



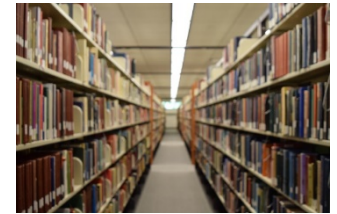
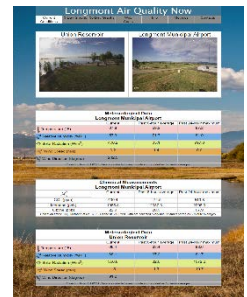
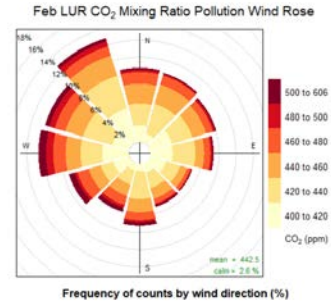
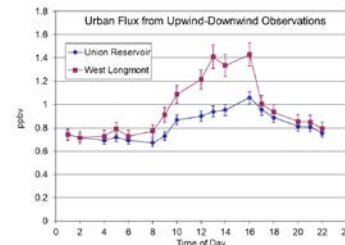
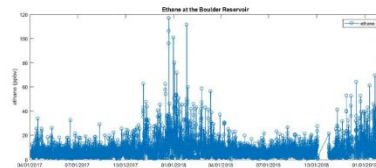
Longmont Air Quality Now

Detlev Helmig

1. Objectives/Motivation/Background
2. Monitoring Station Development
3. Websites
 - Longmont Air Quality Now
 - AirLive Combined
 - Interactive Tool
4. Data Examples and Interpretation
 - Ozone
 - Methane
 - VOCs [Ethane, Benzene]
 - (CO₂, Nitrogen Oxides, Particulate Matter)

Program Objectives

1. Monitor Greenhouse Gases at two Sites Upwind and Downwind of the City of Longmont to Follow Path towards Sustainability
2. Monitor Primary Oil and Gas Emissions
3. Provide Monitoring Data and Interpretation to Public
4. Provide Data to Public, Research Community, Industry Partners



Monitored Atmospheric Pollutants

- Carbon Dioxide
- Methane
- Volatile Organic Compounds (VOCs; *Ethane, Ethene, Propane, Propene, i-Butane, Acetylene, n-Butane, i-Pentane, n-Pentane, Hexane, Isoprene, Benzene, Toluene, Ethylbenzene, m-, p-Xylene, o-Xylene [BTEX]*)
- Nitrogen Oxides (NO and NO₂)
- Ozone
- Particulate Matter PM2.5
- Meteorological Variables (Wind, Temperature, Humidity, Radiation)
- + Webcam

- > All measurements are automated, continuous, 24/7, 365 days per year, at 1 min – 1 hour time resolution

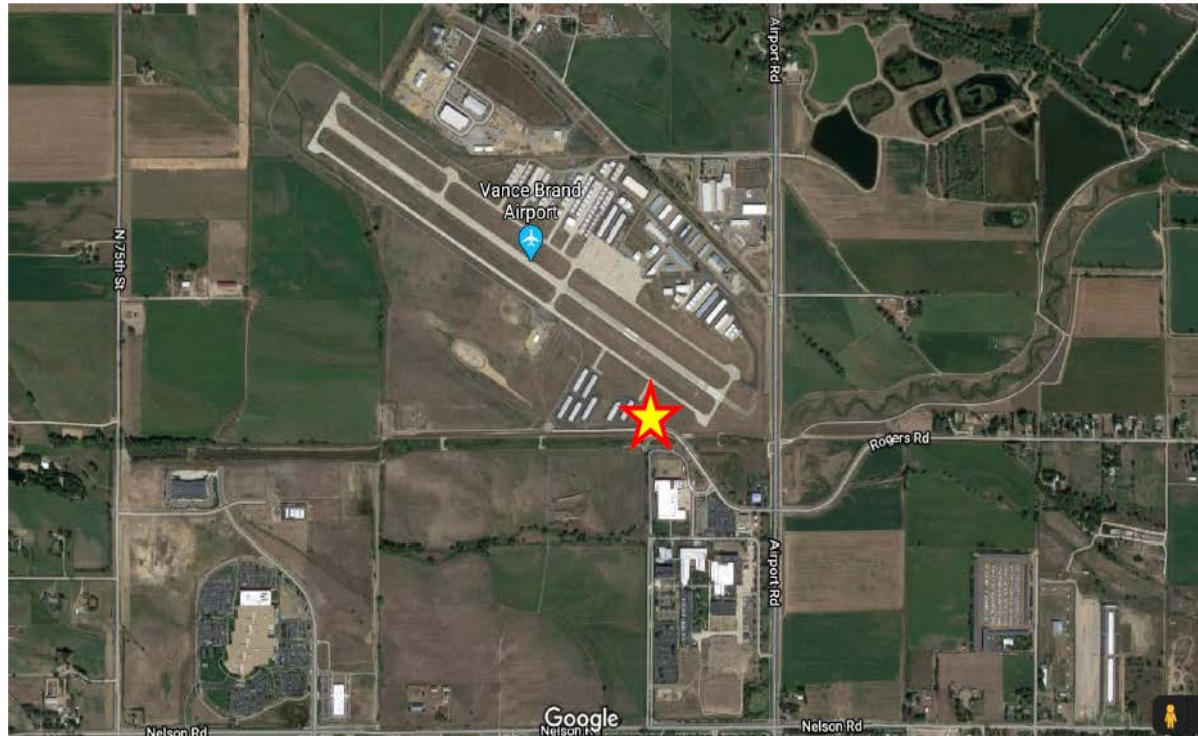
Installation Time Table

[illegible]

2. Monitoring Station Development

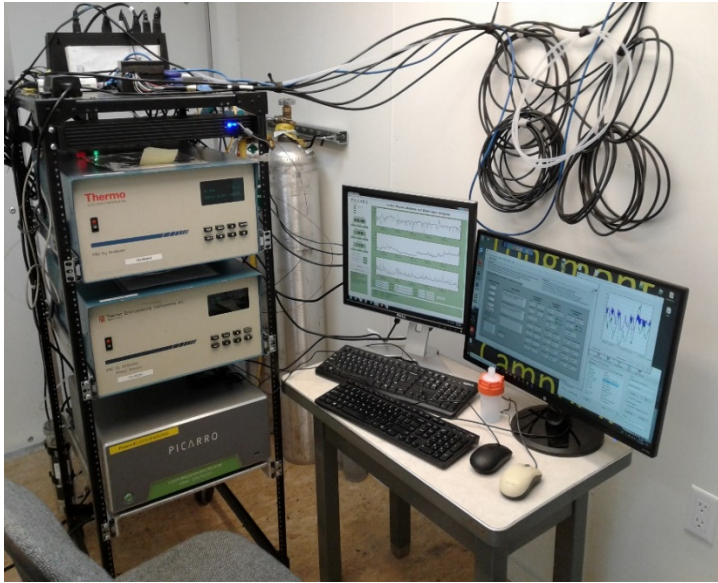
LMA

Longmont Airport; 40.1606222,-105.1597105



Google Earth image with the location of the LMA monitoring site within the fenced airport area indicated by the star.

Monitoring Station Development - LMA



Tower with Gas Sampling Inlets, Meteorological Sensors, Webcam



LMA instrument trailer with the adjacent meteorological tower.



