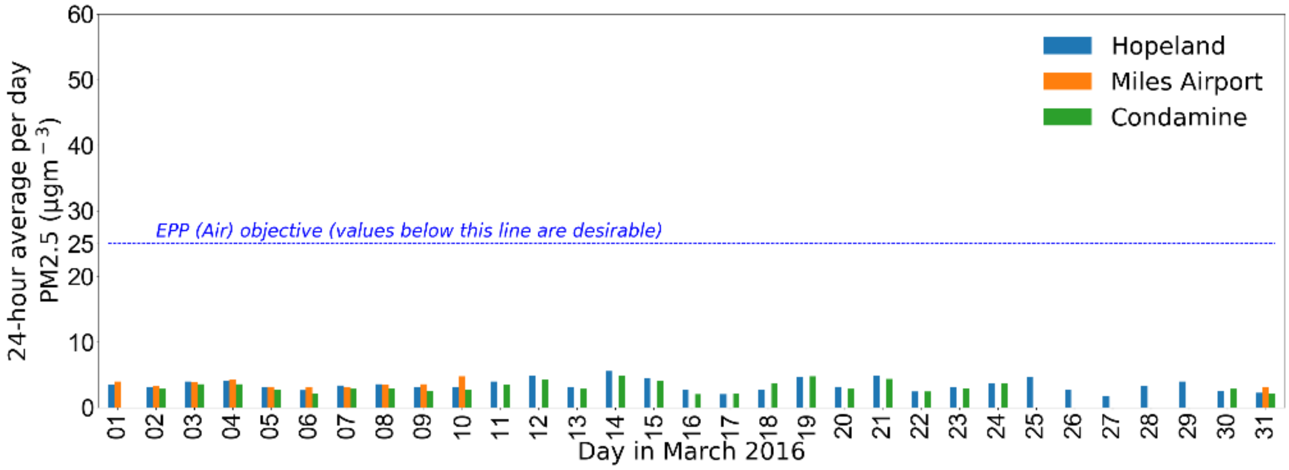
24-hour average per day PM2.5 (μgm^{-3})
60
50
40
30
25
20
10
0
Hopeland
Miles Airport
Condamine
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in December 2015



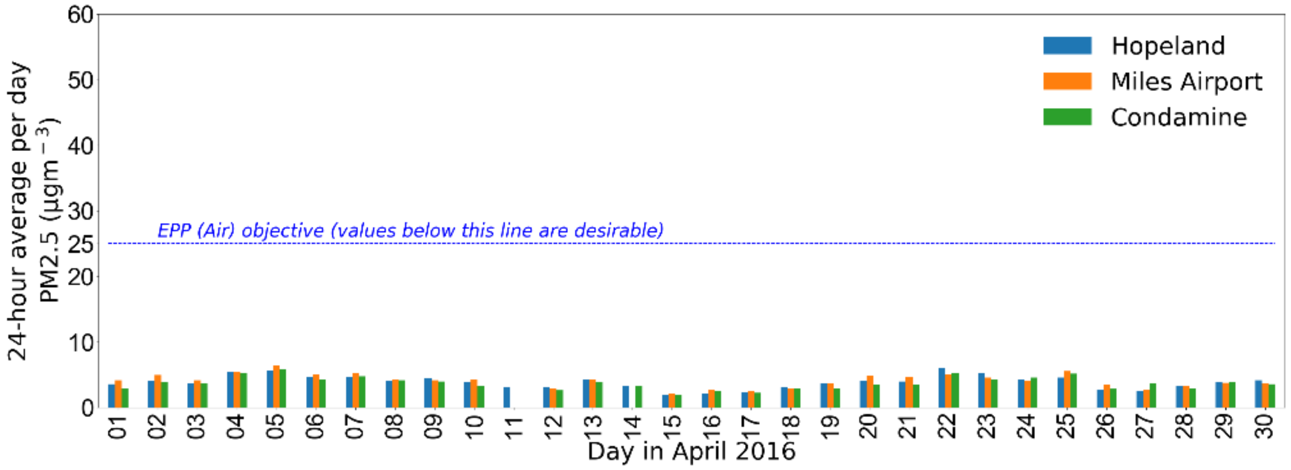
24-hour average per day PM2.5 (μgm^{-3})
60
50
40
30
25
20
10
0
Hopeland
Miles Airport
Condamine
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in January 2016

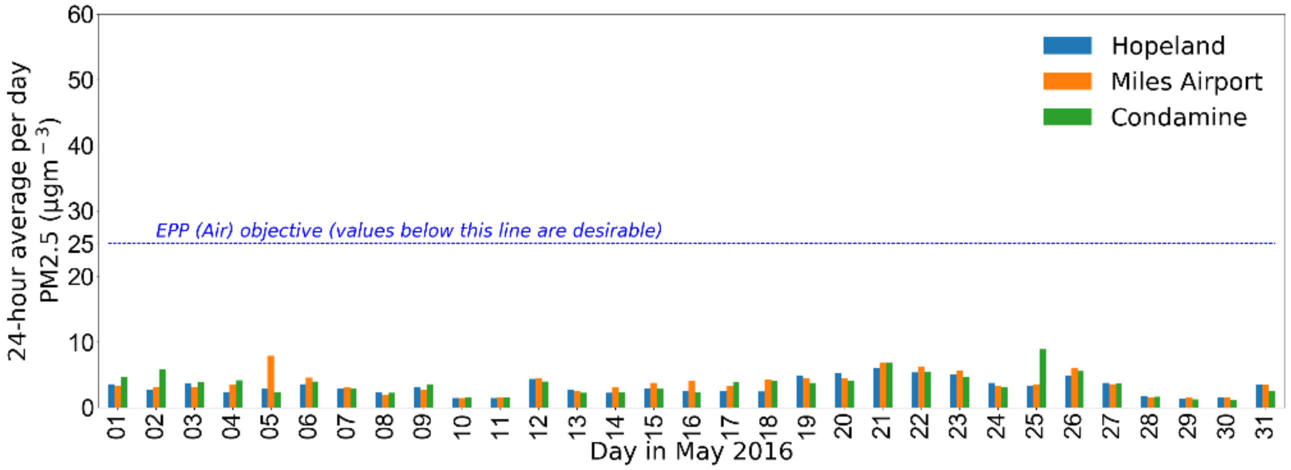


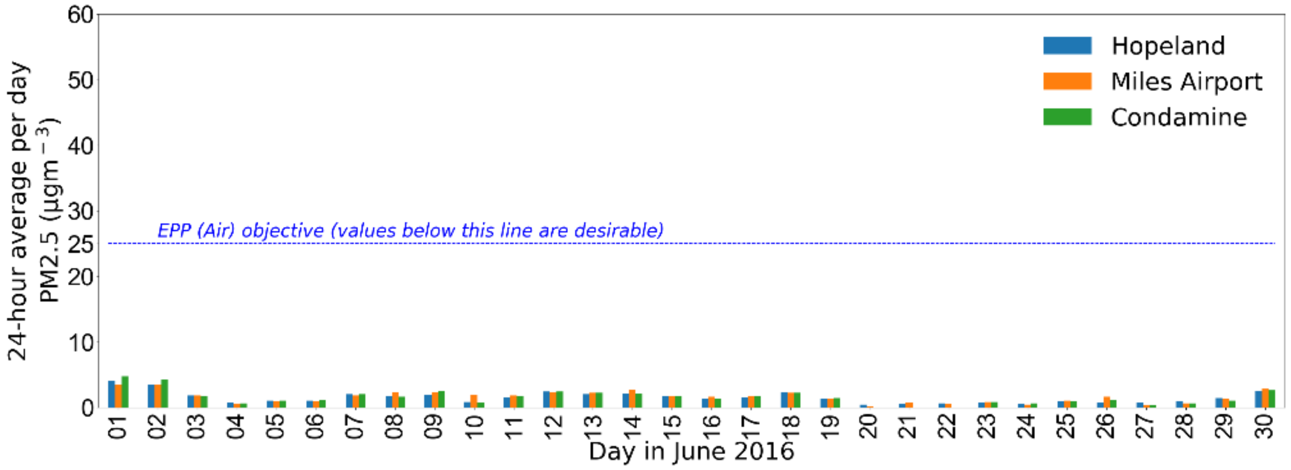
24-hour average per day PM2.5 (μgm^{-3})
60
50
40
30
25
20
10
0
Hopeland
Miles Airport
Condamine
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
Day in February 2016

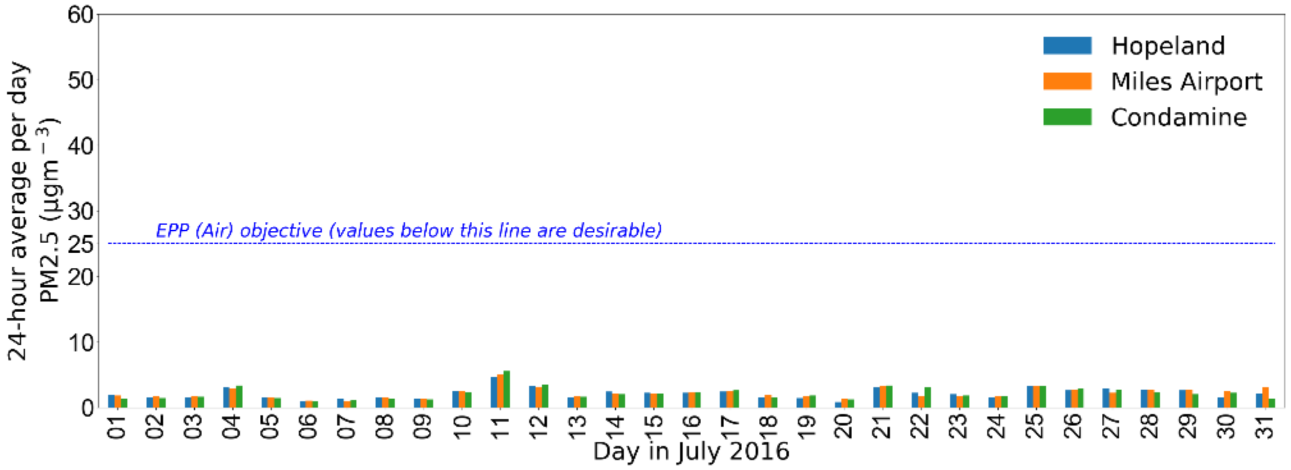


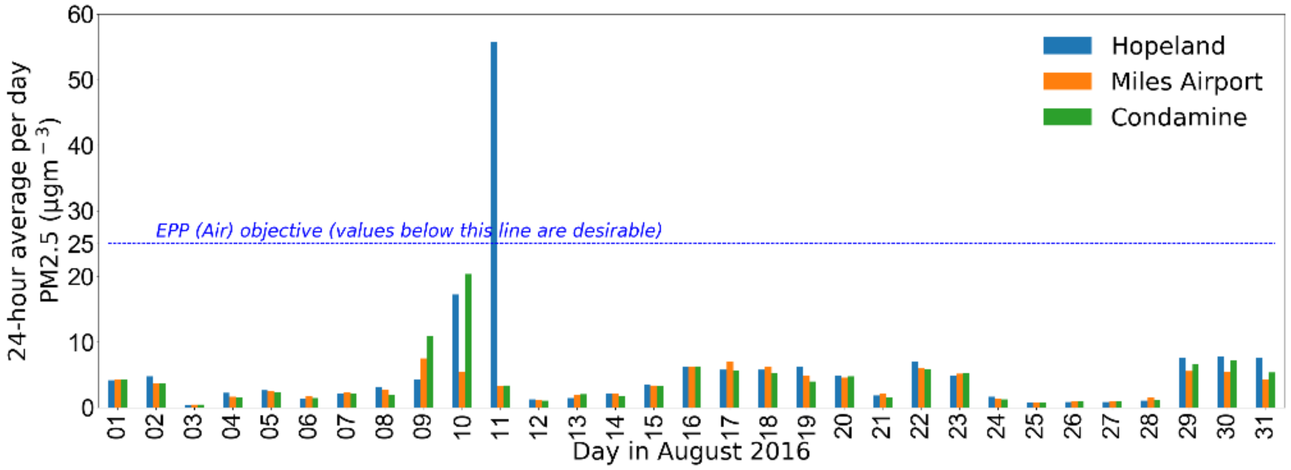
24-hour average per day PM2.5 (μgm^{-3})
60
50
40
30
25
20
10
0
Hopeland
Miles Airport
Condamine
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in March 2016

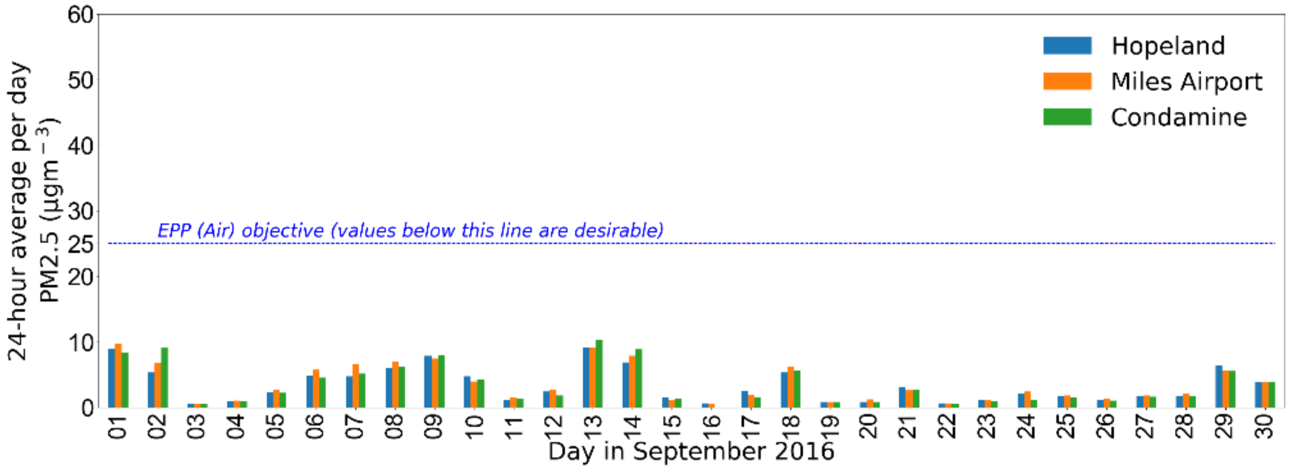

24-hour average per day
PM2.5 (μgm^{-3})
60
50
40
30
25
20
10
0
Hopeland
Miles Airport
Condamine
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in April 2016

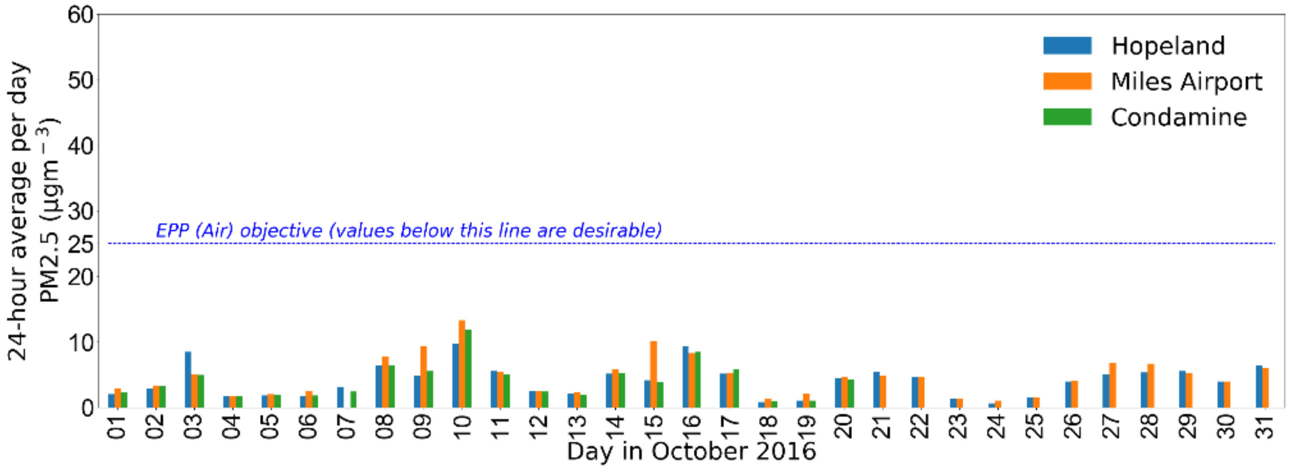

24-hour average per day
PM2.5 (μgm^{-3})
60
50
40
30
25
20
10
0
Hopeland
Miles Airport
Condamine
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in May 2016

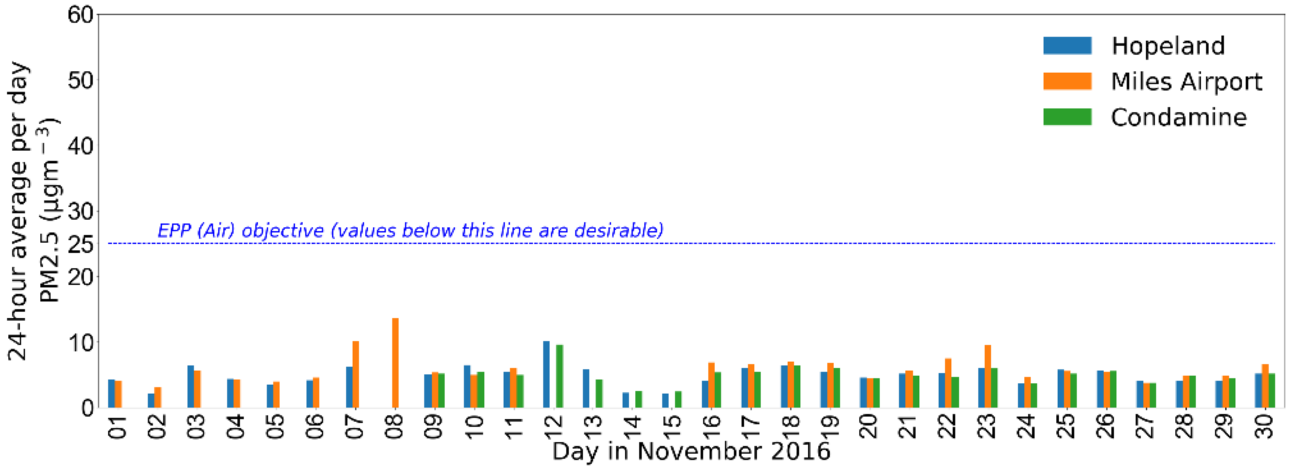

24-hour average per day
PM2.5 (μgm^{-3})
60
50
40
30
25
20
10
0
Hopeland
Miles Airport
Condamine
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in June 2016