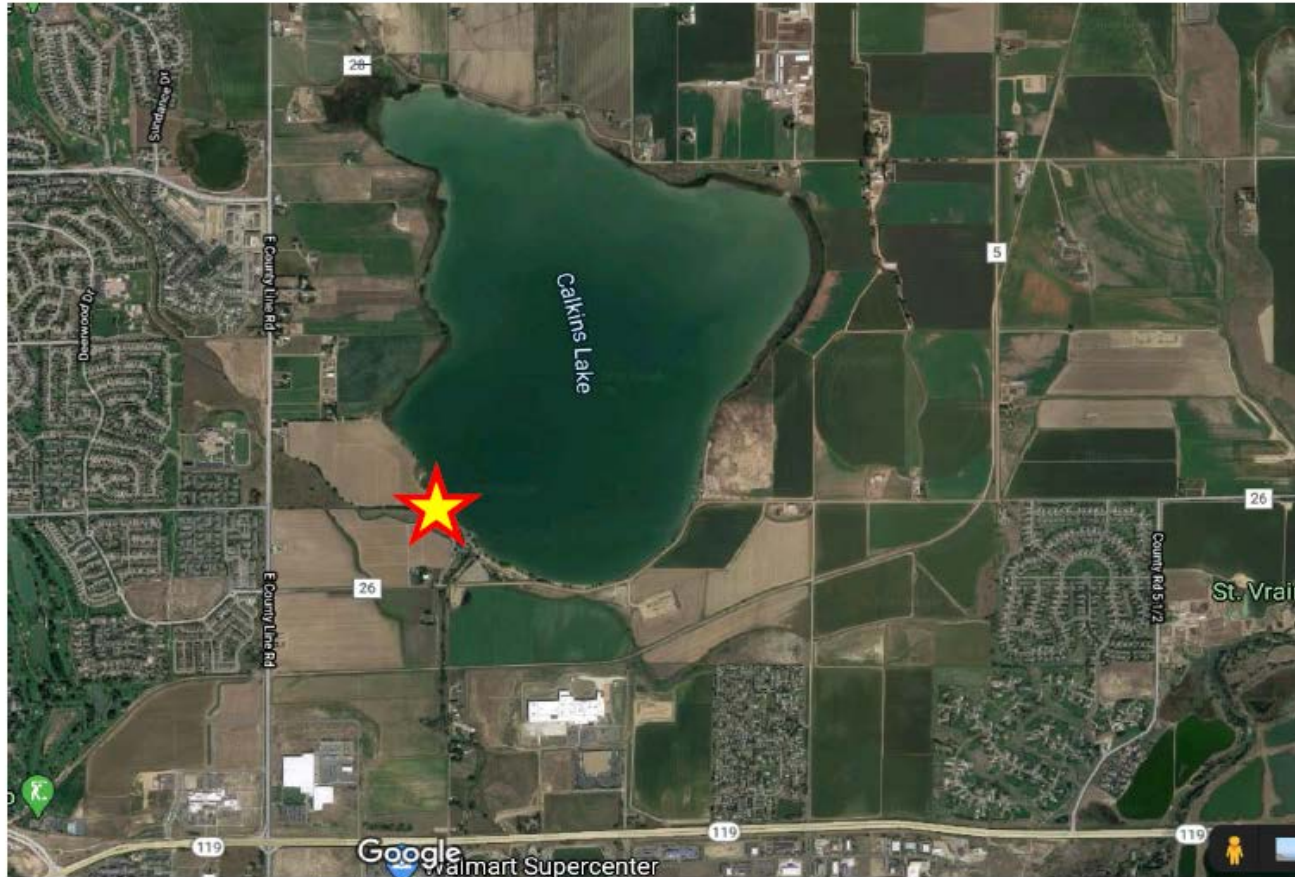
Instruments for

- Ozone
- Methane
- CO₂
- Communication
- Calibration System
- Data Logging
- Calibration Gas Tanks

Monitoring Station Development

Longmont Union Reservoir; 40.1761087,-105.0479298

LUR



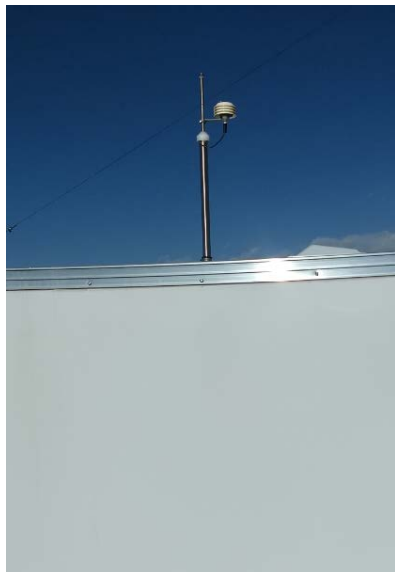
Google Earth image with the location of the LUR monitoring site on the southwest shore of Union Reservoir indicated by the star.

Monitoring Station Development



LUR instrument shelter with adjacent meteorological tower

Monitoring Station Development- LUR



Roof Inlet for
Particle
Sampling



Tower with Gas
Sampling Inlets,
Meteorological
Sensors,
Webcam



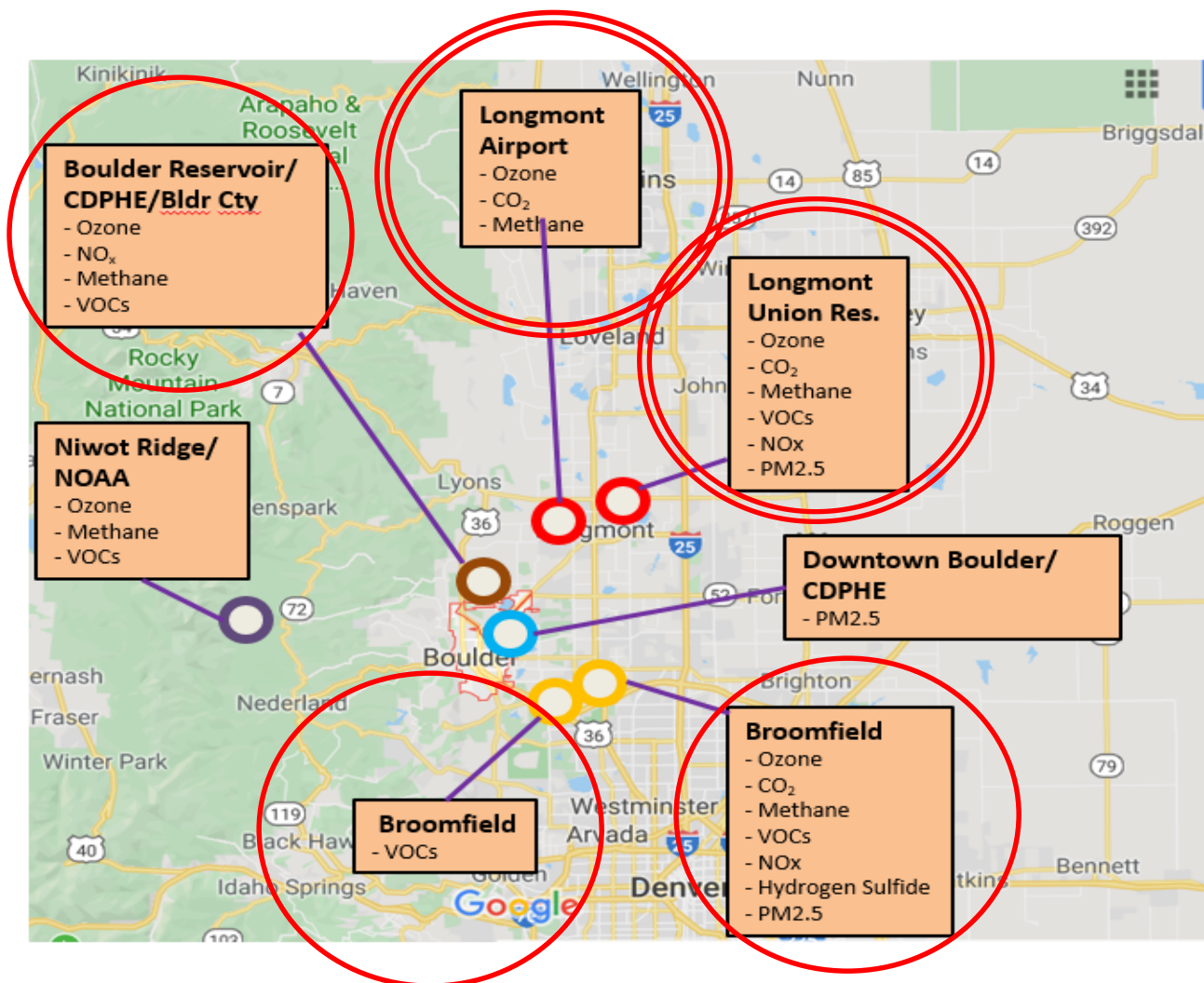
GRIMM EDM-180 Particle
Monitor; PM2.5, PM10