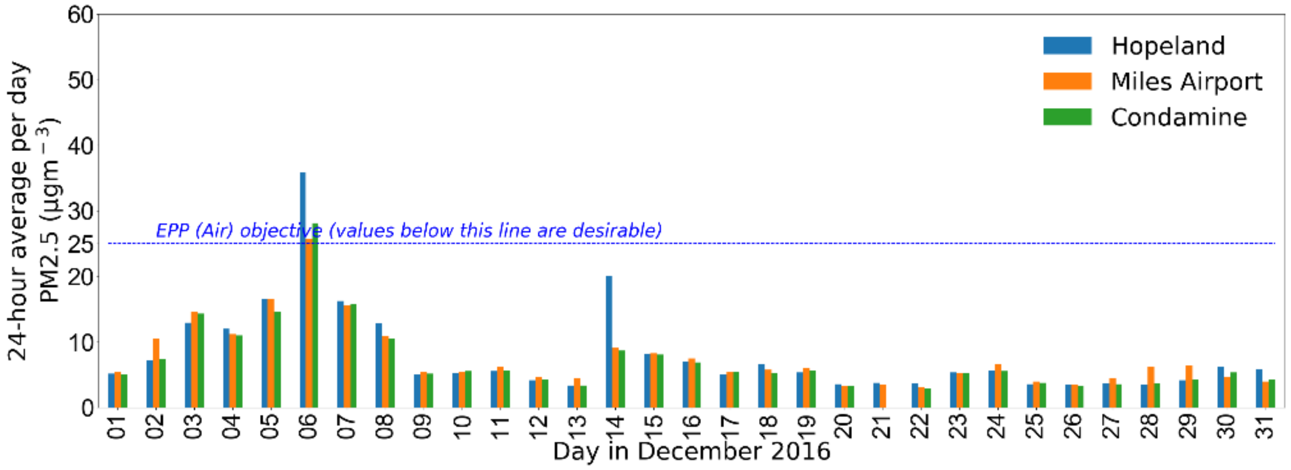

24-hour average per day
PM2.5 (μgm^{-3})
60
50
40
30
25
20
10
0
Hopeland
Miles Airport
Condamine
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in July 2016


24-hour average per day
PM2.5 (µgm^{-3})
0
10
20
25
30
40
50
60
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in August 2016

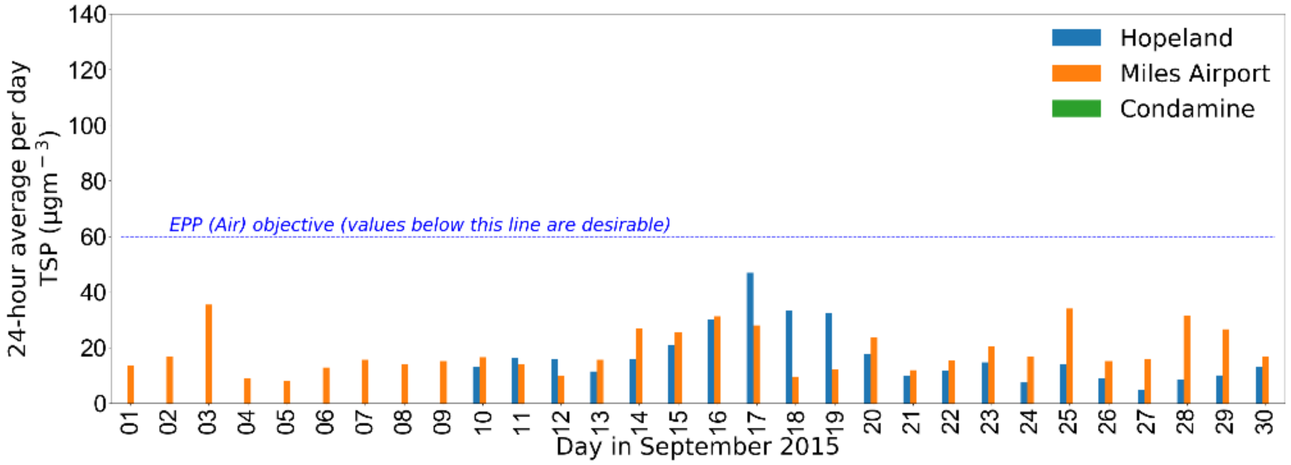

24-hour average per day
PM2.5 (µgm^{-3})
0
10
20
25
30
40
50
60
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in September 2016

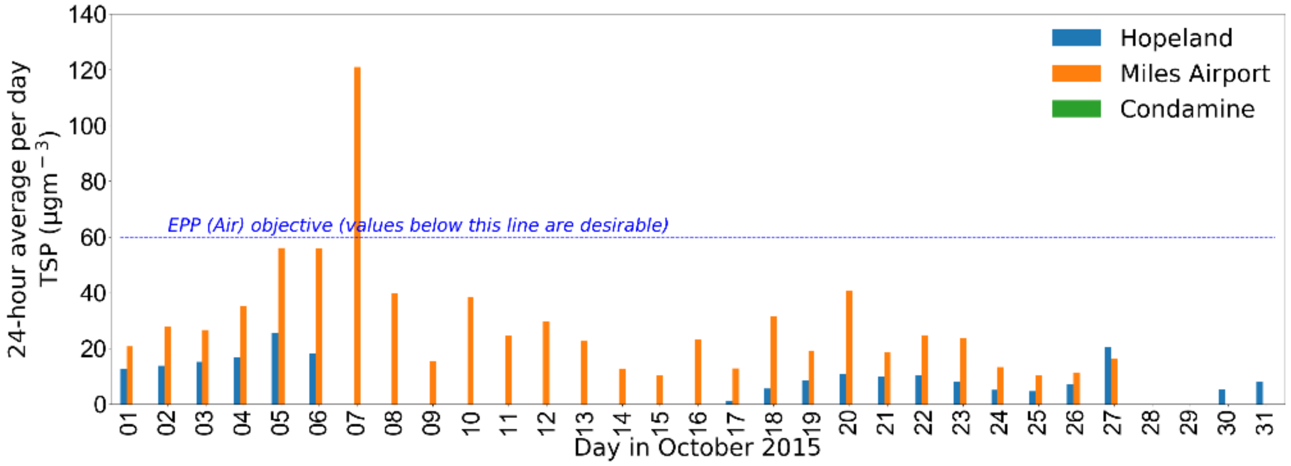

24-hour average per day
PM2.5 (µgm^{-3})
0
10
20
25
30
40
50
60
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in October 2016

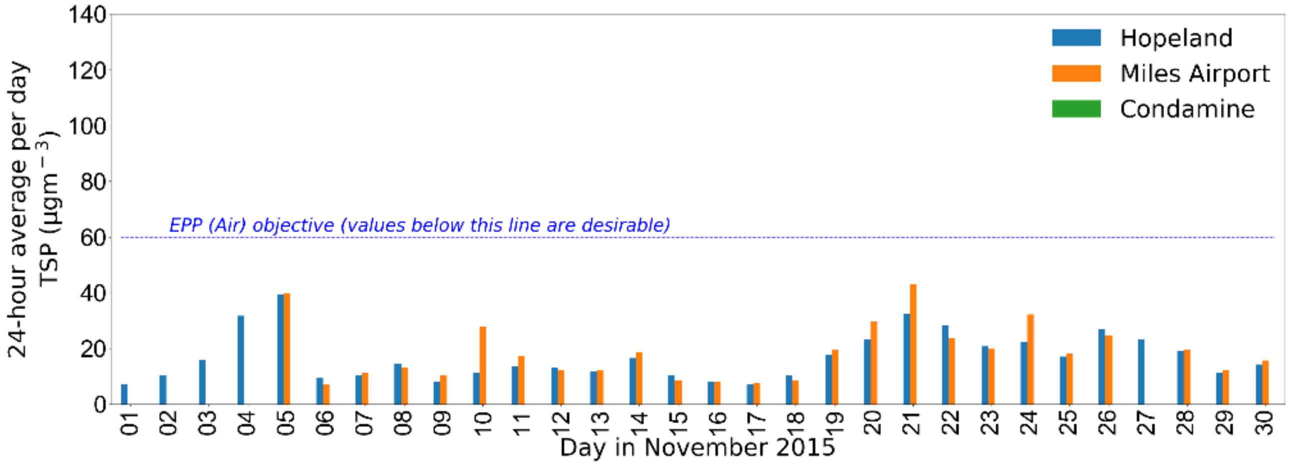

24-hour average per day PM2.5 (μgm^{-3})
60
50
40
30
25
20
10
0
Hopeland
Miles Airport
Condamine
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in November 2016

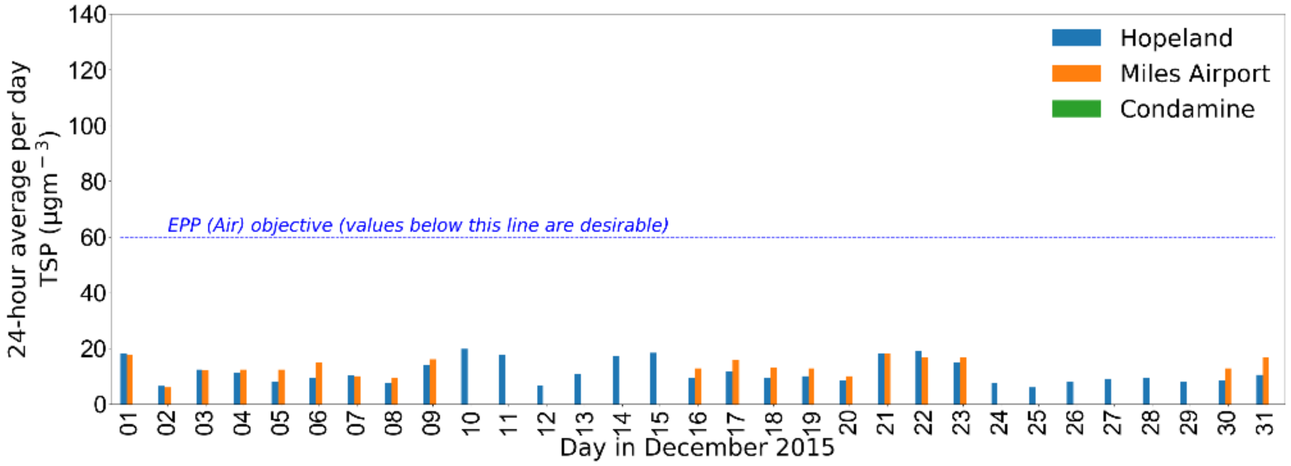

24-hour average per day PM2.5 (μgm^{-3})
60
50
40
30
25
20
10
0
Hopeland
Miles Airport
Condamine
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in December 2016

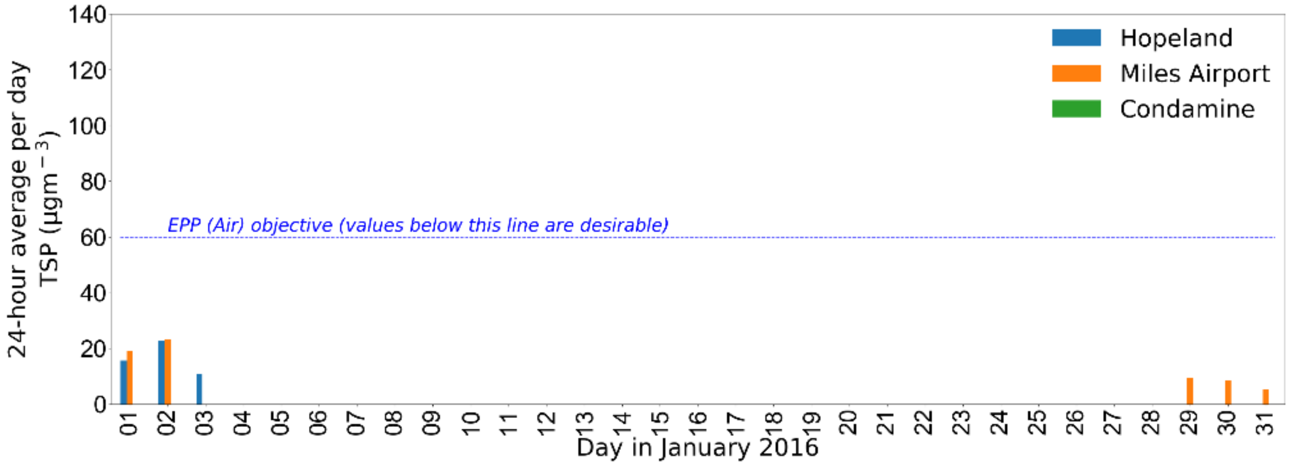
A.6.8 TSP- 24 hour averages, September 2015 – December 2016