Instruments for

- Ozone
- Nitrogen Oxides
- VOCs
- Methane
- CO₂
- Communication
- Automated Calibration
- Data Logging
- Calibration Gases

Northern Colorado Front Range Monitoring Network



Current
Boulder
A.I.R air
quality
monitoring
sites

The two Longmont monitoring sites and included measurements within the regional network and ongoing atmospheric monitoring in neighboring communities.

3. Websites

<https://www.bouldair.com/longmont.htm>

Longmont Air Quality Now

Current Conditions	3-Day Graphs	30-Day Graphs	Web Cams	Info	Methods	Contacts
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Union Reservoir



Longmont Municipal Airport



Meteorological Data Longmont Municipal Airport

	Current	Past 8-hour average	Past 24-hour maximum
Temperature (°F)	67.8	59.2	87.2
Relative Humidity (%RH)	57.3	71.7	81.0
Solar Radiation (W/m ²)	406.2	35.1	997.8
Wind Speed (m/s)	0.2	1.4	9.9
Wind Direction (degree)	242.5		

Collection time: 6/1 07:25. Data are collected every minute and reported as 5-minute averages.

Chemical Measurements Longmont Municipal Airport

	Current	Past 8-hour average	Past 24-hour maximum
CO ₂ (ppm)	430.4	474.5	513.8
Methane (ppb)	1985.8	2037.3	2298.0
Ozone (ppb)	22.9	20.9	67.9

Collection times: CO₂, Methane at 6/1 07:22, Ozone at 6/1 07:23. Data are collected every minute and reported as 5-minute averages.

Meteorological Data Union Reservoir

	Current	Past 8-hour average	Past 24-hour maximum
Temperature (°F)	66.4	63.4	88.6
Relative Humidity (%RH)	68.1	67.2	81.7
Solar Radiation (W/m ²)	356.8	32.6	1072.2
Wind Speed (m/s)	1.5	1.3	10.7
Wind Direction (degree)	91.2		

Collection time: 6/1 07:27. Data are collected every minute and reported as 5-minute averages.

AirLive Combined Data Graphs

Sites

Boulder Reservoir
(BRZ)

Longmont Municipal
Airport (LMA)

Longmont Union
Reservoir (LUR)

Broomfield Soaring
Eagle (BSE)

Broomfield Livingston
(BLV)

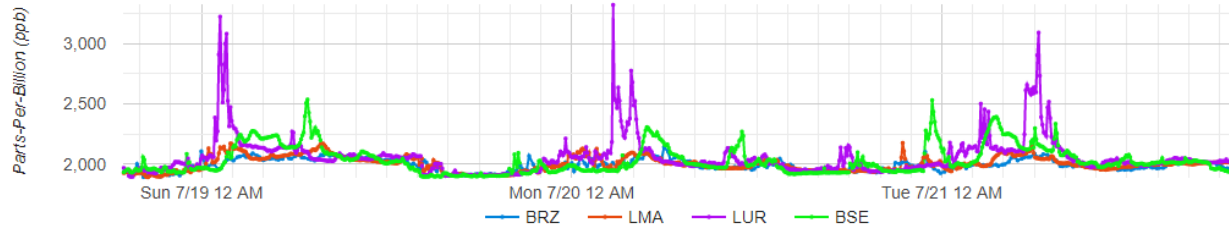
Links

[Boulder Current Conditions](#)

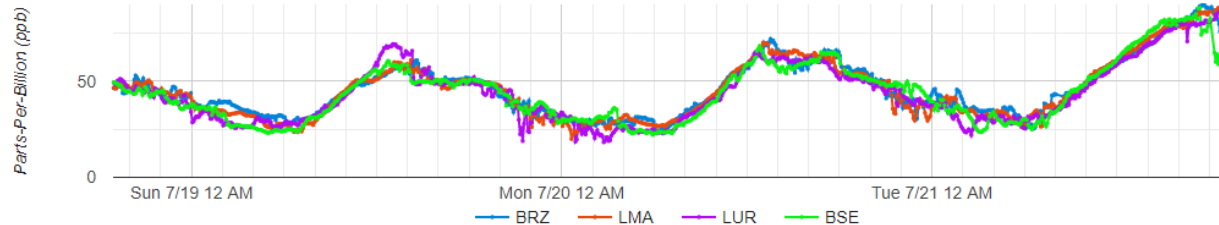
[Broomfield Current
Conditions](#)

[Longmont Current
Conditions](#)

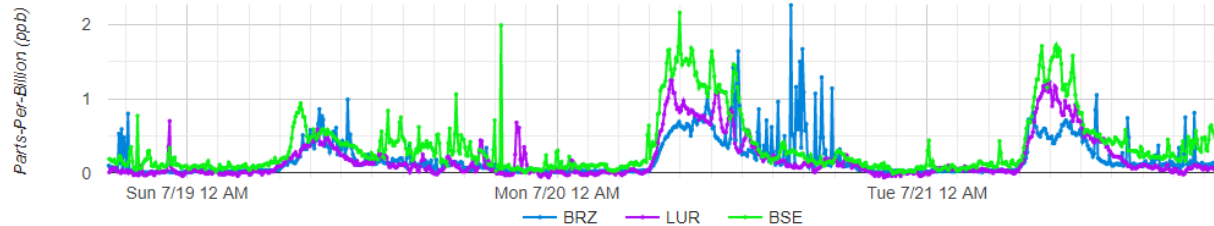
Methane



Ozone



Nitric Oxide (NO)



<https://www.bouldair.com/NoCoFrontRange.htm>

Public Websites

Visits since May 24, 2020

1925



1358



1069



Interactive Data Analysis Tool

[← Home](#)

Boulder A.I.R.
Interactive Data Analysis Tool

[*DISCLAIMER](#) [① User Guide](#)

Site Selection

☒ Many sites mode ☐ One site mode

Data Selection

<input type="checkbox"/> CH ₄	<input checked="" type="checkbox"/> O ₃	<input type="checkbox"/> WD	<input type="checkbox"/> WS
<input type="checkbox"/> CO ₂	<input type="checkbox"/> Rad	<input type="checkbox"/> Temp	<input type="checkbox"/> RH
<input type="checkbox"/> H ₂ S			

VOCs ☐ Display

NO_x ☐ Display

PM ☐ Display

Data Window

Dates →

Or past...