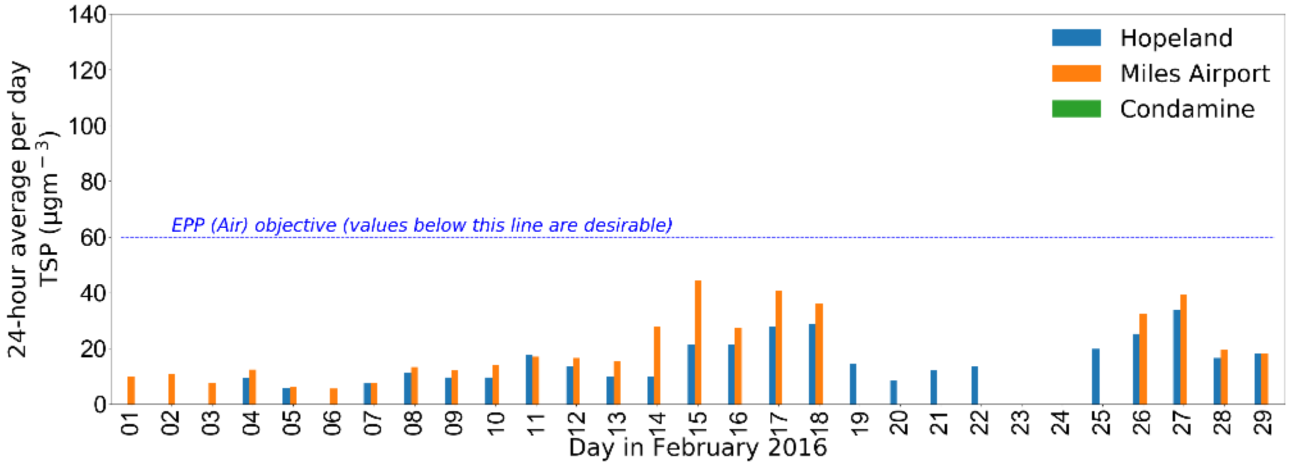


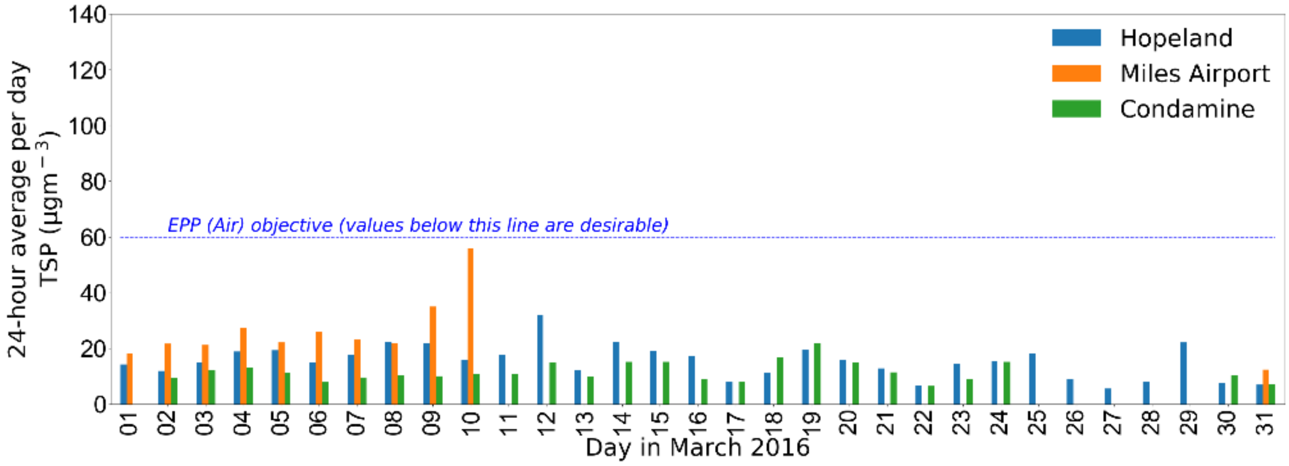


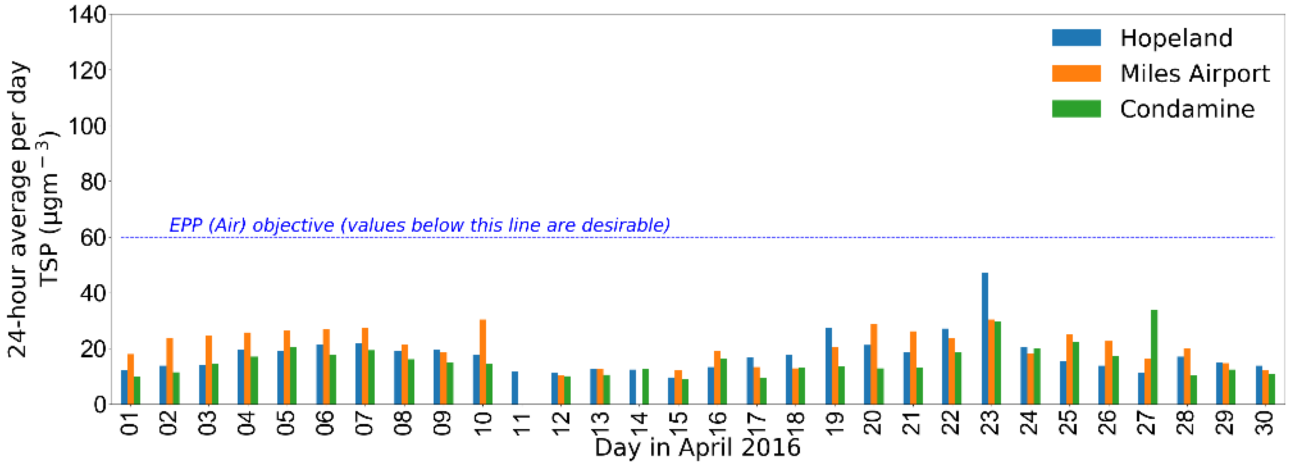


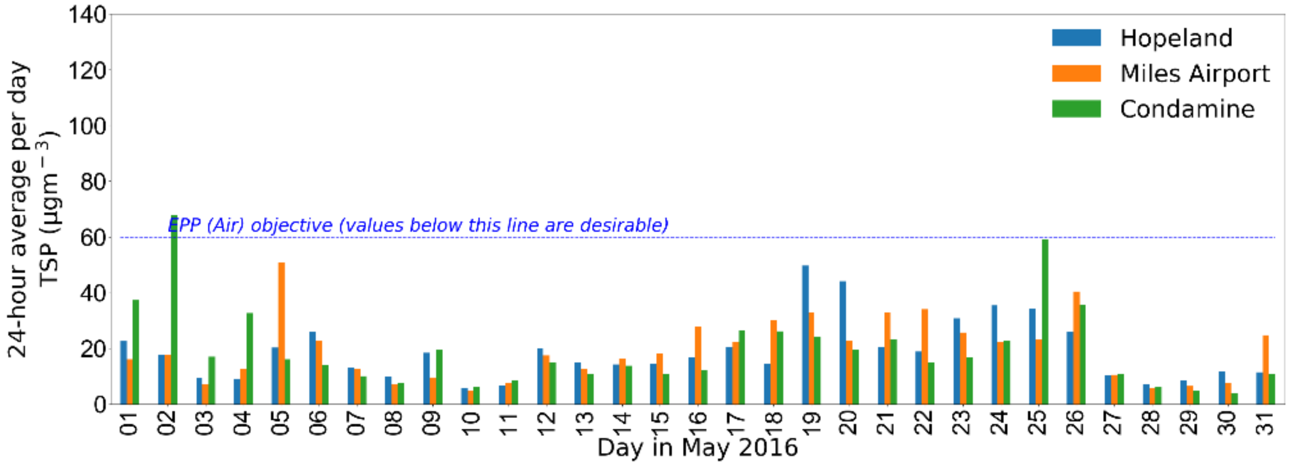


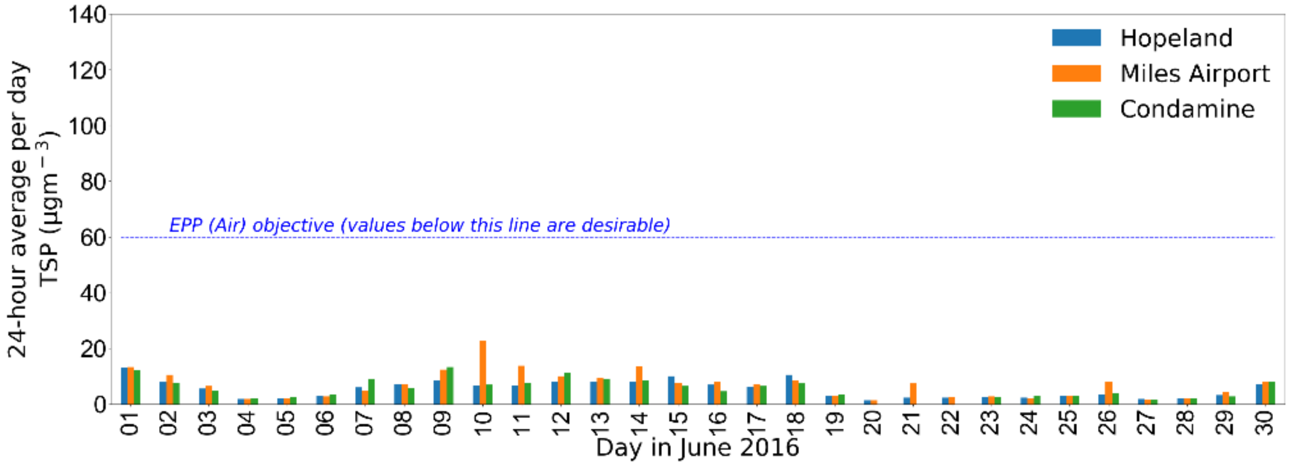

24-hour average per day
TSP (μgm⁻³)
0
20
40
60
80
100
120
140
Hopeland
Miles Airport
Condamine
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in January 2016

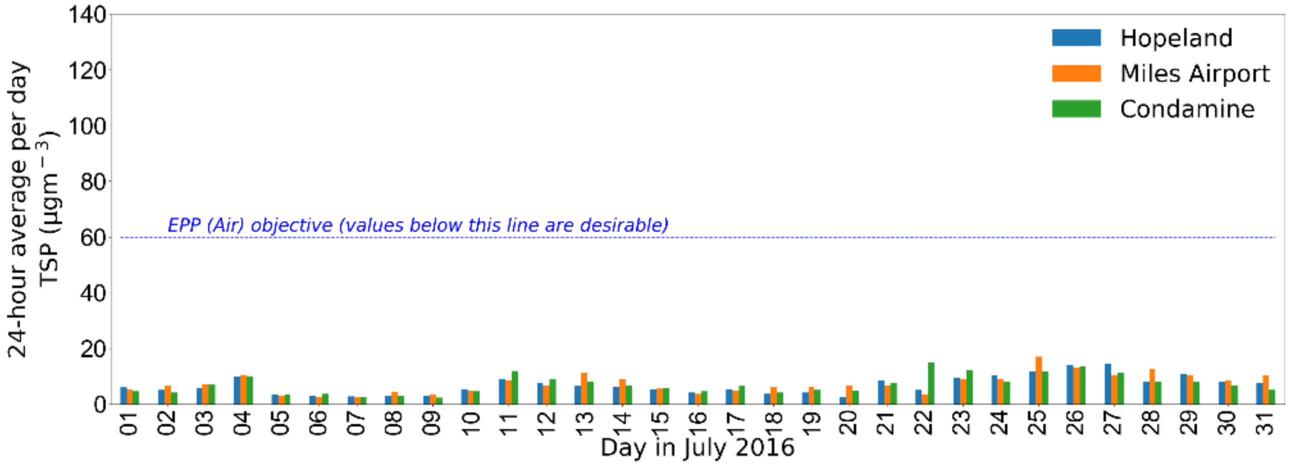

24-hour average per day
TSP (μgm⁻³)
0
20
40
60
80
100
120
140
Hopeland
Miles Airport
Condamine
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
Day in February 2016

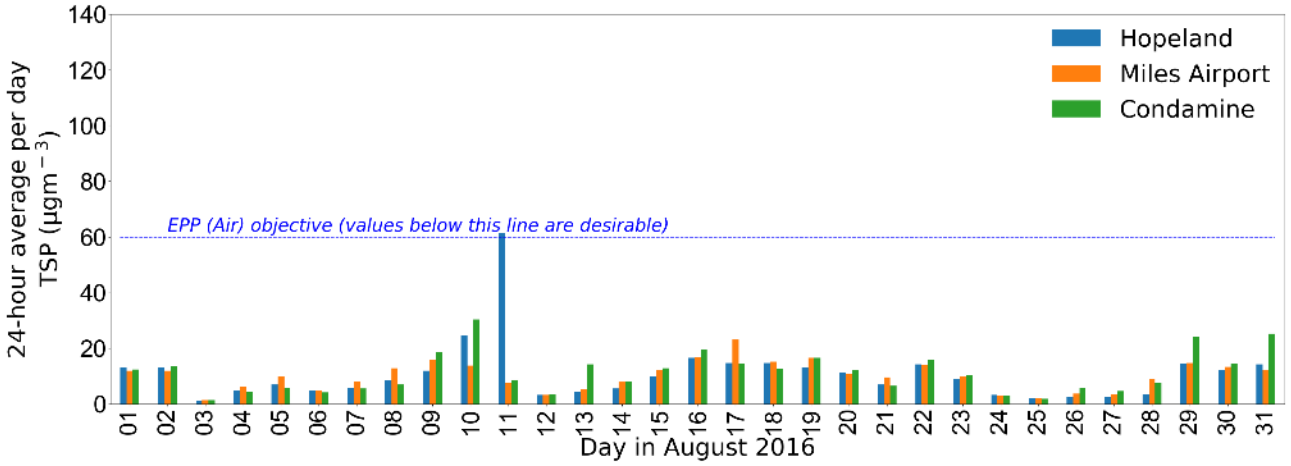

24-hour average per day
TSP (μgm⁻³)
0
20
40
60
80
100
120
140
Hopeland
Miles Airport
Condamine
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in March 2016

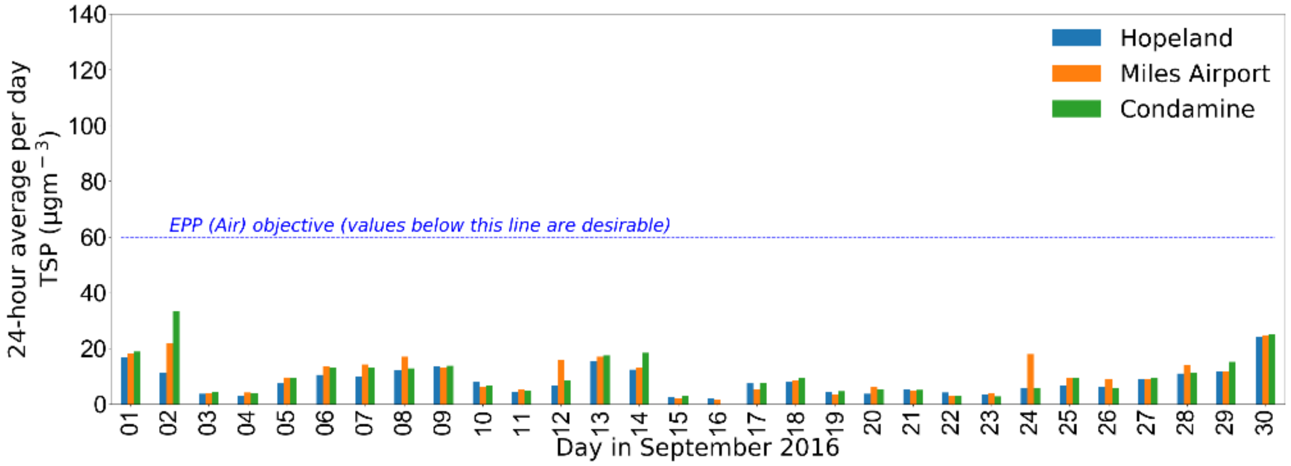

24-hour average per day
TSP (μgm⁻³)
0
20
40
60
80
100
120
140
Hopeland
Miles Airport
Condamine
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in April 2016

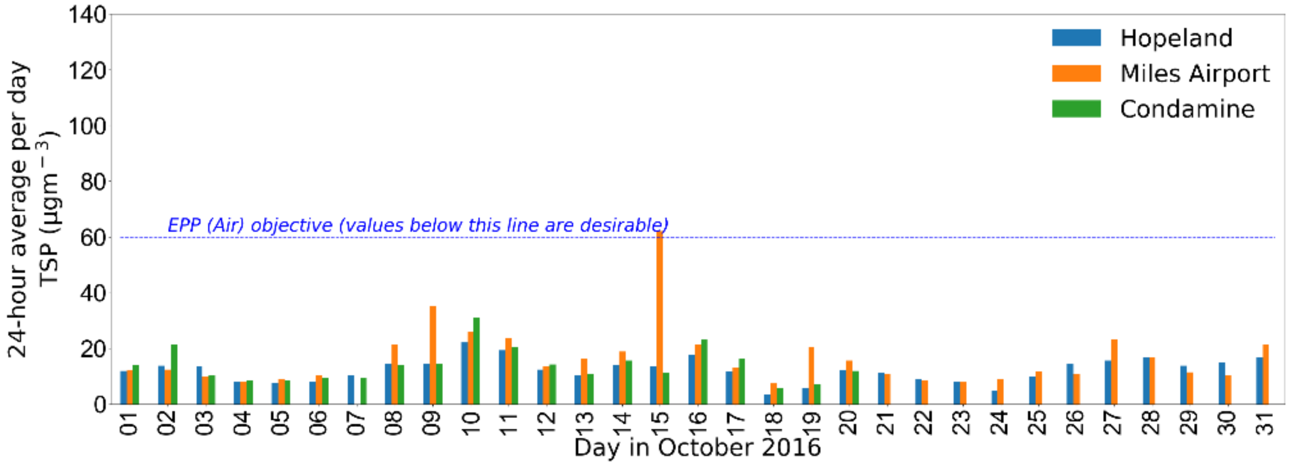

24-hour average per day
TSP (μgm^{-3})
0 20 40 60 80 100 120 140
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in May 2016

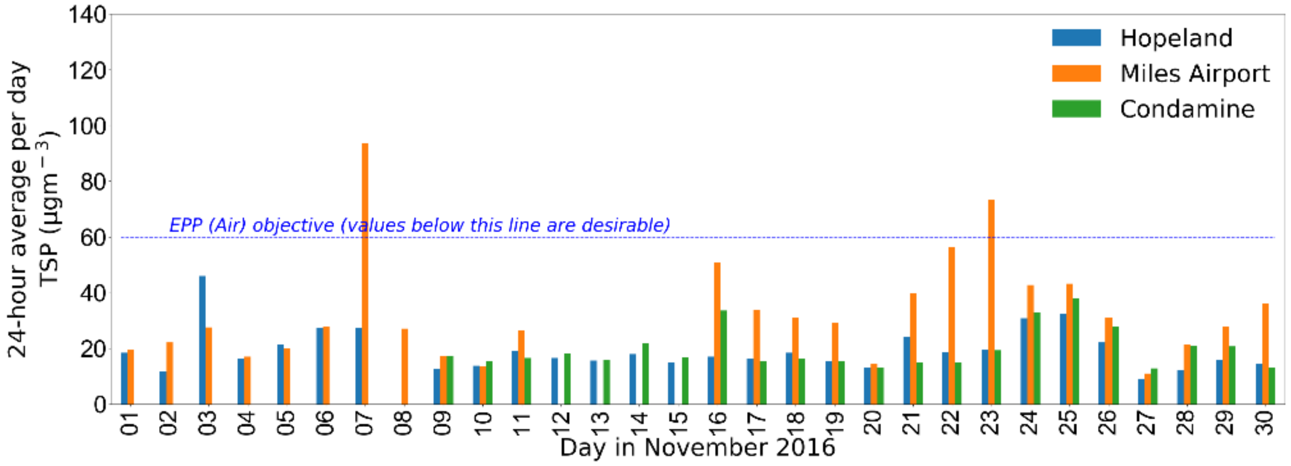

24-hour average per day
TSP (μgm^{-3})
0 20 40 60 80 100 120 140
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in June 2016

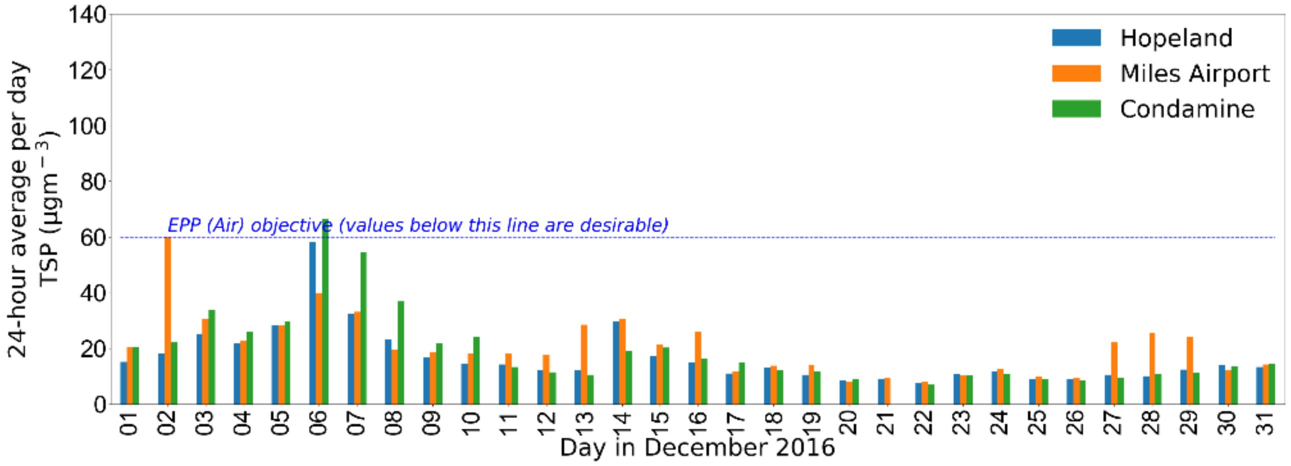

24-hour average per day
TSP (μgm^{-3})
0 20 40 60 80 100 120 140
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in July 2016


24-hour average per day
TSP (μgm^{-3})
0 20 40 60 80 100 120 140
EPP (Air) objective (values below this line are desirable)
Hopeland
Miles Airport
Condamine
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in August 2016


24-hour average per day
TSP (µgm^{-3})
0
20
40
60
80
100
120
140
Hopeland
Miles Airport
Condamine
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in September 2016


24-hour average per day
TSP (µgm^{-3})
0
20
40
60
80
100
120
140
Hopeland
Miles Airport
Condamine
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in October 2016


24-hour average per day
TSP (µgm^{-3})
0
20
40
60
80
100
120
140
Hopeland
Miles Airport
Condamine
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Day in November 2016


24-hour average per day
TSP (µgm^{-3})
0
20
40
60
80
100
120
140
Hopeland
Miles Airport
Condamine
EPP (Air) objective (values below this line are desirable)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Day in December 2016

Appendix B Supplementary information for Part 2

B.1 Radiello species measured and deployment details

B.1.1 VOC passive samplers

Table B. 1 Gases measured with the Radiello Passive VOC sampler

VOC name	CAS Number
Benzene	71-43-2
Bromochloromethane	74-97-5
Butanol	35296-72-1
2-butoxyethanol	111-76-2
Butyl acetate	123-86-4
Carbon tetrachloride	56-23-5
Chlorobenzene	108-90-7
Cyclohexane	110-82-7
Cyclohexanone	108-94-1
n-decane	124-18-5
14-Dichlorobenzene	106-46-7
12-Dichloroethane	107-06-2
1,2-Dichloropropane	78-87-5
N-Dodecane*	112-40-3
Ethyl acetate	141-78-6
Ethylbenzene	100-41-4
2-ethylhexanol	104-76-7
Ethyl-tert-butyl ether	637-92-3
n-Heptane	142-82-5
n-Hexane	110-54-3

Isobutanol	78-83-1
Isooctane	540-84-1
Isopropylbenzene	98-82-8
1-Methoxy-2-propanol	107-98-2
1-Methoxy-2-propyl acetate	108-65-6
Methyl methacrylate	80-62-6
Methylcyclohexane	108-87-2
Methylcyclopentane	96-37-7
Methylethylketone	78-93-3
Methylisobutylketone	108-10-1
2-Methylpentane	107-83-5
3-Methylpentane	96-14-0
Methyl-ter-butyl ether	1634-04-4
Naphthalene	91-20-3
N-Nonane	111-84-2
N-Octane	111-65-9
n-Propylbenzene	103-65-1
Styrene	100-42-5
Tetrachloroethylene	127-18-4
Toluene	108-88-3
1,1,1-Trichloroethane	71-55-6
Trichloroethylene	79-01-6
Trichloromethane	67-66-3
1,2,4-Trimethylbenzene	95-63-6
N-Undecane	1120-21-4
o-Xylene[#]	95-47-6
m&p-Xylenes[#]	108-38-3 / 106-42-3

* dodecane not reported in this study, see B.2.4

m and p xylenes and o xylene reported together as ‘sum of all xylenes’ in this study

B.1.2 Aldehyde Passive samplers

Table B. 2 Gases measured with the Radiello Passive Aldehyde sampler

Aldehyde	CAS number
Formaldehyde	50-00-0
Acrolein*	107-02-8
Acetaldehyde	75-07-0
Propanaldehyde	123-38-6
Butanaldehyde	123-72-8
Pentanaldehyde	110-62-3
Hexanaldehyde	66-25-1
Benzaldehyde	100-52-7
Glutaraldehyde	111-30-8

***acrolein not reported in this study, see B.2.4**

B.1.3 Data provided to CSIRO

Ambient concentration data from the Radiello passive samplers were provided to CSIRO by SGS Leeder in the units of µg m^{-3}. CSIRO converted the data from µg m^{-3} into ppb (parts per billion) assuming a temperature of 298°K, as per the conversion specified in the Radiello manual. Data in the units of ppb has been used to calculate statistics and assess against air quality standards in this study.