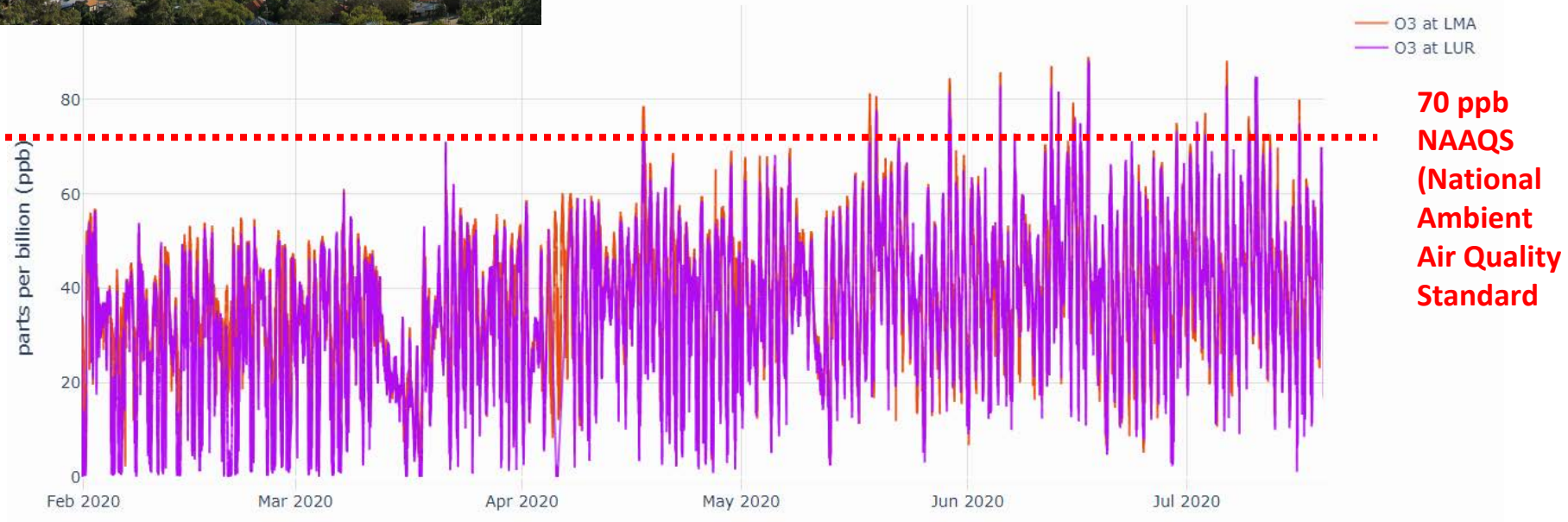
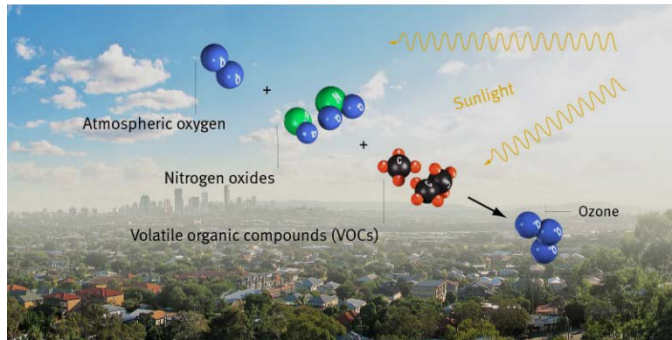
Graph height

Ozone

Currently at private URL; to be linked to public website soon.