Where field and site duplicates were deployed at a site, there were multiple sets of concentration data for that sampling round. In these cases, the field or site duplicates were averaged to give a single set of concentration data for that site, for that time period. Note that Radiello duplicates analysed by SGS Leeder were included in the average while duplicates analysed by Eurofins were not. A comparison of field duplicates is provided in B.2.1.

B.1.4 Location of field and site duplicates, and changes to sampler locations during study

Radiello passive sampler measurement sites were originally determined by consultants. In June 2015 CSIRO audited the site locations and sampler deployment using the same principles employed to select the location of ambient air monitoring stations (without the requirement for access to mains power). As a result of the audit some samplers were moved from the original site to ensure sufficient distance from trees and roads to ensure compliance with the Australian Standard (AS/NZS 2016). In July 2015 the Miles Airport passive site was moved 3 km to be located near a sensitive place. The new site locations were all still within the previously stated distance to

GPFs and Condamine River methane seep. Details of changes to site locations as well as duplicate locations are given in the Table B. 3 below.

Table B. 3 Location of passive sites, location of duplicates and any changes to sampler locations during study if applicable

Passive site	Duplicate	Changes to sampler location if applicable	Comments
Burncluith	n/a	n/a	n/a
Tara Region	VOC Field duplicate	n/a	n/a
Chinchilla	VOC Field duplicate VOC Site duplicate added in July 2015 Aldehyde and H_2S site duplicate added in July 2015	n/a	n/a
Miles Airport	n/a	VOC sampler moved 2.6 km July 2015	Moved to sensitive place
Miles/Condabri North	H_2S Field duplicate Aldehyde Field duplicate	n/a	n/a
Condamine	n/a	n/a	n/a
Hopeland	VOC Site duplicate until June 2015 Analytical duplicate sample collected for analysis by Eurofins California	VOC sampler moved 600 m to Hopeland AQ station in June 2015	Moved alongside AQ station
Nangram/Monreagh	n/a	n/a	n/a
Greenswamp/Purnell	H_2S Field duplicate	VOC sampler moved 200 m in July 2015	Moved to ensure compliance with Aus standard (AS/NZS 2016) regarding distance to trees
Rockwood/Talinga	Aldehyde Field duplicate	VOC sampler moved 1.8 km in July 2015	Moved to ensure compliance with Aus standard (AS/NZS 2016) regarding distance to trees

B.1.5 Sampler exposure details

Table B. 4. Average sampler exposure and sample period by site, including number of individual samples and number of data points of ambient concentrations reported in this study. Number of samples is the total number of individual samplers deployed, including duplicates. Number of data points is the final data set that was used for statistics and plotting. Where number of data points is less than number of samples, this indicates field or site duplicates have been averaged.

	Radiello Type	Average Exposure (days)	Sampling Period	N Samples[1]	N data points[2]
Burncluith	VOC	14	20/1/2015 – 29/1/2016	25	25
	Aldehydes	15	23/7/2015 – 29/1/2016	13	13
	H_2S	15	23/7/2015 – 29/1/2016	13	13
Tara Region	VOC	15	18/8/2014 – 27/1/2016	70	35
	Aldehydes	16	22/7/2015 – 27/1/2016	12	12
	H_2S	16	22/7/2015 – 27/1/2016	12	12
Chinchilla	VOC	14	18/8/2014 – 29/1/2016	86*	36
	Aldehydes	14	23/7/2015 – 29/1/2016	25	13
	H_2S	14	23/7/2015 – 29/1/2016	25	15
Miles Airport	VOC	15	19/8/2014 – 29/1/2016	35	35
	Aldehydes	16	23/7/2015 – 29/1/2016	12	12
	H_2S	16	23/7/2015 – 29/1/2016	12	12
Miles/Condabri North	VOC	15	19/8/2014 – 29/1/2016	35	35
	Aldehydes	16	23/7/2015 – 29/1/2016	24	12
	H_2S	16	23/7/2015 – 29/1/2016	24	12
Condamine	VOC	15	19/8/2014 – 27/1/2016	35	35
	Aldehydes	16	22/7/2015 – 27/1/2016	12	12
	H_2S	16	22/7/2015 – 27/1/2016	12	12
Hopeland	VOC	14	18/8/2014 – 27/1/2016	58	36
	Aldehydes	15	24/6/2015 – 27/1/2016	14	14
	H_2S	15	22/7/2015 – 27/1/2016	13	13
Nangram/Monreagh	VOC	15	19/8/2014 – 29/1/2016	33	33
	Aldehydes	16	23/7/2015 – 29/1/2016	12	12
	H_2S	16	23/7/2015 – 29/1/2016	12	12
Greenswamp/Purnell	VOC	15	18/8/2014 – 29/1/2016	35	35
	Aldehydes	16	23/7/2015 – 29/01/2016	12	12
	H_2S	16	23/7/2015 – 29/01/2016	24	12
Rockwood/Talinga	VOC	14	18/8/2014 – 27/1/2016	36	36
	Aldehydes	15	22/7/2015 – 27/1/2016	26	13
	H_2S	15	22/7/2015 – 27/1/2016	13	13

*Higher number of samples at Chinchilla due to extra samples deployed to test alternative mounting (see B.2.1). As no significant difference between different mounting types were seen (see B.2.1), concentrations from all samples were averaged

B.2 VOC monitoring - Quality Assurance

B.2.1 Measurement and analytical technique - Radiello

Table B. 5 Summary of Radiello analytical techniques. Taken from Study Design report, Lawson et al., 2017

Integrated passive sampling/off-site analysis			
Individual volatile organic compounds (VOCs)	Radiello cartridges: white diffusive body code 120; adsorbing cartridge code 130.	VOCs sampled by passive diffusion onto activated charcoal adsorbent and chemically desorbed with CS2 and analysed by GC-FID. Exposure period is recorded.	SGS laboratory method: MA-5.RAD.02 Volatile Organics in Air, reported in µg/m3 based on Radiello manual Edition 01/2006 method D1: determination of concentration in air based on exposure period, sampling rate and mass/tube.
			SGS laboratory method: MA-5.RAD.03 Volatile Organics in Air, reported in µg/tube based on Radiello manual Edition 01/2006 method D1: determination of mass of VOCs on tube. Extraction by CS2, separation using capillary gas chromatography and identification/quantification with mass spectrometry (MS)
Individual aldehydes	Radiello cartridges: blue diffusive body code 120-1; chemiadsorbing cartridge code 165.	Aldehydes sampled by passive diffusion onto 2,-4-dinitrophenylhydrazine (2,4-DNPH)-coated Florisil to form 2,4-DNP-hydrazones. Exposure period is recorded.	SGS laboratory method MA-1159.RAD.01 Aldehydes in Air, reported in µg/m3, based on Radiello manual Edition 01/2006 method C1: determination of concentration in air based on exposure period, sampling rate and mass/tube
			SGS laboratory method MA-1159.RAD.02 Aldehydes in Air, reported in µg/tube based on Radiello manual Edition 01/2006 method C1: determination of mass of 2,4-DNP-hydrazones on tube. Extraction in acetonitrile, separation using reverse phase high performance liquid chromatography and identification/quantification with selected ion monitoring (SIM) mass spectrometry (MS)
Hydrogen sulphide (H_2S)	Radiello cartridges: white diffusive body code 120; chemiadsorbing cartridge code 170	Hydrogen sulphide is sampled by passive diffusion onto zinc acetate-impregnated polyethylene to form zinc sulphide. Exposure period is recorded.	SGS laboratory method MA-1538.RAD.01 Hydrogen Sulphide in air, reported in ppb, based on Radiello manual Edition 01/2006 method H1: determination of concentration in air based on exposure period, sampling rate and mass/tube
			SGS laboratory method MA-1538.RAD.02 Hydrogen Sulphide in air, in µg/tube based on Radiello manual Edition 01/2006 method H1: determination of mass of sulphide on tube. Sulfide is extracted in water and is reacted to form methylene blue, which is quantified by visible spectrometry.

B.2.2 Accuracy and uncertainty estimate of Radiello measurements

The Radiello passive diffusion method was used to measure VOCs, aldehydes and hydrogen sulphide. Radiello passive diffusion tubes were deployed at field sites for a period of two weeks. After transport to the laboratory, the samples were analysed to determine the mass of the chemical species on the tube:

- VOCs were sampled onto tubes with activated charcoal adsorbent; were chemically desorbed with CS_2 and were analysed by GC-MS.
- Aldehydes were sampled onto a 2,4-dinitrophenylhydrazine coated tubes; extracted with acetonitrile and analysed by HPLC-MS.
- Hydrogen sulphide was sampled onto zinc acetate impregnated tubes; extracted in water, and analysed by visible spectrometry (as methylene blue).

The concentration of the species in air was determined by dividing the mass per tube by the exposure time and the sampling rate for that species. The concentration was determined as mass of species per volume of air (often expressed as 10^{-6} grams per cubic metre or $\mu g/m^3$) at 25^oC. For comparison to air quality objectives, the concentration was converted into a mixing ratio for the volume of the species per volume of air (often expressed in parts per billion, or ppbv).

Uncertainties associated with determination of the mass on the tube, sampling rate and exposure time all contribute to the total uncertainty associated with this measurement technique. For the measurement technique to be appropriate to use for comparing concentrations to air quality objectives the uncertainty and detection limits of the technique need to be significantly lower than the guideline. A variety of quality assurance procedures were used to assess the total uncertainty associated with Radiello measurements and are presented below.

B.2.3 Radiello sampling rates

All air pollutant measurement methods have an uncertainty attached to their reported concentrations based on the accuracy and precision of the method. A major source of measurement uncertainty of the Radiello method is the experimentally-determined sampling rate (the rate the analyte is adsorbed from the air to the adsorbent cartridge) (Pennequin-Cardinal et al 2004). Table B. 6 shows the experimentally-determined sampling rates and measurement uncertainty (to 95% confidence) associated with determination of the rate. The Radiello manufacturer stated uncertainties at 95% confidence for experimentally-determined sampling rates of the compounds measured in this study range from 1.1 – 23.5 % (Radiello Manual, 2006). The rates are reported at standard conditions of 25^oC and 1013 hPa. A temperature correction to the sampling rate can be applied if sampling was performed at other temperatures. For this study the effect of temperature on sampling rate was negligible, with a mean sampling temperature of 20^oC resulting in an uncertainty of 0.5%. The average uncertainty in sampling rate for all species at 95% confidence interval is 18%.

Table B. 6 Sampling rates at 25°C and rate percentage uncertainty for Radiello VOC gas species using the CS_2 chemical desorption method (cartridge code 130), for aldehyde gas species using catridge code 165 and hydrogen sulphide gas using cartridge code 170.

Chemical	Sampling rate	Percentage uncertainty in rate at 2σ
VOC gases (cartridge code 130)	ml/min	%
Benzene	80	1.8
Bromochloromethane	70	1.4
Butanol	74	5
2-butoxyethanol	56	5.7
Butyl acetate	60	3
Carbon tetrachloride	67	9
Chlorobenzene	68	3.6
Cyclohexane	54	4.5
Cyclohexanone	68	4.2
n-decane	43	1.1
1,4-Dichlorobenzene	51	7.7
1,2-Dichloroethane	77	8.2
1,2-Dichloropropane	66	4.5
Ethyl acetate	78	1.5
Ethylbenzene	68	2.4
2-ethyl-1-hexanol	43	10.1
ethyl-tert-butyl ether (ETBE)	61	3
n-Heptane	58	3
n-Hexane	66	2.5
Isobutanol	77	2.5
Isooctane	55	3.2
Isopropylbenzene	58	2.7
1-Methoxy-2-propanol	55	6
1-Methoxy-2-propyl acetate	60	6.2
methyl metacrylate	68	2.5
Methylcyclohexane	66	6.5
Methylcyclopentane	70	2.5
Methylethylketone	79	1.6
Methylisobutylketone	67	8.7
2-Methylpentane	70	2.5
3-Methylpentane	70	2.5
methyl-ter-butyl ether (MTBE)	65	2.5
Naphthalene	25	7
N-Nonane	48	5.4
N-Octane	53	3.2
n-Propylbenzene	57	2.9
Styrene	61	3
Tetrachloroethylene	59	2.5
Toluene	74	1.5
1,1,1-Trichloroethane	62	5.5

Trichloroethylene	69	2.4
Trichloromethane	75	9.7
1,2,4-Trimethylbenzene	50	6.6
N-Undecane	24	10
o-Xylene	65	2.5
m&p-Xylenes	70	2.5
Aldehyde gases (cartridge code 165)	ml/min	%
Formaldehyde	99	13.8
Acetaldehyde	84	15.9
Propanaldehyde	39	17.1
Butanaldehyde	11	23.5
Pentanaldehyde	27	22.9
Hexanaldehyde	18	20.2
Benzaldehyde	92	17.2
Glutaraldehyde	92	14.5
Inorganic gases	ng/ppb/min	%
Hydrogen sulphide (cartridge code 170)	0.096	8.7
All species mean uncertainty at 2σ	N/A	18

The reported uncertainty of 2σ as a percentage shows the error as a percentage for all values within two standard deviations of the mean, which for normally distributed data is typically equivalent to an uncertainty of 95%

B.2.4 Radiello - VOCs not quantitatively measured

While dodecane and acrolein concentrations can be measured using Radiello samplers, data for these compounds are not reported in this study. Alternative measurement techniques should be used for these species.

It should be noted that concentrations of dodecane and acrolein measured using Radiello samplers were at least 10 times lower than the relevant air quality objectives (Texas AMCV for acrolein and Texas ESL for dodecane). However due to concerns with data quality, this data has been deemed not of acceptable reliability for inclusion in this report.

Dodecane data was excluded from this study in response to advice from the sampler manufacturer Radiello. Radiello advised CSIRO that dodecane concentrations measured using this method should be considered as a qualitative due to concerns about the sampling/uptake rate of dodecane on to the sampler.

Acrolein data was excluded from this study because the 2,4-DNPH derivatisation technique has been shown in the scientific literature to be unsuitable for acrolein measurements (Ho et al., 2011). This is because the acrolein which has been derivatised on the sampler may undergo further chemical reactions, leading to an underestimate in the acrolein measurement. USEPA Compendium Method TO-11A (USEPA, 1999) does not includes acrolein in its list of target analytes.

B.2.5 Determination of exposure times for Radiello samples

The optimum exposure time for Radiello samples depends on the expected concentrations of target gases in the air. If concentrations in the air are low, a longer exposure time is needed to collect sufficient mass to be detected during analysis of the sample. If concentrations in the air are high, a shorter exposure time is needed to avoid using up all receptor sites on the sampler before sampling time is finished.

The Aldehyde Radiello passive samplers contain a chemical (2,4-DNPH-dinitrophenylhydrazine) coated on the absorbing surface. When the aldehydes pass through the diffusive surface they react with 2,4 DNPH on the absorbing cartridge to form a reaction product (2,4-dinitrophenylhydrazones). It is these reaction products that are extracted and analysed (see B.2.1).

The optimum exposure time varies with the expected concentration of aldehydes in the air. The advised exposure time from Radiello is one week, based on an assumed atmospheric outdoor urban concentration of formaldehyde of 5-30 µg m^{-3} (4 - 24 ppb) (Radiello, 2006). At these concentrations, after one week, the 2,4-DNPH on the absorbing surface would be depleted. Formaldehyde concentrations in rural areas more typical of this study are likely to be significantly lower, which would allow a longer exposure time than one week. Measurements by CSIRO in 2015 (see Section 7) show that average formaldehyde concentrations are less than 0.5 ppb, well below urban levels of 4-24 ppb. This indicates that the DNPH is unlikely to be depleted over the two week exposure time. A subsequent experiment in Chinchilla township comparing concentrations of aldehydes measured using a Radiello passive sampler exposed for a two week period compared with the average of two samplers exposed for one week each showed agreement within 10%. For this reason, an exposure time of two weeks for Passive Radiello aldehyde samplers was used in this study.

For VOC measurement using the CS_2 method, Radiello suggests exposure times from 8 hours to 30 days, the ideal value being 7 days. For VOCs in rural areas a longer exposure period than a week may be needed to collect sufficient mass to be above analytical detection limit masses thus an exposure time of two weeks was used in this study.

B.2.6 Analysis QA/QC and field Blanks

Table B. 7 summarises the quality assurance criteria used by SGS Leeder during analysis of Radiello tubes to determine the mass on the tube. The sampling rate and exposure time are then used to convert the mass on the tube into a concentration in air.