4. Data Examples and Interpretation - Note: All data are preliminary!

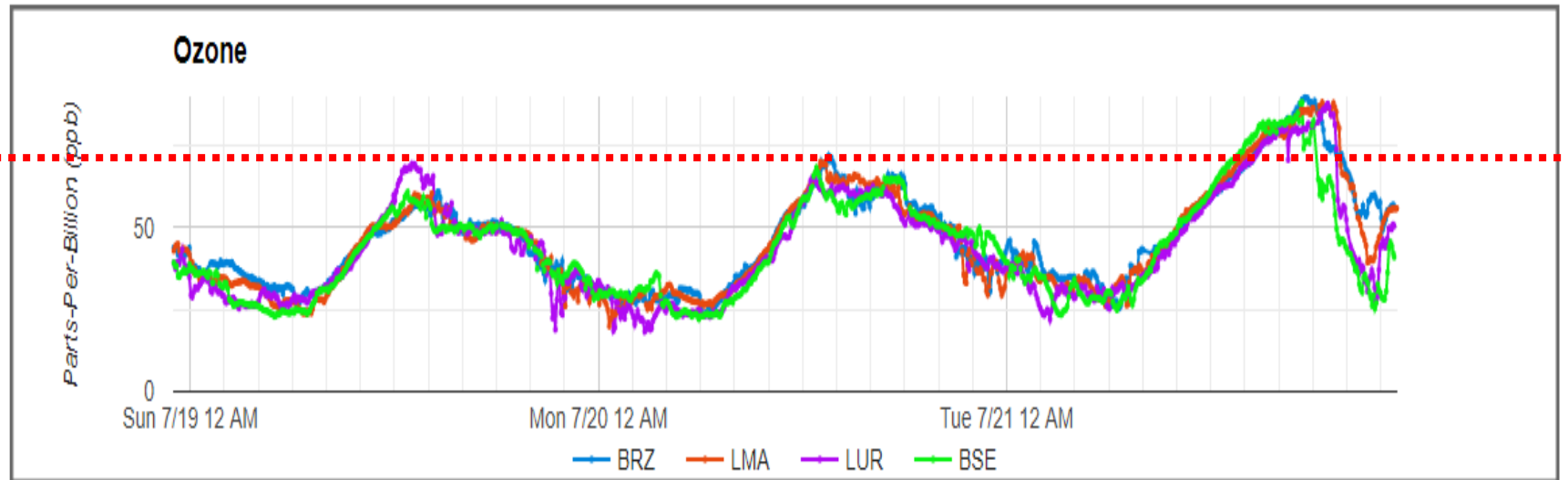
Ozone



Graph from Interactive Data Analysis Tool

Data Examples and Interpretation

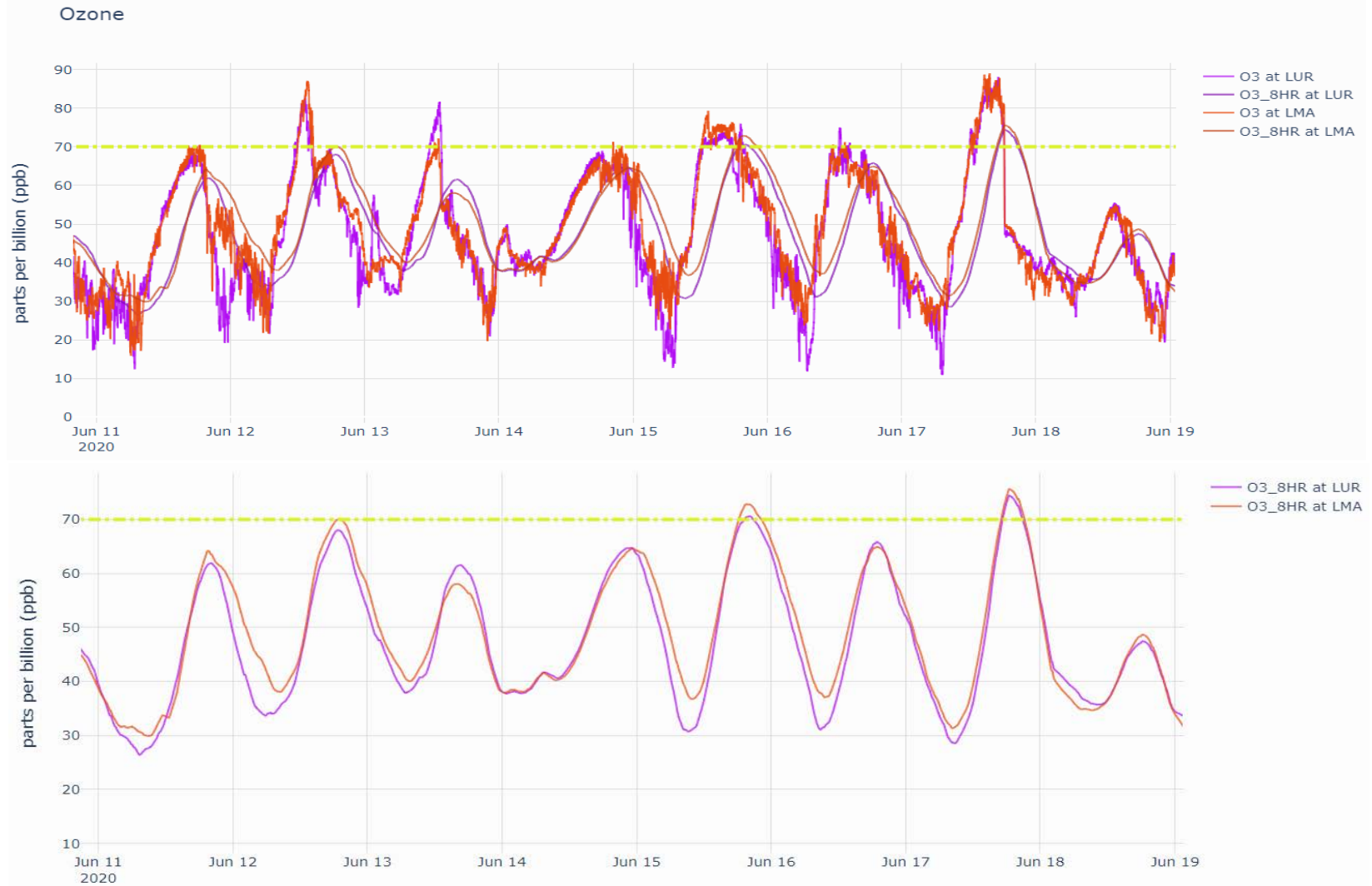
Ozone



BRZ – Boulder Reservoir
LMA – Longmont Municipal Airport
LUR – Longmont Union Reservoir
BSE – Broomfield Soaring Eagle

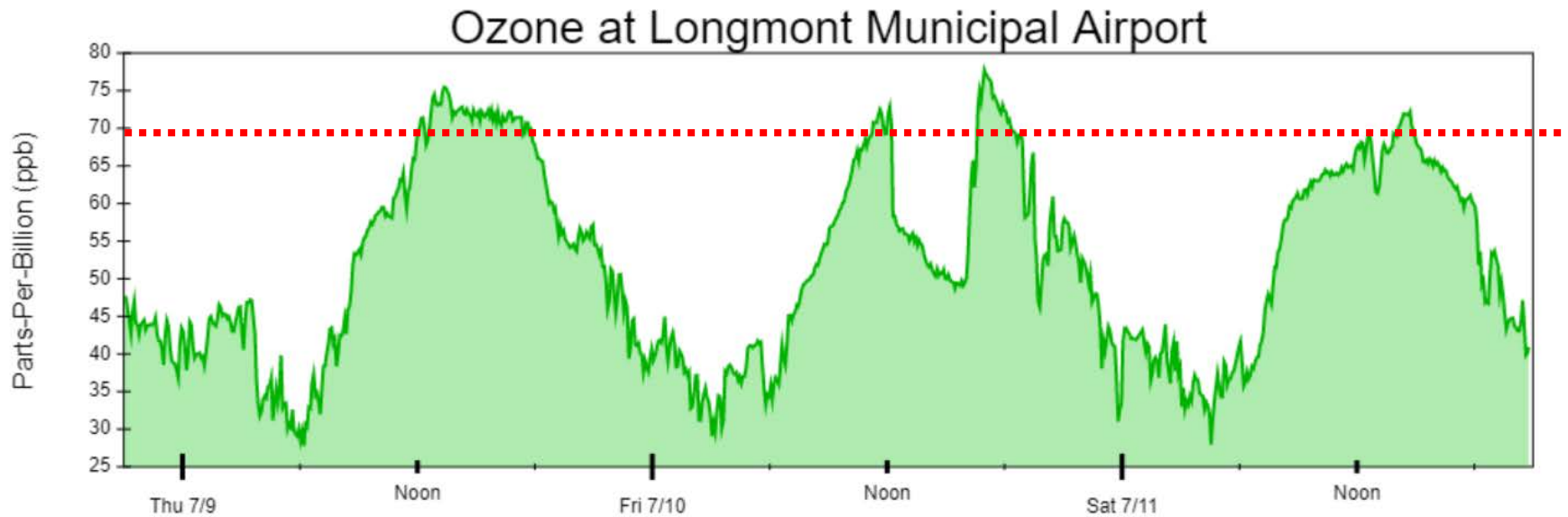
Graph from Interactive Data Analysis Tool

Ozone National Ambient Air Quality Standard (NAAQS) – 8-hour running mean value: **70 ppb**

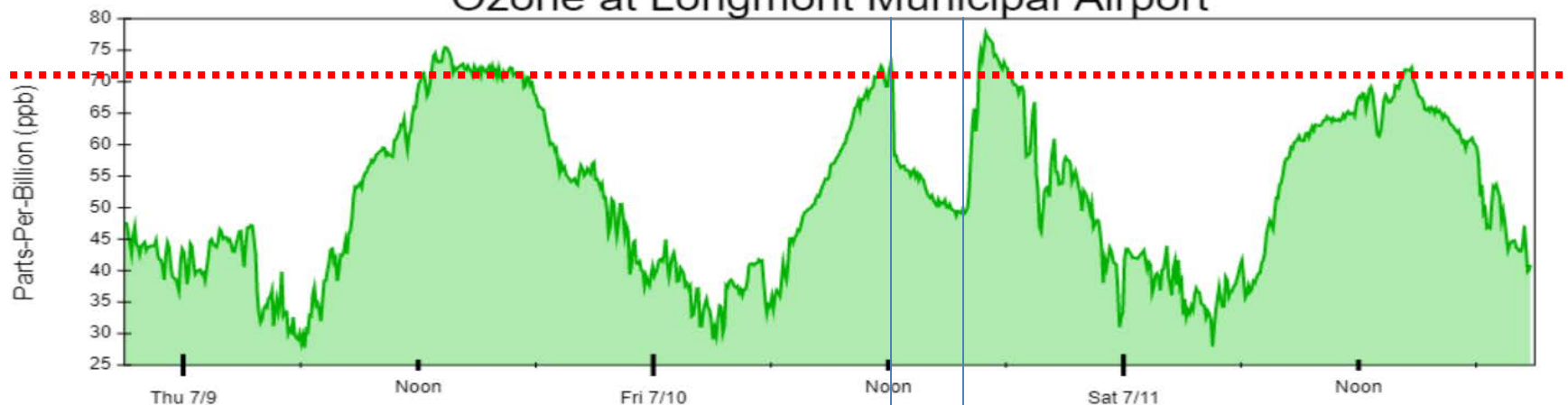


Data Examples and Interpretation – Ozone

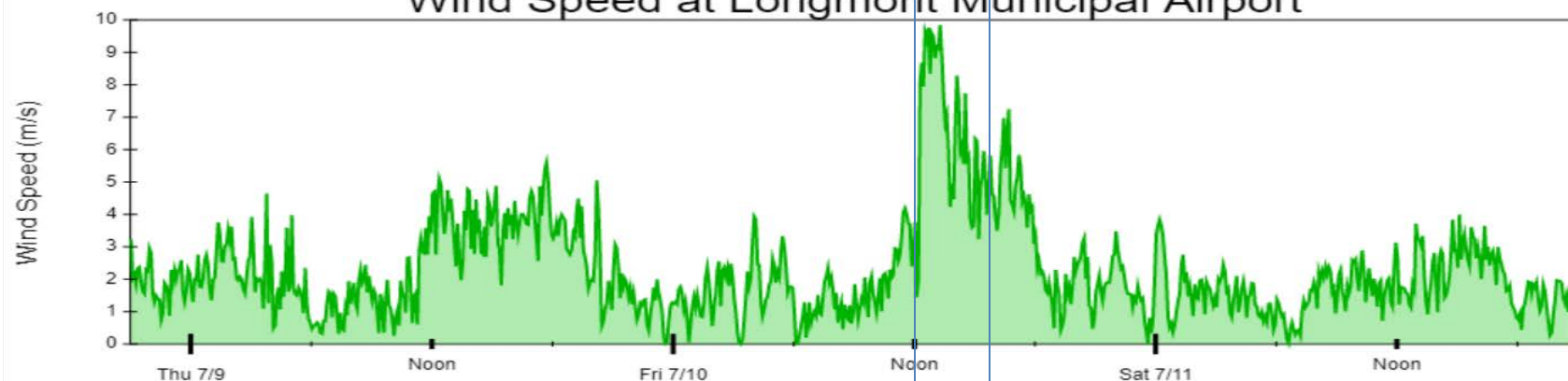
July 10 Event



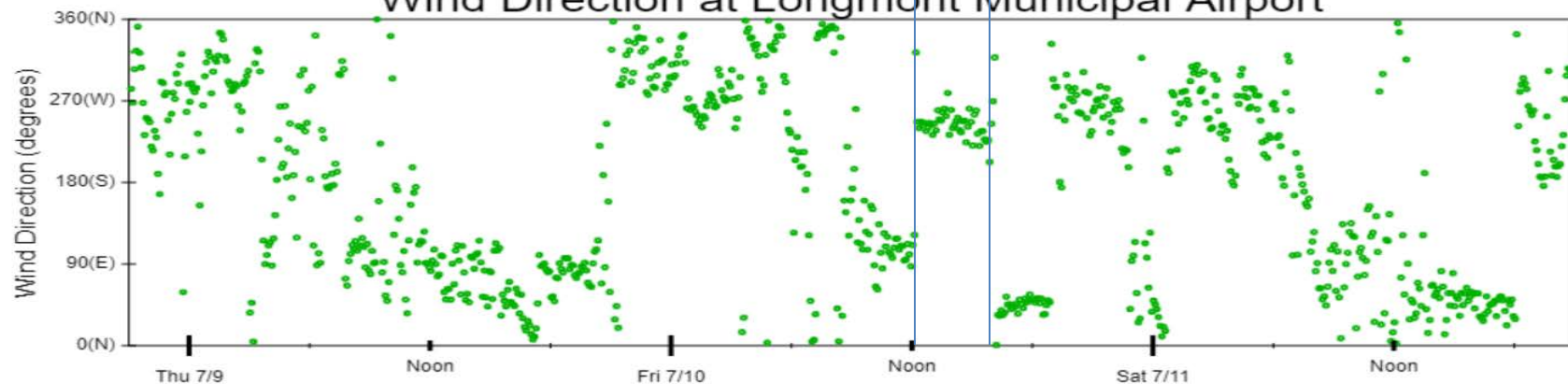
Ozone at Longmont Municipal Airport



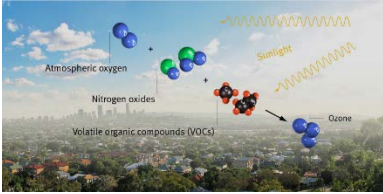
Wind Speed at Longmont Municipal Airport



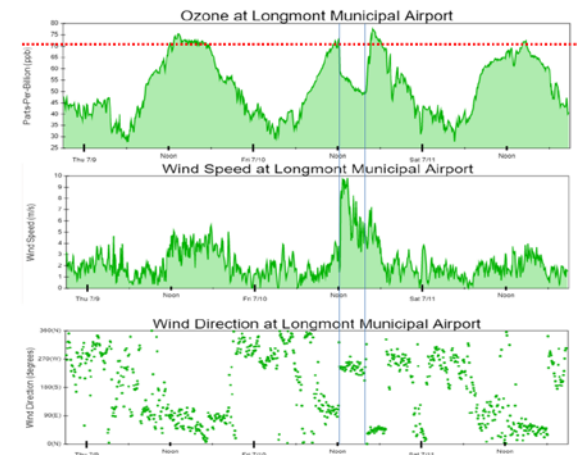
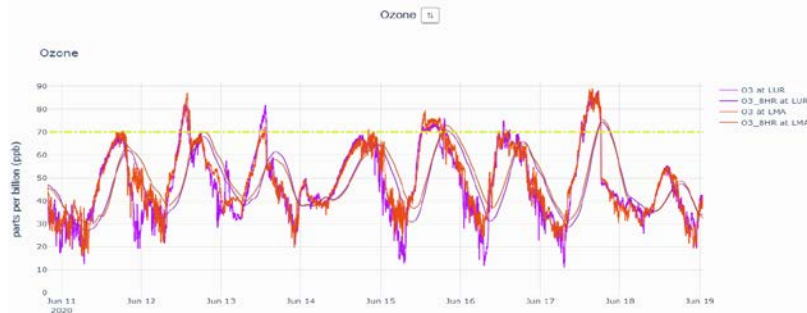
Wind Direction at Longmont Municipal Airport