Method blanks are used to check whether there are sources of contamination in the laboratory. Method blanks were below the limit of detection of 0.1 µg per tube for 36 VOC, 18 carbonyl and 14 H_2S analytical runs.

The method spike prepared in the same matrix as a method blank except that it is spiked with a known amount of each chemical of interest. The method spike is used to determine the accuracy of the analysis. This accuracy is expressed as a percent recovery. A method spike recovery of 100% means that the analytically determined chemical mass is the same as the mass that was added as a spike. Average recoveries for 7 VOCs species ranged from 103 to 105%, for 5 aldehydes 81 to 105% and for hydrogen sulphide, 96%. Using recoveries from spikes in all analytical runs (n=134), the uncertainty in accuracy at 95% is 22%.

Analysis of duplicate method spikes provides an estimate of analytical precision, expressed as the relative percent difference (RPD). RPD is calculated by dividing the absolute difference between the duplicates by the average of the duplicates and multiplying by 100 to convert to a percentage.

Average RPD for 7 VOCs species ranged from 103 to 105%, for 5 aldehydes 81 to 105% and for hydrogen sulfide, 96%. Using duplicate method spikes from all analytical runs (n=67), the uncertainty in analytical precision at 95% is 13%.

Table B. 7 Analytical quality assurance procedures to determine method blanks, accuracy (spike recovery) and precision (spiked duplicates).

Chemical	**Method blank mass per tube µg/tube**	**Method spike average percent recovery**	**Method spike duplicate precision %RPD**
VOC	**n=36**	**n=72**	**n=36**
Benzene	<0.1	105 (87-118)	3 (0-9)
Bromochloromethane	<0.1		
Butanol	<0.1		
2-butoxyethanol	<0.1		
Butyl acetate	<0.1		
Carbon tetrachloride	<0.1		
Chlorobenzene	<0.1	103 (81-119)	4 (0-13)
Cyclohexane	<0.1		
Cyclohexanone	<0.1		
n-decane	<0.1		
1,4-Dichlorobenzene	<0.1	103 (84-117)	4 (0-13)
1,2-Dichloroethane	<0.1		
1,2-Dichloropropane	<0.1		
Ethyl acetate	<0.1		
Ethylbenzene	<0.1	103 (82-122)	4 (0-13)
2-ethyl-1-hexanol	<0.1		
ethyl-tert-butyl ether (ETBE)	<0.1		
n-Heptane	<0.1		
n-Hexane	<0.1		
Isobutanol	<0.1		
Isooctane	<0.1		
Isopropylbenzene	<0.1		
1-Methoxy-2-propanol	<0.1		
1-Methoxy-2-propyl acetate	<0.1		
methyl metacrylate	<0.1		
Methylcyclohexane	<0.1		
Methylcyclopentane	<0.1		
Methylethylketone	<0.1		
Methylisobutylketone	<0.1		
2-Methylpentane	<0.1		
3-Methylpentane	<0.1		
methyl-ter-butyl ether (MTBE)	<0.1		
Naphthalene	<0.1		

N-Nonane	<0.1		
N-Octane	<0.1		
n-Propylbenzene	<0.1		
Styrene	<0.1		
Tetrachloroethylene	<0.1		
Toluene	<0.1	103 (81-118)	3 (0-12)
1,1,1-Trichloroethane	<0.1		
Trichloroethylene	<0.1		
Trichloromethane	<0.1		
1,2,4-Trimethylbenzene	<0.1		
N-Undecane	<0.1		
o-Xylene	<0.1	104 (81-120)	4 (0-14)
m&p-Xylenes	<0.1	104 (80-127)	3 (0-11)
Aldehydes	**n=18**	**n=36**	**n=18**
Formaldehyde	<0.1	96 (67-112)	6 (0-28)
Acetaldehyde	<0.1	97 (79-113)	8 (0-25)
Propanaldehyde	<0.1	94 (74-113)	8 (1-22)
Butanaldehyde	<0.1	81 (64-107)	7 (1-14)
Pentanaldehyde	<0.1	N/A	N/A
Hexanaldehyde	<0.1	N/A	N/A
Benzaldehyde	<0.1	105 (83-113)	8 (1-26)
Glutaraldehyde	<0.1	N/A	N/A
Inorganic gas	**n=1**	**n=26**	**n=13**
Hydrogen sulfide	<0.1	96 (85-109)	4 (1-7)
All samples U95%		22	13

B.2.1 Field blanks and duplicate precision

Table B. 8 summarises the quality assurance criteria used to determine precision and accuracy of the sampling, transport, storage and analysis process.

Field blanks are used to check sampling, transport and laboratory sources of contamination. The field blank sampler is identical for those used for sampling and is subjected to the same transport, handling and analysis procedures. Field blanks were below the limit of detection for 12 hydrogen sulphide trip blanks and 47 VOC blanks. Field blanks were below the limit of detection for most aldehydes for 14 trip blanks. There were blanks detected for formaldehyde and acetaldehyde in two blanks. These were not subtracted from the samples due to the low frequency of detects and low concentrations relative to the ambient concentrations. The blanks may have contributed of 0.1-0.2 ppb to ambient levels in September 2015, which were well below air quality guidelines.

Field duplicates are two samplers which are deployed in the same location side by side, exposed for the same amount of time, and treated and analysed identically. VOC field duplicates were deployed at Tara Region, Chinchilla and Hopeland sites; aldehyde field duplicates were deployed at Miles/Condabri North and Rockwood, and hydrogen sulphide field duplicates were deployed at Miles/Condabri North and Greenswamp.

The purpose of a field duplicate is to provide an estimate of both the sampling and analysis precision, expressed as the relative percent difference (RPD). The precision is calculated only for species where the mass reported for both duplicates is greater than the analytical limit of detection.

Table B. 8 shows the average, minimum and maximum field blank concentrations. Field duplicate precision is reported as an absolute difference in concentration and as a relative percent difference (%RPD). The number of species detected in field duplicates and the average ratio of sample mass to detection limit is reported. Blank cells Blank cells indicate that duplicate concentrations were below the detection limit.

Chemical	**Field blank concentration ppb avg (min-max)**	**Field duplicate difference ppb avg (min-max)**	**Field duplicate precision %RPD avg (min-max)**	**Number detects>DL**	**Sample: DL ratio**
VOC	n=47	n=107	n=107	n=107	n=107
Benzene	<0.02 (<0.01-<0.03)	0.01 (0.00-0.03)	9 (0-34)	51	3.3
Bromochloromethane	<0.01 (<0.01-<0.02)				
Butanol	<0.02 (<0.01-<0.03)	0.00 (0.00-0.00)	4 (4-4)	1	4.1
2-butoxyethanol	<0.02 (<0.01-<0.04)				
Butyl acetate	<0.02 (<0.01-<0.04)				
Carbon tetrachloride	<0.01 (<0.01-<0.02)	0.01 (0.00-0.04)	7 (0-35)	107	6.8
Chlorobenzene	<0.02 (<0.01-<0.02)				
Cyclohexane	<0.03 (<0.02-<0.06)	0.01 (0.00-0.03)	12 (0-30)	25	2.8
Cyclohexanone	<0.02 (<0.01-<0.02)	0.01 (0.00-0.04)	27 (0-64)	10	2.3
n-decane	<0.02 (<0.01-<0.03)	0.01 (0.00-0.03)	20 (0-67)	26	1.5
1,4-Dichlorobenzene	<0.02 (<0.01-<0.03)				
1,2-Dichloroethane	<0.02 (<0.01-<0.02)				
1,2-Dichloropropane	<0.02 (<0.01-<0.02)				
Ethyl acetate	<0.02 (<0.01-<0.03)	0.00 (0.00-0.01)	10 (0-36)	17	1.8
Ethylbenzene	<0.02 (<0.01-<0.02)	0.00 (0.00-0.01)	8 (0-29)	19	1.7
2-ethyl-1-hexanol	<0.02 (<0.02-<0.04)				
ethyl-tert-butyl ether (ETBE)	<0.02 (<0.01-<0.05)				
n-Heptane	<0.02 (<0.01-<0.05)	0.01 (0.00-0.02)	15 (0-45)	16	1.8
n-Hexane	<0.02 (<0.01-0.03)	0.01 (0.00-0.03)	16 (0-55)	33	3.4
Isobutanol	<0.02 (<0.01-<0.03)				
Isooctane	<0.02 (<0.01-<0.04)	0.00 (0.00-0.01)	10 (0-36)	19	1.6
Isopropylbenzene	<0.02 (<0.01-<0.04)				
1-Methoxy-2-propanol	<0.02 (<0.02-<0.05)				
1-Methoxy-2-propyl acetate	<0.02 (<0.01-<0.04)				
methyl metacrylate	<0.02 (<0.01-<0.02)				
Methylcyclohexane	<0.02 (<0.01-<0.02)	0.00 (0.00-0.00)	9 (0-20)	10	1.5
Methylcyclopentane	<0.02 (<0.01-<0.03)	0.00 (0.00-0.01)	11 (0-24)	21	1.9

Methylethylketone	<0.02 (<0.01-<0.03)	0.01 (0.00-0.01)	16 (0-36)	7	1.6
Methylisobutylketone	<0.02 (<0.01-<0.02)				
2-Methylpentane	<0.02 (<0.01-<0.03)	0.01 (0.00-0.05)	15 (0-110)	37	5.6
3-Methylpentane	<0.02 (<0.01-<0.03)	0.00 (0.00-0.01)	8 (0-26)	23	2.5
methyl-ter-butyl ether (MTBE)	<0.02 (<0.01-<0.03)				
Naphthalene	<0.04 (<0.02-<0.08)				
N-Nonane	<0.02 (<0.01-<0.04)	0.00 (0.00-0.01)	12 (0-26)	7	1.5
N-Octane	<0.02 (<0.01-<0.04)	0.00 (0.00-0.00)	15 (10-20)	3	1.2
n-Propylbenzene	<0.02 (<0.01-<0.04)				
Styrene	<0.02 (<0.01-<0.05)				
Tetrachloroethylene	<0.01 (<0.01-<0.03)				
Toluene	<0.02 (<0.01-<0.03)	0.01 (0.00-0.08)	8 (0-46)	59	7.1
1,1,1-Trichloroethane	<0.01 (<0.01-<0.03)				
Trichloroethylene	<0.01 (<0.01-<0.02)				
Trichloromethane	<0.02 (<0.01-<0.04)	0.00 (0.00-0.01)	13 (0-40)	14	1.1
1,2,4-Trimethylbenzene	<0.02 (<0.01-<0.04)	0.00 (0.00-0.01)	8 (0-18)	21	1.8
N-Undecane	<0.03 (<0.02-<0.06)	0.01 (0.00-0.02)	14 (0-34)	25	1.4
o-Xylene	<0.02 (<0.01-<0.02)	0.00 (0.00-0.01)	10 (0-25)	24	1.8
m&p-Xylenes	<0.02 (<0.01-<0.02)	0.00 (0.00-0.03)	8 (0-21)	44	3.5
Aldehydes	**n=14**	**n=37**	**n=37**	**n=37**	**n=37**
Formaldehyde	0.06 (<0.02-0.16)	0.04 (0.00-0.24)	7 (0-50)	36	17.5
Acetaldehyde	0.05 (<0.02-0.17)	0.03 (0.00-0.11)	18 (0-53)	29	6.2
Propanaldehyde	<0.05 (<0.04-<0.13)	0.02 (0.00-0.09)	19 (0-67)	20	2.3
Butanaldehyde	<0.17 (<0.10-<0.31)	0.03 (0.00-0.05)	13 (0-23)	11	1.4
Pentanaldehyde	<0.06 (<0.03-<0.11)	0.01 (0.01-0.01)	9 (9-10)	2	1.2
Hexanaldehyde	<0.08 (<0.05-<0.15)	0.05 (0.00-0.15)	33 (3-78)	12	1.9
Benzaldehyde	<0.01 (<0.01-<0.02)				
Glutaraldehyde	<0.02 (<0.01-<0.02)				
Inorganic gas	**n=12**	**n=35**	**n=35**	**n=35**	**n=35**
Hydrogen sulfide	<0.5 (<0.25-<0.82)				
All samples U95%		0.05	35		

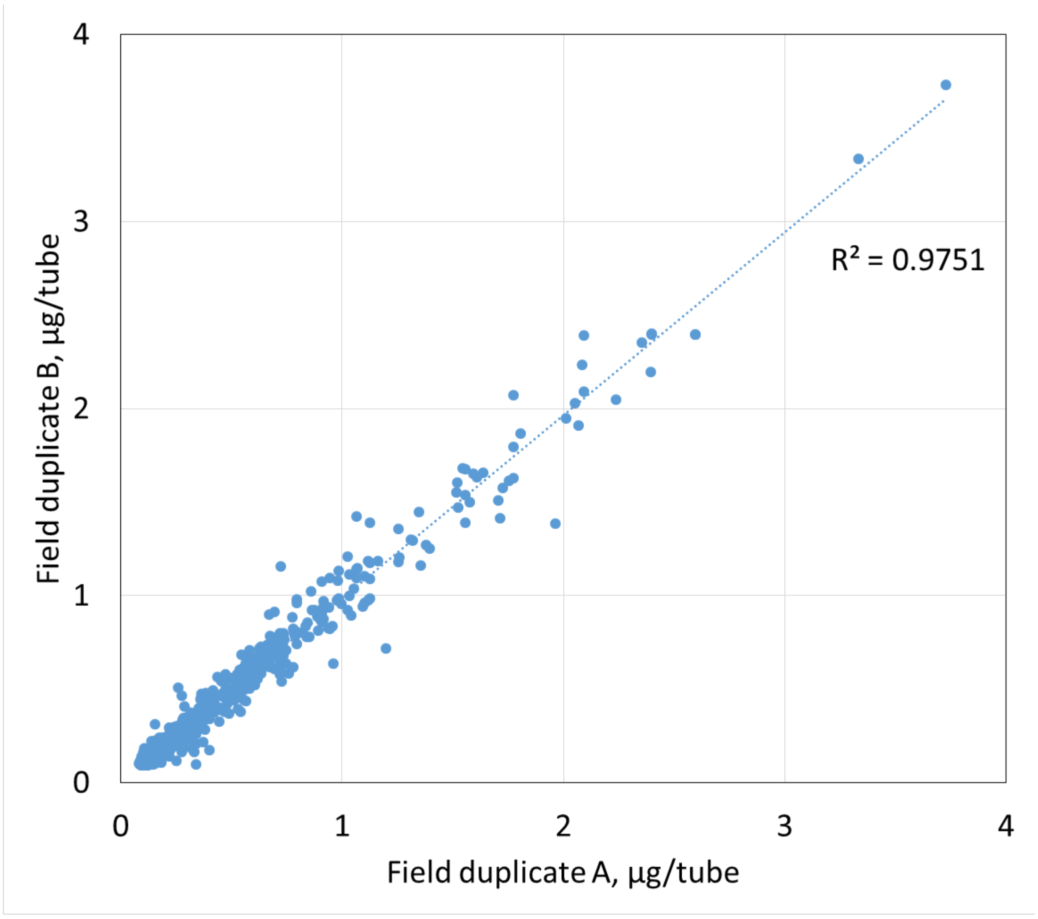


Figure B. 1 Masses measured on co-located field duplicate samples for all masses greater than the detection limit of 0.1 µg/tube.

There was strong and significant agreement between the mass measured on field duplicates (R^2=0.98). The SGS laboratory used field duplicates to determine whether the results are valid. The RPD control limit was 40% for detections where the sample mass was greater than ten times the detection limit mass. All runs met this criteria. There were a small number of occasions when the RPD exceeded the 40% control limit but these were deemed acceptable as the sample mass was less than ten times above the detection limit. When expressed as a concentration, the largest difference observed was only a fraction of a ppb; the maximum difference was 0.24 ppb for formaldehyde.

Average field duplicate precision RPD for 6 aldehydes species ranged from 7% to 33% and from 4 to 27% for 24 VOC species. Using field duplicates from all analytical runs (n=142), the uncertainty in analytical precision at 95% is 35% or when expressed as a percentage, 0.05 ppb.

For each gas measured with the samplers, the impact of the duplicate variability was examined in terms of comparison with air quality objectives. For each gas, the maximum difference between duplicates was added to the maximum fortnightly concentration from any site category, and compared to the air quality objective. This comparison assumed that the maximum fortnightly concentration and the maximum duplicate difference occurred simultaneously, and extended for the entire study period. This is the theoretically highest concentration that could have occurred over a fortnight taking into account the variability in the duplicates. In all cases, this maximum concentration was well below relevant air quality objectives, with the maximum calculated concentration 5 times lower than the Texas AMCV for formaldehyde to tens to hundreds to thousands of times lower than air quality objectives for other gases.

This indicates that the variability in the Radiello duplicate field samplers is acceptable for the purpose of comparing measured concentrations of these gases with air quality standards in this study. When the differences between concentrations from field duplicates are used to calculate a maximum theoretical concentration for all gases, the concentrations are still below air quality objectives for all gases.

B.2.2 Radiello field duplicate comparison between laboratories

An independent check of the sampling accuracy and precision was performed by sending a duplicate field sample to a second laboratory for analysis. VOC samples were deployed in triplicate at the Hopeland site (See Table B. 3). Two samplers were analysed by SGS Leeder, Mitcham Australia (to determine sampling and analysis precision; see previous section) and one sample was analysed by Eurofins California, US. Both laboratories are accredited to ISO17025 which means they have demonstrated competence in testing and maintain traceability to primary standards throughout the analysis procedure.

The average and maximum absolute concentration difference between samples analysed by both laboratories was calculated for each VOC and is shown in Table B. 9. This was also reported as average and maximum relative percent difference (RPD). The calculation is only made for species where the mass reported for both duplicates is greater than the analytical limit of detection.

Table B. 9 Statistics for Passive Radiello Analytical duplicates including the average (minimum-maximum) absolute difference and the average (min-max) relative percent difference (RPD) for each gas measured. Statistics based on Radiello Passive VOC samplers deployed at Hopeland and analysed by two different laboratories, SGS Leeder and Eurofins. Results reported for species where both duplicate masses were greater than the analytical limit of detection.