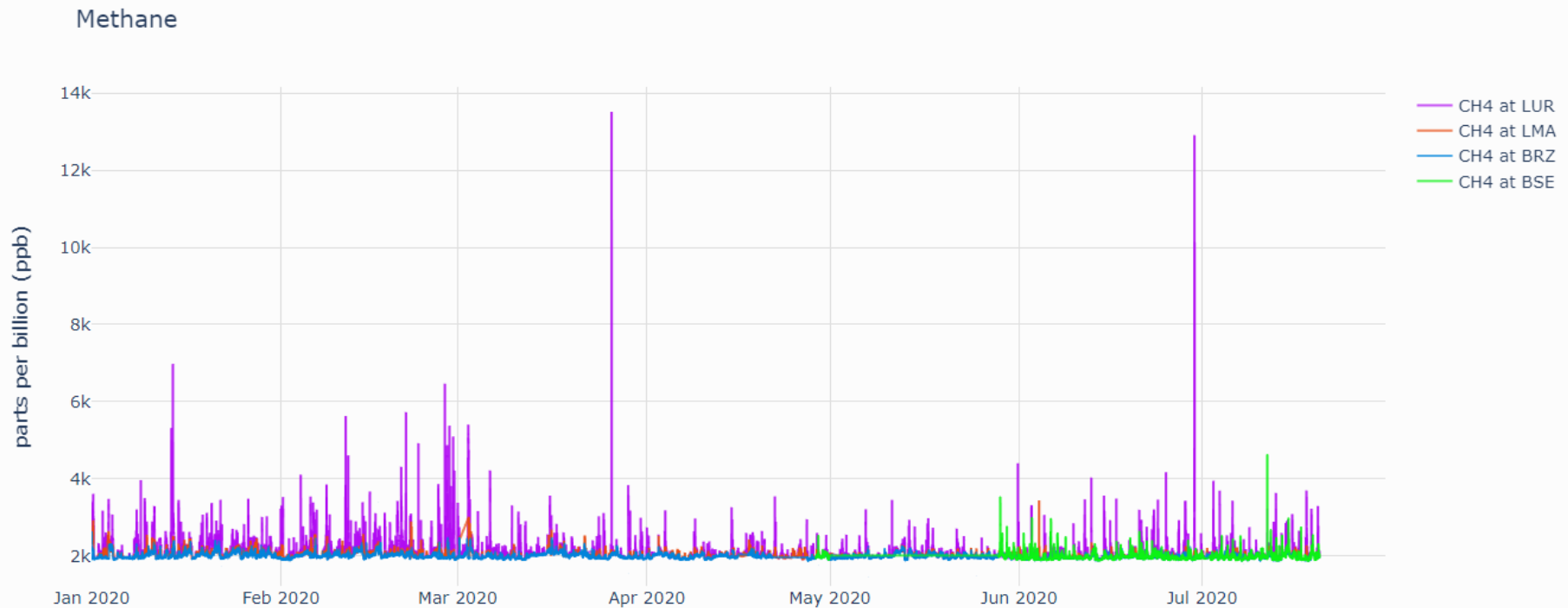
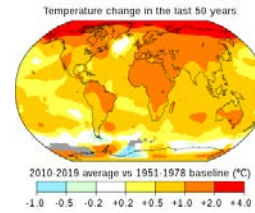
Ozone Summary



- Ozone is monitored at both LMA and LUR
- Four days with Exceedance of the ozone National Ambient Air Quality Standard this year so far
- So far, exceedances at LMA have been slightly higher than at LUR
- Most times there is higher ozone in easterly winds than in westerly transport