VOC	Duplicates >DL	Absolute difference in conc ppb	%RPD
Carbon tetrachloride	24	0.02 (0.00-0.04)	24 (0-48)
Toluene	2	<0.00 (<0.00-<0.00)	16 (13-18)
Trichloromethane	2	<0.00 (<0.00-0.01)	25 (18-32)
n-Hexane	1	0.00	0

Carbon tetrachloride was detected in all 24 intercomparison samples, toluene and trichloromethane were detected in two samples and n-Hexane was detected in one sample. The average RPD was 23%, with the highest RPD of 48%. SGS used a control limit RPD of 40% for concentrations where exceedances require investigation. On five occasions, the RPD of carbon tetrachloride was between 43% and 48%. Upon examination these were deemed acceptable as the sample mass was less than ten times above the detection limit. When reported as a concentration, the average difference between field duplicates was 0.01 ppb and the maximum difference was 0.04 ppb.

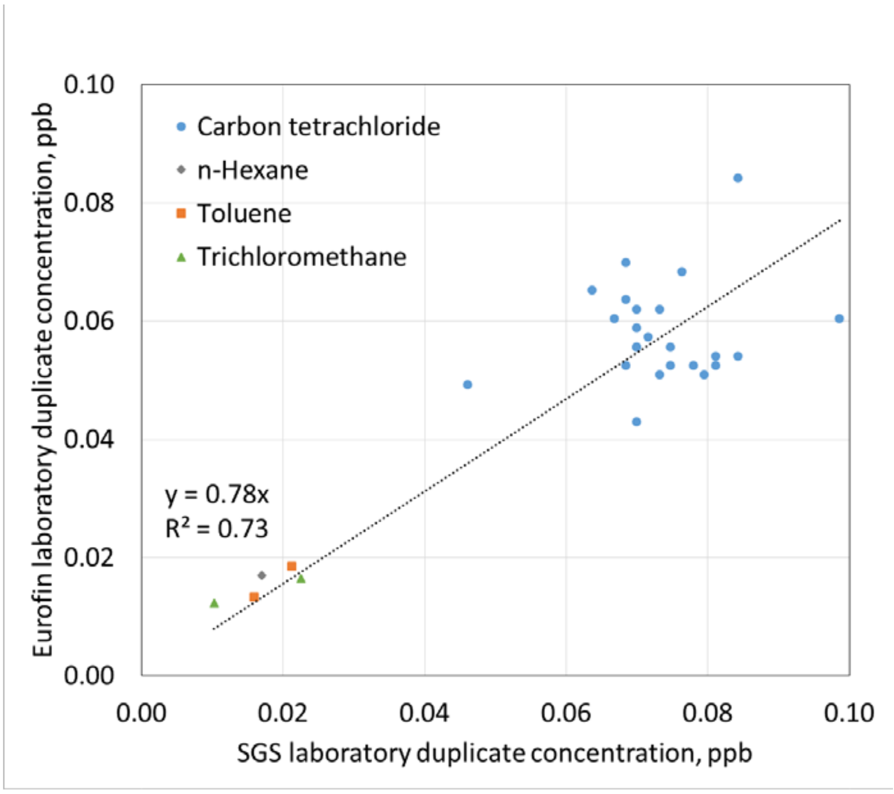


Figure B. 2 Concentrations of duplicates measured by two laboratories, SGS Leeder and Eurofins.

Figure B. 2 shows the concentrations of duplicates measured by SGS and Eurofins. There is significant agreement between the duplicates, with a correlation coefficient of r^2=0.73. There appears to be a slight bias in carbon tetrachloride measurements, where SGS concentrations are higher by about 22%. While significant ($p<0.05$), this difference is still below the control limit of 40% thus is deemed acceptable. This bias was also observed in a comparison with active sampling performed by CSIRO. The carbon tetrachloride CSIRO and SGS Leeder concentrations agreed to within 15%, with a lower concentration reported by Eurofins laboratory.

For each gas measured with the VOCs samplers, the impact of the analytical duplicate variability was examined in terms of comparison with air quality objectives. The maximum difference between duplicates was added to the maximum fortnightly concentration from any site category, and compared to the air quality objective. This comparison assumed that the maximum fortnightly concentration and the maximum duplicate difference occurred simultaneously, and extended for the entire study period. This is the theoretically highest concentration that could have occurred over a fortnight taking into account the variability in the duplicates. For all gases, this maximum calculated concentration was ten to thousands of times lower than relevant air quality objectives (Section 6).

B.2.1 Radiello - comparison of results from differently mounted Radiello samplers – Chinchilla township site

Radiello site locations and mounting were originally determined by consultants. In June 2015 CSIRO audited the site locations and sampler deployment using the same principles used to select location of ambient air monitoring stations (without the requirement for access to mains power). As a result of the audit CSIRO recommended alternative mounting procedures to meet requirements of AS/NZS (2016), and samples were mounted on poles 2 m above the ground in June 2015. Previously samples were mounted approximately 1.5 m above the ground and were not the required distance from trees.

To compare results from the original and new mounting techniques, from June 2015 – Jan 2016, VOC, aldehyde and hydrogen sulphide samplers continued to be mounted using the original technique at Chinchilla alongside samplers mounted on poles. Comparing results from these otherwise identically handled, exposed and analysed samplers allows any effect of the mounting technique to be assessed. The average and maximum absolute concentration difference between differently mounted samplers was calculated for each gas, as well as the average and maximum relative percent difference (RPD).

Table B. 10 below shows the Chinchilla site Duplicate results for VOCs, where the average absolute difference and average RPD are given, followed by the minimum and maximum absolute and RPD values in brackets. Five of eight aldehydes and 23 of 46 VOC species had at least one pair of collocated samples at concentrations above the detection limit. Using a paired t-test there was no significant difference in average concentrations between samplers on the original mountings and samples with the new mounting. Figure B. 3 shows strong agreement between the co-located pairs (R^2=0.97), with no significant bias.

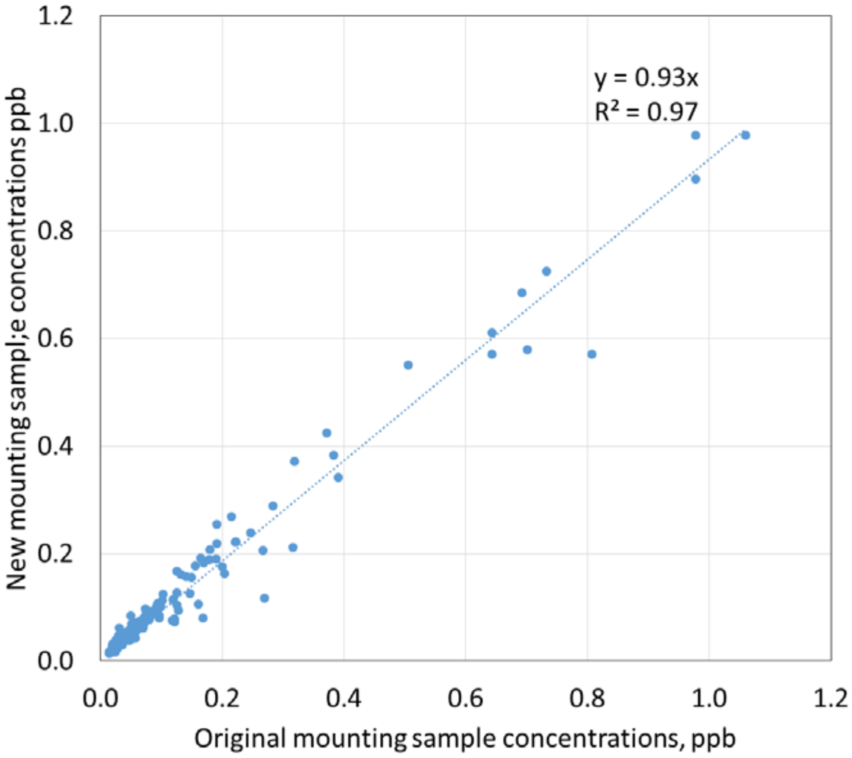


Figure B. 3 Original versus newly mounted samples at Chinchilla township site for 28 chemical species, totalling 181 paired concentrations.

The average RPD for each species ranged from 6% to 54%, with an average of 15% for all 181 observations. There were 11 times when the control limit ranged from 40-54%; on these occasions the sample mass was greater than the detection limit by a factor of less than 4 thus these differences were due to the low concentration.

Table B. 10.Statistics for Passive Radiello site duplicates mounted using original and new mounting techniques at Chinchilla site. The average and maximum absolute difference and the average and maximum relative percent difference (RPD) is provided for each gas concentration that was greater than the detection limit.

	Diff ppb avg (min-max)	RPD% avg (min-max)	Number detects Sample>DL	Sample:DL ratio avg (min-max)
Benzene	0.01 (0.00-0.03)	10 (0-22)	11	4 (1-11)
Carbon tetrachloride	0.00 (0.00-0.01)	6 (0-12)	14	6 (5-7)
Cyclohexane	0.01 (0.00-0.02)	15 (0-23)	7	3 (1-4)
Cyclohexanone	0.02 (0.00-0.03)	30 (17-52)	3	2 (1-4)
n-decane	0.01 (0.01-0.03)	36 (17-67)	5	2 (1-3)
Ethyl acetate	0.00 (0.00-0.01)	11 (0-19)	5	2 (1-2)
Ethylbenzene	0.00 (0.00-0.01)	14 (0-29)	5	2 (1-3)
n-Heptane	0.01 (0.00-0.02)	24 (10-45)	5	2 (1-3)
n-Hexane	0.01 (0.00-0.02)	17 (0-43)	9	3 (1-6)
Isooctane	0.01 (0.00-0.01)	18 (9-31)	6	2 (1-2)
Methylcyclohexane	0.00 (0.00-0.00)	8 (0-15)	3	2 (2-2)
Methylcyclopentane	0.01 (0.00-0.01)	14 (5-22)	5	2 (1-3)
Methylethylketone	0.01 (0.01-0.01)	22 (22-22)	1	2 (2-2)
2-Methylpentane	0.01 (0.00-0.04)	12 (0-29)	9	6 (2-11)
3-Methylpentane	0.01 (0.00-0.01)	12 (7-26)	6	3 (2-4)
N-Nonane	0.00 (0.00-0.00)	11 (0-18)	3	2 (1-2)
N-Octane	0.00 (0.00-0.00)	18 (17-20)	2	1 (1-1)
Toluene	0.02 (0.00-0.06)	11 (0-29)	14	8 (2-22)
Trichloromethane	0.00 (0.00-0.01)	13 (0-40)	5	1 (1-1)
1,2,4-Trimethylbenzene	0.00 (0.00-0.01)	12 (6-15)	6	2 (1-3)
N-Undecane	0.01 (0.01-0.01)	22 (10-34)	6	2 (1-3)
o-Xylene	0.00 (0.00-0.01)	12 (0-24)	6	2 (1-3)
m&p-Xylenes	0.01 (0.00-0.03)	10 (0-21)	11	3 (1-9)
Formaldehyde	0.06 (0.00-0.24)	9 (0-34)	11	17 (9-25)
Acetaldehyde	0.04 (0.00-0.11)	20 (0-51)	9	7 (2-16)
Propanaldehyde	0.03 (0.01-0.05)	23 (13-43)	7	2 (2-3)
Butanaldehyde	0.03 (0.02-0.04)	16 (13-22)	3	1 (1-1)
Hexanaldehyde	0.08 (0.04-0.15)	54 (22-78)	4	3 (1-4)

When expressed as absolute differences in concentration, the average difference is 0.02 ppb, with the highest difference observed for one formaldehyde pair of 0.24 ppb. Assuming this maximum concentration difference occurred for all samples over all sample periods, the maximum difference plus maximum observed concentration resulted in total concentrations being well below relevant air quality objectives. Using this approach formaldehyde was more than four times lower than the Texas AMCV for formaldehyde and other species were tens to thousands of times lower than air quality objectives for other gases.

This indicates that any variability in the concentrations from differently mounted samples was too small to adversely affect the use of this technique to compare measurements with air quality objectives for all gases.

B.2.2 CSIRO VOC and aldehyde sampling and analytical methods

Table B. 11 CSIRO VOC and aldehyde analytical methods. Taken from Study Design report, Lawson et al 2017

CSIRO analysis			
Individual volatile organic compounds (VOCs)	Markes multi-sorbent thermal desorption tubes containing Carbograph 1TD and Carbopack X sorbent	VOCs are sampled by pumping of air through a manifold and through two tubes in series, each containing a multi-sorbent bed. The sample volume is recorded.	CSIRO laboratory method: determination of speciated VOC masses. Thermal desorption of sample, separation of VOCs using gas chromatography, identification by mass spectrometry and quantification via flame ionization detection according to USEPA Compendium method TO-17 (USEPA 1999b)
Individual aldehydes	Supleco 2,4-DNPH S10 Cartridges	Aldehydes are sampled by pumping of air through an ozone scrubber and onto a tube containing silica coated with 2,4-DNPH where they react to form 2,4-DNP-hydrazones. The sample volume is recorded.	CSIRO laboratory method: determination of mass of 2,4-DNP-hydrazones. Sample extraction in acetonitrile, separation using reverse phase ultra-high-performance liquid chromatography, quantification with diode array detection (DAD) and identification with mass spectrometry (MS). The analysis was based on EPA Method TO11A (USEPA, 1999a).

B.2.3 CSIRO - VOC and aldehyde quality assurance

VOCs and aldehydes were sampled using an active sampling system where air is actively/mechanically drawn though a sorbent tube. The sampled volume plus the mass of the species on the tube is used to determine ambient concentration. This is in contrast to the Radiello method where published sampling rates from the Radiello manual are used to determine sample volume for the Radiello passive samplers. The active technique offers greater sample volumes over shorter time periods to be collected which provides higher time resolution observations and lower detection limits. The disadvantage is the requirement for power and much greater sampling and analytical resources.

VOCs and aldehydes were sampled in parallel using a CSIRO custom designed and built Sequencer device which allows up to 16 VOC adsorbent tubes and 16 2,4-DNPH cartridges to be automatically and sequentially sampled via 2 flow paths. The Sequencer drew air via the heated glass sample manifold at Hopeland station. The active sampling is only possible for shorter periods before the capacity of the sample is exceeded, and so a total of 28 12-hour active VOC and aldehyde samples were collected with a sample volume of 13 litres for VOC adsorbent tubes and ~1040 litres for aldehydes. The average concentration of the 12 hour active samples which were collected over the two week period can were then compared to the 2 weekly Radiello passive concentration.

Quality control procedures included use of calibrated flow meters for determination of sample volumes. Breakthrough or loss of sampled species can occur if the sample volume exceeds the capacity of the sampler. A second tube is installed on the outlet of the first tube and this is analysed to check that no chemicals collected have been lost from the first tube.

Field blanks were installed in sample ports in the Sequencer which received no sample flow. Eight VOC and aldehyde field blanks were used for 28 samples. During transport and storage samples were sealed with passivated stainless Swagelock caps. Analysis of field blanks showed no systematic contamination from sampling and handling, however two VOC samples were removed from the calculation of the 2-weekly average VOC concentration due to probable contamination. These samples were identified as being contaminated by air during transport to or from the Hopeland station, likely due to a loose cap during transport.

Comparison of the active technique with the Radiello passive technique showed agreement of 15% for carbon tetrachloride, 5% for formaldehyde and 10% for acetaldehyde. These differences fall within the sampling and analysis precision determined by Radiello spiked samples and field duplicates.

B.3 Radiello site summary statistics

Concentration values less than the detection limit were given a value equal to the detection and were included when calculating averages, percentiles and range. Consequently, the summary statistics can be considered as an upper estimate of the VOC concentrations measured. For VOCs detected at greater than the detection limit less than 10% of the time, the minimum, equivalent to the lowest detection limit, and the maximum observed concentration are presented for each site.

[a]Detection Frequency refers to % samples > detection limit

All statistics calculated are based on 16 months of passive gas data except for formaldehyde, acetaldehyde, propanaldehyde, butanaldehyde, pentanaldehyde, hexanadehyde, glutaraldehyde, benzaldehyde and hydrogen sulphide which were based on 7 months of passive gas data.

Table B. 12. Summary statistics for alkanes and cyclo-alkanes with overall detection frequency > 10% at one site or more

	2-Methylpentane	**3-Methylpentane**	**n-Hexane**	**n-Decane**	**n-Undecane**	**Cyclohexane**
DL range (ppb)	0.01 – 0.05	0.01 – 0.05	0.01 – 0.25	0.01 – 0.05	0.02 – 0.08	0.01 – 0.06
Burncluith						
N samples (N data points)	25 (25)	25 (25)	25 (25)	25 (25)	25 (25)	25 (25)
Detection Frequency (%)[a]	4	0.0	4	20	28	0
Avg (all) ± stdev (ppb)	0.02 ± 0.01	-	0.03 ± 0.04	0.02 ± 0.01	0.04 ± 0.03	
25, 50, 75, 95th %ile (ppb)	0.02, 0.02, 0.02, 0.02	-	0.02, 0.02, 0.02, 0.04	0.02, 0.02, 0.02, 0.03	0.03, 0.03, 0.03, 0.08	
Range (ppb)	0.01 – 0.05	0.01 – 0.02	0.02 – 0.21	0.01 – 0.08	0.02 – 0.19	0.02 – 0.03
Tara Region						
N samples (N data points)	70 (35)	70 (35)	70 (35)	70 (35)	70 (35)	70 (35)
Detection Frequency (%)[a]	6	3	11	26	20	0.0
Avg (all) ± stdev (ppb)	0.02 ± 0.00	0.02 ± 0.00	0.04 ± 0.04	0.02 ± 0.01	0.03 ± 0.01	
25, 50, 75, 95th %ile (ppb)	0.02, 0.02, 0.02, 0.03	0.02, 0.02, 0.02, 0.02	0.02, 0.02, 0.02, 0.12	0.02, 0.02, 0.02, 0.04	0.03, 0.03, 0.03, 0.04	
Range (ppb)	0.01 – 0.03	0.01 – 0.03	0.01 – 0.21	0.01 – 0.04	0.02 – 0.06	0.02 – 0.05
Chinchilla						
N samples (N data points)	86 (36)	86 (36)	86 (36)	86 (36)	86 (36)	86 (36)
Detection Frequency (%)[a]	72	53	64	56	47	58
Avg (all) ± stdev (ppb)	0.09 ± 0.07	0.03 ± 0.02	0.06 ± 0.05	0.02 ± 0.01	0.06 ± 0.02	0.05 ± 0.04
25, 50, 75, 95th %ile (ppb)	0.02, 0.07, 0.13, 0.23	0.02, 0.02, 0.04, 0.07	0.02, 0.04, 0.80, 0.15	0.02, 0.02, 0.02, 0.04	0.03, 0.03, 0.04, 0.06	0.03, 0.03, 0.07, 0.12
Range (ppb)	0.02 – 0.27	0.01 – 0.10	0.02 – 0.21	0.01 – 0.06	0.02 – 0.09	0.03 – 0.16

	2-Methylpentane	3-Methylpentane	n-Hexane	n-Decane	n-Undecane	Cyclohexane
DL range (ppb)	0.01 – 0.05	0.01 – 0.05	0.01 – 0.25	0.01 – 0.05	0.02 – 0.08	0.01 – 0.06
Miles Airport						
N samples (N data points)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)
Detection Frequency (%)[a]	3	0	9	11	20	0
Avg (all) ± stdev (ppb)	0.02 ± 0.01	-	0.04 ± 0.05	0.02 ± 0.01	0.03 ± 0.01	-
25, 50, 75, 95th %ile (ppb)	0.02, 0.02, 0.02, 0.02	-	0.02, 0.02, 0.03, 0.13	0.02, 0.02, 0.02, 0.04	0.03, 0.03, 0.03, 0.06	-
Range (ppb)	0.01 – 0.05	0.02 – 0.02	0.01 – 0.25	0.01 – 0.05	0.02 – 0.08	0.02 – 0.06
Miles/Condabri North						
N samples (N data points)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)
Detection Frequency (%)[a]	6	0	9	11	17	0
Avg (all) ± stdev (ppb)	0.02 ± 0.02	-	0.04 ± 0.05	0.02 ± 0.01	0.04 ± 0.02	
25, 50, 75, 95th %ile (ppb)	0.02, 0.02, 0.02, 0.03	-	0.02, 0.02, 0.02, 0.11	0.02, 0.02, 0.02, 0.04	0.03, 0.03, 0.03, 0.08	
Range (ppb)	0.01 – 0.13	0.01 – 0.05	0.01 – 0.25	0.01 – 0.07	0.02 – 0.12	0.02 – 0.06
Condamine						
N samples (N data points)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)
Detection Frequency (%)[a]	3	0	11	17	20	0
Avg (all) ± stdev (ppb)	0.02 ± 0.01	-	0.04 ± 0.05	0.02 ± 0.01	0.03 ± 0.01	-
25, 50, 75, 95th %ile (ppb)	0.02, 0.02, 0.02, 0.03	-	0.02, 0.02, 0.03, 0.13	0.02, 0.02, 0.02, 0.03	0.05, 0.05, 0.05, 0.10	-
Range (ppb)	0.01 – 0.05	0.01 – 0.05	0.01 – 0.25	0.01 – 0.08	0.02 – 0.08	0.01 – 0.06

	2-Methylpentane	3-Methylpentane	n-Hexane	n-Decane	n-Undecane	Cyclohexane
DL range (ppb)	0.01 – 0.05	0.01 – 0.05	0.01 – 0.25	0.01 – 0.05	0.02 – 0.08	0.01 – 0.06
Hopeland						
N samples (N data points)	58 (36)	58 (36)	58 (36)	58 (36)	58 (36)	58 (36)
Detection Frequency (%)[a]	14	0	14	14	19	0
Avg (all) ± stdev (ppb)	0.03 ± 0.02	-	0.03 ± 0.04	0.02 ± 0.01	0.04 ± 0.01	-
25, 50, 75, 95th %ile (ppb)	0.02, 0.02, 0.02, 0.07	-	0.02, 0.02, 0.02, 0.12	0.02, 0.02, 0.02, 0.04	0.03, 0.03, 0.03, 0.05	-
Range (ppb)	0.01 – 0.11	0.01 – 0.04	0.01 – 0.21	0.01 – 0.04	0.02 – 0.06	0.02 – 0.05
Nangram/Monreagh						
N samples (N data points)	33 (33)	33 (33)	33 (33)	33 (33)	33 (33)	33 (33)
Detection Frequency (%)[a]	6	0	9	24	27	0
Avg (all) ± stdev (ppb)	0.02 ± 0.01	-	0.04 ± 0.05	0.03 ± 0.02	0.03 ± 0.01	-
25, 50, 75, 95th %ile (ppb)	0.02, 0.02, 0.02, 0.03	-	0.02, 0.02, 0.02, 0.15	0.02, 0.02, 0.02, 0.06	0.03, 0.03, 0.03, 0.06	-
Range (ppb)	0.01 – 0.09	0.01 – 0.05	0.01 – 0.25	0.01 – 0.12	0.02 – 0.08	0.02 – 0.06
Greeenswamp/Purnell						
N samples (N data points)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)
Detection Frequency (%)[a]	6	0.00	20	11	14	0
Avg (all) ± stdev (ppb)	0.02 ± 0.02	-	0.04 ± 0.04	0.02 ± 0.00	0.03 ± 0.01	-
25, 50, 75, 95th %ile (ppb)	0.02, 0.02, 0.02, 0.03	-	0.02, 0.02, 0.03, 0.12	0.02, 0.02, 0.02, 0.02	0.03, 0.03, 0.03, 0.06	-
Range (ppb)	0.01 – 0.13	0.01 – 0.04	0.01 – 0.21	0.01 – 0.04	0.02 – 0.09	0.02 – 0.05
Rockwood/Talinga						
N samples (N data points)	36 (36)	36 (36)	36 (36)	36 (36)	36 (36)	36 (36)
Detection Frequency (%)[a]	3	0	17	17	22	0
Avg (all) ± stdev (ppb)	0.02 ± 0.01	-	0.04 ± 0.05	0.02 ± 0.02	0.04 ± 0.01	-
25, 50, 75, 95th %ile (ppb)	0.02, 0.02, 0.02, 0.03	-	0.02, 0.02, 0.02, 0.12	0.02, 0.02, 0.02, 0.05	0.03, 0.03, 0.04, 0.06	-

Range (ppb)	0.01 – 0.06	0.01 – 0.03	0.01 – 0.25	0.01 – 0.12	0.02 – 0.06	0.02 – 0.05

Table B. 13 Summary statistics by site for aromatic VOCs with overall detection frequency > 10%

	Benzene	**Toluene**	**Sum xylenes**	**1,2,4-Trimethylbenzene**
DL range (ppb)	0.01 – 0.05	0.01 – 0.04	0.02 – 0.07***	0.01 – 0.05
Burncluith				
N samples (N data points)	25 (25)	25 (25)	25 (25)	25 (25)
Detection Frequency (%)[a]	32	56	0	4
Avg (all) ± stdev (ppb)	0.03 ± 0.01	0.02 ± 0.01	0.03 ± 0.00	0.02 ± 0.00
25, 50, 75, 95th %ile (ppb)	0.02, 0.02, 0.03, 0.05	0.02, 0.02, 0.03, 0.03	0.03, 0.03, 0.03, 0.04	0.02, 0.02, 0.02, 0.02
Range (ppb)	0.02 – 0.05	0.01 – 0.03	0.02 – 0.04	0.01 – 0.04
Tara Region				
N samples (N data points)	70 (35)	70 (35)	70 (35)	70 (35)
Detection Frequency (%)[a]	29	23	0	0
Avg (all) ± stdev (ppb)	0.02 ± 0.01	0.02 ± 0.00	0.03 ± 0.01	0.02 ± 0.00
25, 50, 75, 95th %ile (ppb)	0.02, 0.02, 0.02, 0.04	0.02, 0.02, 0.02, 0.02	0.03, 0.03, 0.04, 0.04	0.02, 0.02, 0.02, 0.02
Range (ppb)	0.01 – 0.04	0.01 – 0.03	0.02 – 0.06	0.01 – 0.03
Chinchilla				
N samples (N data points)	86 (36)	86 (36)	86 (36)	86 (36)
Detection Frequency (%)[a]	92	100	94	44
Avg (all) ± stdev (ppb)	0.06 ± 0.04	0.15 ± 0.09	0.08 ± 0.05	0.03 ± 0.01
25, 50, 75, 95th %ile (ppb)	0.03, 0.05, 0.08, 0.13	0.10, 0.10, 0.18, 0.35	0.04, 0.07, 0.10, 0.19	0.02, 0.02, 0.03, 0.05
Range (ppb)	0.02 - 0.20	0.03 – 0.39	0.03 – 0.22	0.01 – 0.07

	Benzene	**Toluene**	**Sum xylenes**	**1,2,4-Trimethylbenzene**
DL range (ppb)	0.01 – 0.05	0.01 – 0.04	0.02 – 0.07***	0.01 – 0.05
Condamine				
N samples (N data points)	35 (35)	35 (35)	35 (35)	35 (35)
Detection Frequency (%)[a]	34	43	0	0
Avg (all) ± stdev (ppb)	0.02 ± 0.01	0.02 ± 0.01	0.03 ± 0.01	0.02 ± 0.01
25, 50, 75, 95th %ile (ppb)	0.02, 0.02, 0.03, 0.04	0.02, 0.02, 0.02, 0.03	0.03, 0.03, 0.03, 0.04	0.02, 0.02, 0.02, 0.02
Range (ppb)	0.01 – 0.05	0.01 – 0.04	0.02 – 0.08	0.01 – 0.05
Miles/Condabri North				
N samples (N data points)	35 (35)	35 (35)	35 (35)	35 (35)
Detection Frequency (%)[a]	29	23	0	6
Avg (all) ± stdev (ppb)	0.02 ± 0.01	0.02 ± 0.01	0.03 ± 0.01	0.02 ± 0.01
25, 50, 75, 95th %ile (ppb)	0.02, 0.02, 0.02, 0.05	0.02, 0.02, 0.02, 0.03	0.03, 0.03, 0.03, 0.04	0.02, 0.02, 0.02, 0.03
Range (ppb)	0.01 – 0.05	0.01 – 0.04	0.02 – 0.08	0.01 – 0.05
Condamine				
N samples (N data points)	35 (35)	35 (35)	35 (35)	35 (35)
Detection Frequency (%)[a]	26	23	0	0
Avg (all) ± stdev (ppb)	0.02 ± 0.01	0.02 ± 0.01	0.03 ± 0.01	0.02 ± 0.01
25, 50, 75, 95th %ile (ppb)	0.02, 0.02, 0.02, 0.04	0.02, 0.02, 0.02, 0.03	0.03, 0.03, 0.03, 0.04	0.02, 0.02, 0.02, 0.02
Range (ppb)	0.01 – 0.03	0.01 – 0.04	0.02 – 0.08	0.02 – 0.05

	Benzene	**Toluene**	**Sum xylenes**	**1,2,4-Trimethylbenzene**
DL range (ppb)	0.01 – 0.05	0.01 – 0.04	0.02 – 0.07***	0.01 – 0.05
Hopeland				
N samples (N data points)	58 (36)	58 (36)	58 (36)	58 (36)
Detection Frequency (%)[a]	19	31	0	3
Avg (all) ± stdev (ppb)	0.02 ± 0.01	0.02 ± 0.00	0.03 ± 0.01	0.02 ± 0.00
25, 50, 75, 95th %ile (ppb)	0.02, 0.02, 0.02, 0.04	0.02, 0.02, 0.02, 0.03	0.03, 0.03, 0.03, 0.04	0.02, 0.02, 0.02, 0.03
Range (ppb)	0.01 – 0.08	0.01 – 0.04	0.02 – 0.07	0.01 – 0.04
Nangram/Monreagh				
N samples (N data points)	33 (33)	33 (33)	33 (33)	33 (33)
Detection Frequency (%)[a]	27	18	0	3
Avg (all) ± stdev (ppb)	0.02 ± 0.01	0.02 ± 0.01	0.03 ± 0.01	0.02 ± 0.01
25, 50, 75, 95th %ile (ppb)	0.02, 0.02, 0.02, 0.04	0.02, 0.02, 0.02, 0.02	0.03, 0.03, 0.03, 0.04	0.02, 0.02, 0.02, 0.03
Range (ppb)	0.01 – 0.05	0.01 – 0.04	0.02 – 0.08	0.01 – 0.05
Greenswamp/Purnell				
N samples (N data points)	35 (35)	35 (35)	35 (35)	35 (35)
Detection Frequency (%)[a]	29	54	9	0
Avg (all) ± stdev (ppb)	0.02 ± 0.01	0.02 ± 0.01	0.03 ± 0.01	0.02 ± 0.00
25, 50, 75, 95th %ile (ppb)	0.02, 0.02, 0.02, 0.04	0.02, 0.02, 0.02, 0.03	0.03, 0.03, 0.04, 0.04	0.02, 0.02, 0.02, 0.02
Range (ppb)	0.01 – 0.04	0.01 – 0.04	0.02 – 0.06	0.01 – 0.04
Rockwood/Talinga				
N samples (N data points)	36 (36)	36 (36)	36 (36)	36 (36)
Detection Frequency (%)[a]	25.7	14	0	0
Avg (all) ± stdev (ppb)	0.02 ± 0.01	0.02 ± 0.00	0.03 ± 0.01	0.02 ± 0.00
25, 50, 75, 95th %ile (ppb)	0.02, 0.02, 0.02, 0.04	0.02, 0.02, 0.02, 0.03	0.03, 0.04, 0.04, 0.04	0.02, 0.02, 0.02, 0.02

Range (ppb)	0.01 – 0.05	0.01 – 0.04	0.02 – 0.06	0.01 – 0.03

Table B. 14 Summary statistics by site for substituted VOCs with overall detection frequency > 10%

	Carbon Tetrachloride	**Ethyl acetate**	**Cyclohexanone**
DL range (ppb)	0.01 – 0.01	0.01 – 0.04	0.01 – 0.04
Burncluith			
N samples (N data points)	25 (25)	25 (25)	25 (25)
Detection Frequency (%)[a]	100	16	4
Avg (all) ± stdev (ppb)	0.07 ± 0.01	0.02 ± 0.01	0.02 ± 0.00
25, 50, 75, 95th %ile (ppb)	0.07, 0.07, 0.08, 0.09	0.02, 0.02, 0.02, 0.04	0.02, 0.02, 0.02, 0.02
Range (ppb)	0.05 – 0.10	0.01 – 0.05	0.01 – 0.04
Tara Region			
N samples (N data points)	70 (35)	70 (35)	70 (35)
Detection Frequency (%)[a]	100	14	11
Avg (all) ± stdev (ppb)	0.09 ± 0.01	0.02 ± 0.01	0.02 ± 0.01
25, 50, 75, 95th %ile (ppb)	0.08, 0.08, 0.09, 0.11	0.02, 0.02, 0.02, 0.03	0.02, 0.02, 0.02, 0.04
Range (ppb)	0.05 – 0.12	0.01 – 0.04	0.01 – 0.06
Chinchilla			
N samples (N data points)	86 (36)	86 (36)	86 (36)
Detection Frequency (%)[a]	100	22	11
Avg (all) ± stdev (ppb)	0.07 ± 0.01	0.02 ± 0.01	0.02 ± 0.01
25, 50, 75, 95th %ile (ppb)	0.07, 0.07, 0.08, 0.09	0.02, 0.02, 0.02, 0.04	0.02, 0.02, 0.02, 0.04
Range (ppb)	0.04 – 0.11	0.01 – 0.06	0.01 – 0.06

	Carbon Tetrachloride	**Ethyl acetate**	**Cyclohexanone**
DL range (ppb)	0.01 – 0.01	0.01 – 0.04	0.01 – 0.04
Miles Airport			
N samples (N data points)	35 (35)	35 (35)	35 (35)
Detection Frequency (%)[a]	100	17	11
Avg (all) ± stdev (ppb)	0.08 ± 0.01	0.02 ± 0.01	0.02 ± 0.01
25, 50, 75, 95th %ile (ppb)	0.07, 0.08, 0.09, 0.10	0.02, 0.02, 0.02, 0.04	0.02, 0.02, 0.02, 0.03
Range (ppb)	0.05 – 0.12	0.01 – 0.05	0.01 – 0.04
Miles/Condabri North			
N samples (N data points)	35 (35)	35 (35)	35 (35)
Detection Frequency (%)[a]	100	17	14
Avg (all) ± stdev (ppb)	0.08 ± 0.02	0.02 ± 0.01	0.02 ± 0.01
25, 50, 75, 95th %ile (ppb)	0.07, 0.08, 0.09, 0.11	0.02, 0.02, 0.02, 0.05	0.02, 0.02, 0.02, 0.04
Range (ppb)	0.03 – 0.13	0.01 – 0.06	0.01 – 0.07
Condamine			
N samples (N data points)	35 (35)	35 (35)	35 (35)
Detection Frequency (%)[a]	100	17	14
Avg (all) ± stdev (ppb)	0.08 ± 0.0	0.02 ± 0.01	0.02 ± 0.02
25, 50, 75, 95th %ile (ppb)	0.07, 0.08, 0.09, 0.09	0.02, 0.02, 0.02, 0.04	0.02, 0.02, 0.02, 0.04
Range (ppb)	0.05 – 0.10	0.01 – 0.06	0.01 – 0.14
Hopeland			
N samples (N data points)	58 (36)	58 (36)	58 (36)
Detection Frequency (%)[a]	100	17	14
Avg (all) ± stdev (ppb)	0.08 ± 0.01	0.02 ± 0.01	0.02 ± 0.01
25, 50, 75, 95th %ile (ppb)	0.07, 0.08, 0.09, 0.10	0.02, 0.02, 0.02, 0.04	0.02, 0.02, 0.02, 0.05

Range (ppb)	0.05 – 0.11	0.01 – 0.04	0.01 – 0.08

	Carbon tetrachloride	**Ethyl acetate**	**Cyclohexanone**
DL range (ppb)	0.01 – 0.01	0.01 – 0.04	0.01 – 0.04
Nangram/Monreagh			
N samples (N data points)	33 (33)	33 (33)	33 (33)
Detection Frequency (%)[a]	100	21	12
Avg (all) ± stdev (ppb)	0.08 ± 0.01	0.02 ± 0.01	0.02 ± 0.02
25, 50, 75, 95th %ile (ppb)	0.07, 0.08, 0.08, 0.09	0.02, 0.02, 0.02, 0.04	0.02, 0.02, 0.02, 0.04
Range (ppb)	0.05 – 0.11	0.01 – 0.08	0.01 – 0.14
Greenswamp/Purnell			
N samples (N data points)	35 (35)	35 (35)	35 (35)
Detection Frequency (%)[a]	100	23	14
Avg (all) ± stdev (ppb)	0.08 ± 0.01	0.03 ± 0.04	0.02 ± 0.01
25, 50, 75, 95th %ile (ppb)	0.07, 0.08, 0.08, 0.09	0.02, 0.02, 0.02, 0.07	0.02, 0.02, 0.02, 0.03
Range (ppb)	0.04 – 0.13	0.01 – 0.21	0.01 – 0.04
Rockwood/Talinga			
N samples (N data points)	36 (36)	36 (36)	36 (36)
Detection Frequency (%)[a]	100	11	11
Avg (all) ± stdev (ppb)	0.07 ± 0.01	0.02 ± 0.01	0.02 ± 0.01
25, 50, 75, 95th %ile (ppb)	0.07, 0.08, 0.08, 0.09	0.02, 0.02, 0.02, 0.05	0.02, 0.02, 0.02, 0.03
Range (ppb)	0.04 – 0.10	0.01 – 0.06	0.01 – 0.05

Table B. 15 Summary statistics by site for aldehydes with overall detection frequency > 10%

	Formaldehyde	Acetaldehyde	Propanaldehyde	Butanaldehyde	Pentanaldehyde	Hexanaldehyde
DL range (ppb)	0.05 – 0.05	0.02 – 0.06	0.03 – 0.12	0.07 – 0.27	0.03 – 0.11	0.03 – 0.13
Burncluith						
N samples (N data points)	13 (13)	13 (13)	13 (13)	13 (13)	13 (13)	13 (13)
Detection Frequency (%)[a]	92	85	62	15	8	38
Avg (all) ± stdev (ppb)	0.52 ± 0.20	0.13 ± 0.10	0.09 ± 0.04	0.16 ± 0.05	0.05 ± 0.01	0.08 ± 0.03
25, 50, 75, 95th % ile (ppb)	0.48, 0.55, 0.62, 0.73	0.04, 0.13, 0.15, 0.27	0.07, 0.08, 0.08, 0.15	0.15, 0.15, 0.16, 0.25	0.05, 0.05, 0.05, 0.06	0.07, 0.07, 0.08, 0.12
Range (ppb)	0.04 – 0.77	0.03 – 0.40	0.05 – 0.19	0.11 – 0.31	0.04 – 0.06	0.05 – 0.16
Tara Region						
N samples (N data points)	12 (12)	12 (12)	12 (12)	12 (12)	12 (12)	12 (12)
Detection Frequency (%)[a]	100	92	67	50	25	58
Avg (all) ± stdev (ppb)	0.81 ± 0.31	0.18 ± 0.14	0.11 ± 0.06	0.19 ± 0.08	0.05 ± 0.01	0.08 ± 0.03
25, 50, 75, 95th % ile (ppb)	0.73, 0.81, 0.92, 1.25	0.108, 0.12, 0.25, 0.38	0.07, 0.12, 0.14, 0.20	0.15, 0.17, 0.21, 0.31	0.05, 0.05, 0.06, 0.07	0.07, 0.07, 0.10, 0.15
Range (ppb)	0.24 – 1.39	0.02 – 0.50	0.04 – 0.24	0.08 – 0.41	0.03 – 0.08	0.03 – 0.16
Chinchilla						
N samples (N data points)	25 (13)	25 (13)	25 (13)	25 (13)	25 (13)	25 (13)
Detection Frequency (%)[a]	100	92	77	23	8	38
Avg (all) ± stdev (ppb)	0.65 ± 0.23	0.16 ± 0.14	0.09 ± 0.03	0.16 ± 0.02	0.05 ± 0.01	0.11 ± 0.06
25, 50, 75, 95th % ile (ppb)	0.56, 0.64, 0.73, 0.99	0.05, 0.11, 0.24, 0.38	0.07, 0.09, 0.10, 0.15	0.15, 0.15, 0.17, 0.19	0.06, 0.05, 0.05, 0.06	0.07, 0.07, 0.12, 0.21
Range (ppb)	0.24 – 1.02	0.03 – 0.53	0.05 – 0.17	0.10 – 0.19	0.03 – 0.07	0.04 – 0.24

	Formaldehyde	Acetaldehyde	Propanaldehyde	Butanaldehyde	Pentanaldehyde	Hexanaldehyde
DL range (ppb)	0.05 – 0.05	0.02 – 0.06	0.03 – 0.12	0.07 – 0.27	0.03 – 0.11	0.03 – 0.13
Miles Airport						
N samples (N data points)	12 (12)	12 (12)	12 (12)	12 (12)	12 (12)	12 (12)
Detection Frequency (%)[a]	100	92	75	33	17	58
Avg (all) ± stdev (ppb)	0.75 ± 0.42	0.19 ± 0.15	0.11 ± 0.07	0.18 ± 0.08	0.05 ± 0.01	0.07 ± 0.02
25, 50, 75, 95th % ile (ppb)	0.57, 0.65, 0.77, 1.47	0.09, 0.16, 0.28, 0.43	0.07, 0.08, 0.13, 0.23	0.14, 0.15, 0.20, 0.33	0.05, 0.05, 0.06, 0.06	0.07, 0.08, 0.09, 0.10
Range (ppb)	0.18 – 1.87	0.02 – 0.51	0.03 – 0.24	0.08 – 0.37	0.03 – 0.07	0.05 – 0.11
Miles/Condabri North						
N samples (N data points)	24 (12)	24 (12)	24 (12)	24 (12)	24 (12)	24 (12)
Detection Frequency (%)[a]	100	83	58	25	8	33
Avg (all) ± stdev (ppb)	0.72 ± 0.35	0.18 ± 0.13	0.10 ± 0.05	0.16 ± 0.06	0.05 ± 0.01	0.07 ± 0.02
25, 50, 75, 95th % ile (ppb)	0.55, 0.66, 0.72, 1.29	0.11, 0.16, 0.21, 0.42	0.07, 0.08, 0.11, 0.19	0.13, 0.15, 0.17, 0.27	0.05, 0.05, 0.05, 0.06	0.06, 0.07, 0.08, 0.12
Range (ppb)	0.20 – 1.63	0.02 – 0.46	0.03 – 0.20	0.08 – 0.28	0.03 – 0.06	0.04 – 0.14
Condamine						
N samples (N data points)	12 (12	12 (12	12 (12	12 (12	12 (12	12 (12
Detection Frequency (%)[a]	100	83	67	50	17	42
Avg (all) ± stdev (ppb)	0.69 ± 0.37	0.20 ± 0.14	0.11 ± 0.05	0.18 ± 0.07	0.05 ± 0.01	0.08 ± 0.04
25, 50, 75, 95th % ile (ppb)	0.51, 0.62, 0.73, 1.37	0.06, 0.22, 0.32, 0.38	0.07, 0.09, 0.16, 0.18	0.14, 0.17, 0.23, 0.29	0.05, 0.06, 0.06, 0.06	0.06, 0.07, 0.09, 0.14
Range (ppb)	0.20 – 1.55	0.02 – 0.41	0.03 – 0.19	0.07 – 0.30	0.03 – 0.07	0.04 – 0.19
Hopeland						
N samples (N data points)	14 (14)	14 (14	14 (14	14 (14	14 (14	14 (14
Detection Frequency (%)[a]	100	85	69	31	23	62
Avg (all) ± stdev (ppb)	0.61 ± 0.23	0.14 ± 0.11	0.10 ± 0.05	0.19 ± 0.08	0.05 ± 0.01	0.08 ± 0.02
25, 50, 75, 95th % ile (ppb)	0.48, 0.57, 0.75, 0.92	0.06, 0.12, 0.15, 0.38	0.07, 0.08, 0.11, 0.20	0.15, 0.17, 0.18, 0.33	0.05, 0.05, 0.06, 0.07	0.07, 0.09, 0.10, 0.12

Range (ppb)	0.20 – 1.14	0.03 – 0.42	0.05 – 0.21	0.10 – 0.37	0.03 – 0.09	0.05 – 0.12
	Formaldehyde	**Acetaldehyde**	**Propanaldehyde**	**Butanaldehyde**	**Pentanaldehyde**	**Hexanaldehyde**
DL range (ppb)	0.05 – 0.05	0.02 – 0.06	0.03 – 0.12	0.07 – 0.27	0.03 – 0.11	0.03 – 0.13
Nangram/Monreagh						
N samples (N data points)	12/12	12/12	12/12	12/12	12/12	12/12
Detection Frequency (%)[a]	100	83	58	33	8	50
Avg (all) ± stdev (ppb)	0.72 ± 0.35	0.15 ± 0.13	0.09 ± 0.04	0.17 ± 0.06	0.05 ± 0.01	0.09 ± 0.04
25, 50, 75, 95th % ile (ppb)	0.58, 0.63, 0.80, 1.27	0.05, 0.11, 0.19, 0.39	0.07, 0.08, 0.09, 0.15	0.14, 0.15, 0.17, 0.27	0.05, 0.05, 0.05, 0.06	0.07, 0.07, 0.10, 0.16
Range (ppb)	0.29 – 1.63	0.03 – 0.42	0.03 – 0.19	0.08 – 0.33	0.03 – 0.06	0.03 – 0.16
Greenswamp/Purnell						
N samples (N data points)	12 (12)	12 (12)	12 (12)	12 (12)	12 (12)	12 (12)
Detection Frequency (%)[a]	100	83	67	25	17	42
Avg (all) ± stdev (ppb)	0.55 ± 0.26	0.14 ± 0.10	0.09 ± 0.04	0.16 ± 0.05	0.05 ± 0.02	0.08 ± 0.04
25, 50, 75, 95th % ile (ppb)	0.42, 0.53, 0.63, 0.91	0.06, 0.13, 0.20, 0.28	0.07, 0.08, 0.09, 0.16	0.14, 0.15, 0.17, 0.23	0.05, 0.05, 0.06, 0.07	0.06, 0.07, 0.08, 0.16
Range (ppb)	0.13 – 1.22	0.02 – 0.34	0.03 – 0.19	0.08 – 0.25	0.03 – 0.09	0.05 – 0.17
Rockwood/Talinga						
N samples (N data points)	26 (13)	26 (13)	26 (13)	26 (13)	26 (13)	26 (13)
Detection Frequency (%)[a]	100	92	69	38	8	38
Avg (all) ± stdev (ppb)	0.69 ± 0.32	0.15 ± 0.11	0.10 ± 0.05	0.17 ± 0.05	0.05 ± 0.01	0.08 ± 0.03
25, 50, 75, 95th % ile (ppb)	0.54, 0.66, 0.80, 1.17	0.04, 0.15, 0.21, 0.32	0.07, 0.08, 0.10, 0.19	0.15, 0.15, 0.18, 0.26	0.05, 0.05, 0.06, 0.06	0.07, 0.07, 0.08, 0.14
Range (ppb)	0.20 – 1.47	0.03 – 0.41	0.05 – 0.21	0.11 – 0.33	0.04 – 0.07	0.05 – 0.18

Table B. 16 Summary statistics by site for VOCs with overall detection frequency < 10% (where the VOC was detected at at least one site)

	Methylcyclopentane	Methylcyclohexane	n-Heptane	iso-Octane	n-Octane	n-Nonane
DL range (ppb)	0.01 – 0.05	0.01 – 0.04	0.01 – 0.05	0.01 – 0.04	0.01 – 0.05	0.01 – 0.05
Burncluith						
N samples (N data points)	25 (25)	25 (25)	25 (25)	25 (25)	25 (25)	25 (25)
Detection Frequency (%)[a]	0	0	0	0	0	0
Range (ppb)	0.01 – 0.02	0.01 -0.02	0.01 – 0.02	0.01 – 0.02	0.01 - 0.02	0.01 – 0.02
Tara Region						
N samples (N data points)	70 (35)	70 (35)	70 (35)	70 (35)	70 (35)	70 (35)
Detection Frequency (%)[a]	0	0	0	0	0	0
Range (ppb)	0.01 – 0.03	0.01 – 0.03	0.01 – 0.04	0.01 – 0.03	0.01 – 0.03	0.01 – 0.03
Chinchilla						
N samples (N data points)	86 (36)	86 (36)	86 (36)	86 (36)	86 (36)	86 (36)
Detection Frequency (%)[a]	44	19	36	42	8	11
Range (ppb)	0.01 – 0.07	0.01 – 0.04	0.01 – 0.06	0.01 – 0.09	0.01 – 0.04	0.01 – 0.04
Miles Airport						
N samples (N data points)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)
Detection Frequency (%)[a]	0	0	0	0	0	0
Range (ppb)	0.01 – 0.05	0.01 – 0.04	0.01 – 0.05	0.01 – 0.04	0.01 – 0.05	0.01 – 0.05
Miles/Condabri North						
N samples (N data points)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)
Detection Frequency (%)[a]	0	0	0	0	0	0
Range (ppb)	0.01 – 0.05	0.01 – 0.05	0.01 – 0.05	0.01 – 0.05	0.01 0.05	0.01 – 0.05

	Methylcyclopentane	**Methylcyclohexane**	**n-Heptane**	**Iso-Octane**	**n-Octane**	**n-Nonane**
DL range (ppb)	0.01 – 0.05	0.01 – 0.04	0.01 – 0.05	0.01 – 0.04	0.01 – 0.05	0.01 – 0.05
Condamine						
N samples (N data points)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)
Detection Frequency (%)[a]	0	0	0	0	0	0
Range (ppb)	0.01 – 0.05	0.01 -0.04	0.01 – 0.05	0.01 – 0.04	0.01 – 0.05	0.01 – 0.05
Hopeland						
N samples (N data points)	58 (36)	58 (36)	58 (36)	58 (36)	58 (36)	58 (36)
Detection Frequency (%)[a]	0	0	0	0	0	0
Range (ppb)	0.01 – 0.04	0.01 – 0.04	0.01 – 0.04	0.01 – 0.04	0.01 – 0.04	0.01 – 0.04
Nangram/Monreagh						
N samples (N data points)	33 (33)	33 (33)	33 (33)	33 (33)	33 (33)	33 (33)
Detection Frequency (%)[a]	0	0	0	0	0	0
Range (ppb)	0.01 – 0.05	0.01 – 0.04	0.01 – 0.05	0.01 – 0.04	0.01 – 0.05	0.01 – 0.05
Greenswamp/Purnell						
N samples (N data points)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)
Detection Frequency (%)[a]	0	0	0	0	0	0
Range (ppb)	0.01 – 0.0	0.01 – 0.03	0.01 – 0.04	0.01 – 0.04	0.01 – 0.04	0.01 – 0.04
Rockwood/Talinga						
N samples (N data points)	36 (36)	36 (36)	36 (36)	36 (36)	36 (36)	36 (36)
Detection Frequency (%)[a]	0	0	0	0	0	0
Range (ppb)	0.01 – 0.03	0.01 – 0.03	0.01 – 0.04	0.01 – 0.03	0.01 – 0.03	0.01 – 0.03

Table B. 17 Summary statistics by site for VOCs with overall detection frequency < 10% (where VOCs were detected at at least one site)

	Ethylbenzene	**Trichloromethane**	**Butanol**	**2-Butoxyethanol**	**Methyl ethyl ketone**	**Benzaldehyde**
DL range (ppb)	0.01 – 0.04	0.01 – 0.03	0.01 – 0.05	0.01 – 0.04	0.01 – 0.05	0.01 – 0.03
Burncluith						
N samples (N data points)	25 (25)	25 (25)	25 (25)	25 (25)	25 (25)	13 (13)
Detection Frequency (%)[a]	0	52	0	0	4	0
Range (ppb)	0.01 – 0.02	0.01 – 0.06	0.02 – 0.02	0.01 – 0.02	0.01 – 0.04	0.01 – 0.01
Tara Region						
N samples (N data points)	70 (35)	70 (35)	70 (35)	70 (35)	70 (35)	12 (12)
Detection Frequency (%)[a]	0	0	0	0	9	0
Range (ppb)	0.01 – 0.03	0.01 – 0.02	0.01 – 0.04	0.01 – 0.03	0.01 – 0.04	0.01 – 0.01
Chinchilla						
N samples (N data points)	86 (36)	86 (36)	86 (36)	86 (36)	86 (36)	29 (15)
Detection Frequency (%)[a]	50	33	3	0	25	0
Range (ppb)	0.01 – 0.05	0.01 – 0.03	0.01 – 0.09	0.01 – 0.04	0.01 – 0.04	0.01 – 0.03
Miles Airport						
N samples (N data points)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)	12 (12)
Detection Frequency (%)[a]	0	0	0	3	6	0
Range (ppb)	0.01 – 0.04	0.01 – 0.03	0.01 – 0.05	0.01 – 0.08	0.01 – 0.05	0.01 – 0.01
Miles/Condabri North						
N samples (N data points)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)	24 (12)
Detection Frequency (%)[a]	0	3	0	0	0	0
Range (ppb)	0.01 – 0.04	0.01 – 0.03	0.01 – 0.05	0.01 – 0.04	0.01 – 0.05	0.01 – 0.01
	Ethylbenzene	**Trichloromethane**	**Butanol**	**2-Butoxyethanol**	**Methyl ethyl ketone**	**Benzaldehyde**

Condamine						
N samples (N data points)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)	12 (12)
Detection Frequency (%)[a]	0	0	0	0	3	8
Range (ppb)	0.01 – 0.04	0.01 – 0.03	0.01 – 0.05	0.01 – 0.04	0.01 – 0.05	0.01 – 0.02
DL range (ppb)	0.01 – 0.04	0.01 – 0.03	0.01-0.05	0.01 – 0.04	0.01 – 0.05	
Hopeland						
N samples (N data points)	58 (36)	58 (36)	58 (36)	58 (36)	58 (36)	14(14)
Detection Frequency (%)[a]	0	11	0	0	8	0
Range (ppb)	0.01 – 0.03	0.01 – 0.03	0.01 – 0.04	0.01 – 0.04	0.01 – 0.04	0.01 – 0.02
Nangram/Monreagh						
N samples (N data points)	33 (33)	33 (33)	33 (33)	33 (33)	33 (33)	12/12
Detection Frequency (%)[a]	0	9	0	0	3	0
Range (ppb)	0.01 – 0.04	0.01 – 0.03	0.01 – 0.05	0.01 – 0.04	0.01 – 0.05	0.01 – 0.01
Greenswamp/Purnell						
N samples (N data points)	35 (35)	35 (35)	35 (35)	35 (35)	35 (35)	12 (12)
Detection Frequency (%)[a]	45	0	0	0	3	
Range (ppb)	0.01 – 0.03	0.01 – 0.02	0.01 – 0.04	0.01 – 0.03	0.01 – 0.04	0.01 -0.01
Rockwood/Talinga						
N samples (N data points)	36 (36)	36 (36)	36 (36)	36 (36)	36 (36)	26 (13)
Detection Frequency (%)[a]	0	6	0	0	0	0
Range (ppb)	0.01 – 0.03	0.01 – 0.02	0.02 – 0.04	0.01 – 0.03	0.01 – 0.04	0.01 – 0.01

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B.4 References Appendix B2

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