Data Examples and Interpretation – Methane



BRZ – Boulder Reservoir

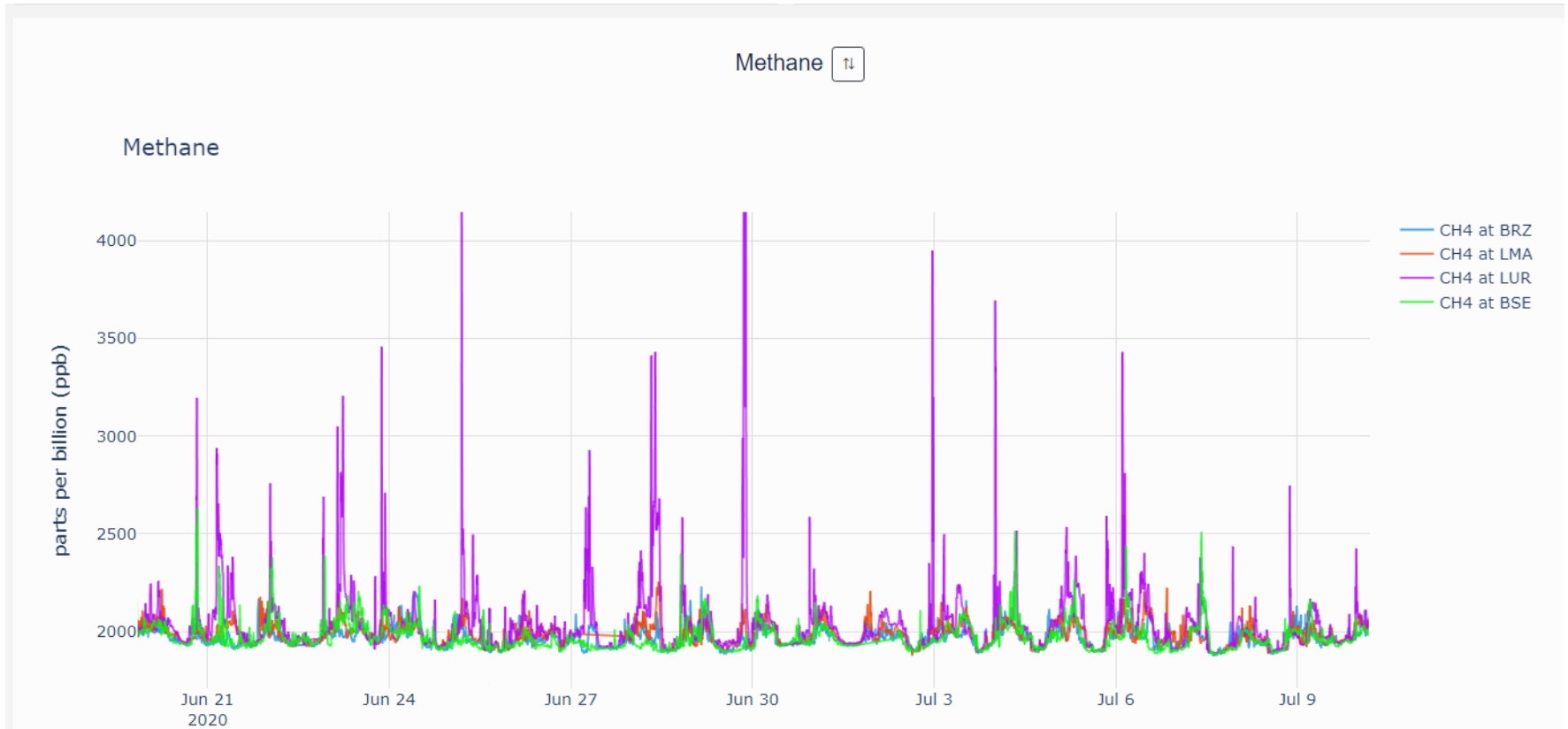
LMA – Longmont Municipal Airport

LUR – Longmont Union Reservoir

BSE – Broomfield Soaring Eagle

Graph from Interactive Data Analysis Tool

Data Examples and Interpretation – Methane



BRZ – Boulder Reservoir

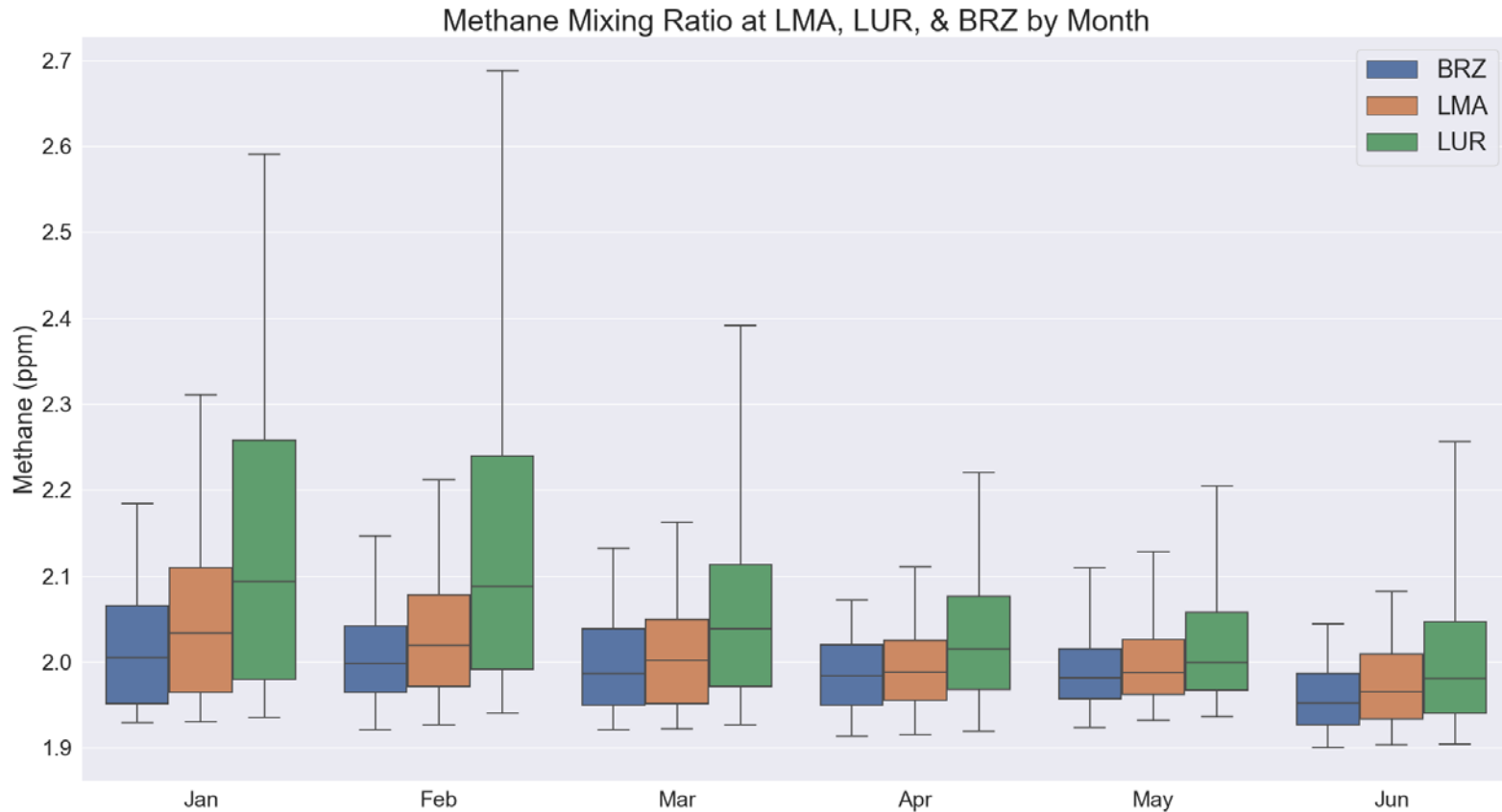
LMA – Longmont Municipal Airport

LUR – Longmont Union Reservoir

BSE – Broomfield Soaring Eagle

Graph from Interactive Data Analysis Tool

Data Examples and Interpretation – Methane

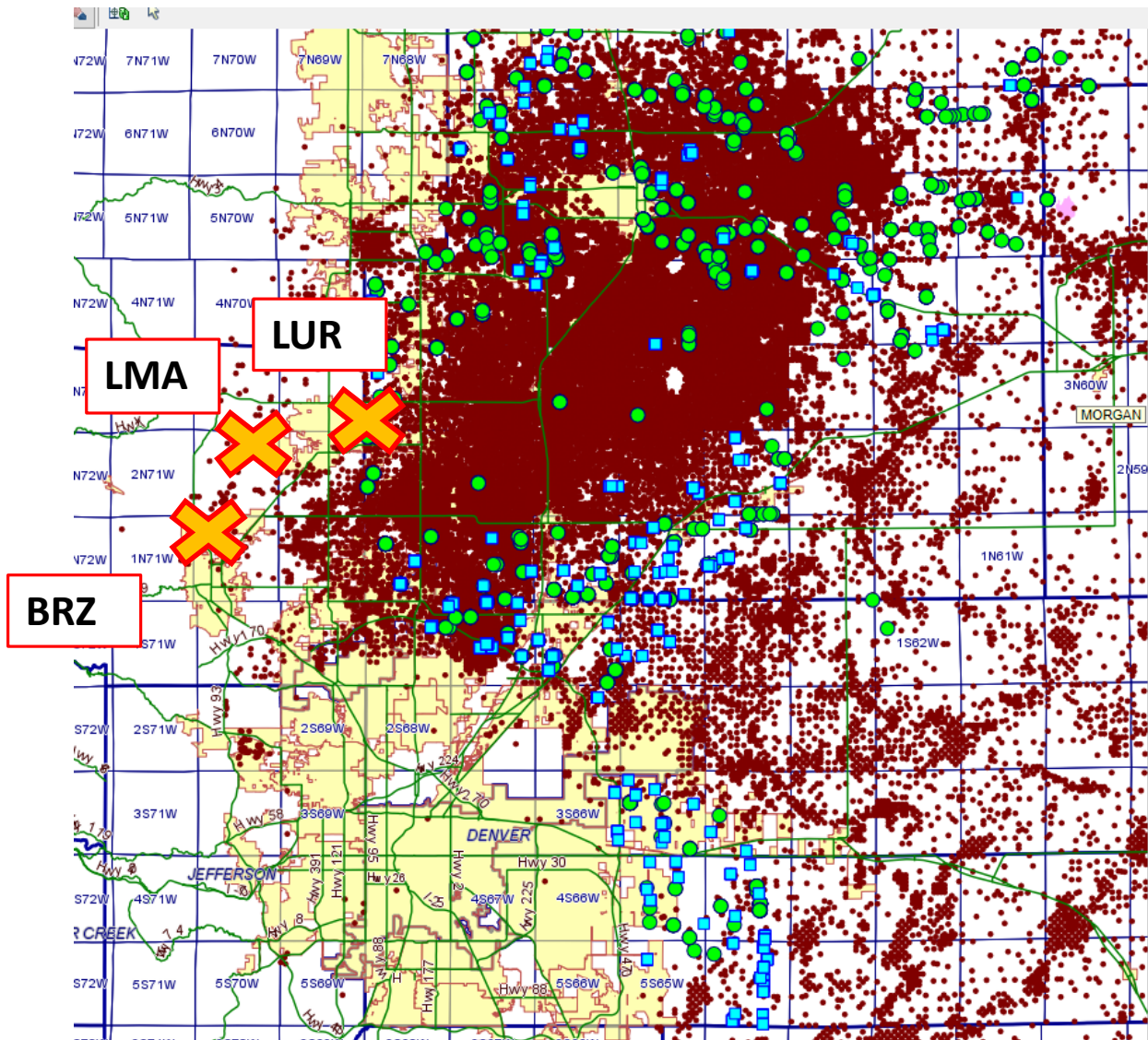


BRZ – Boulder Reservoir

LMA – Longmont Municipal Airport

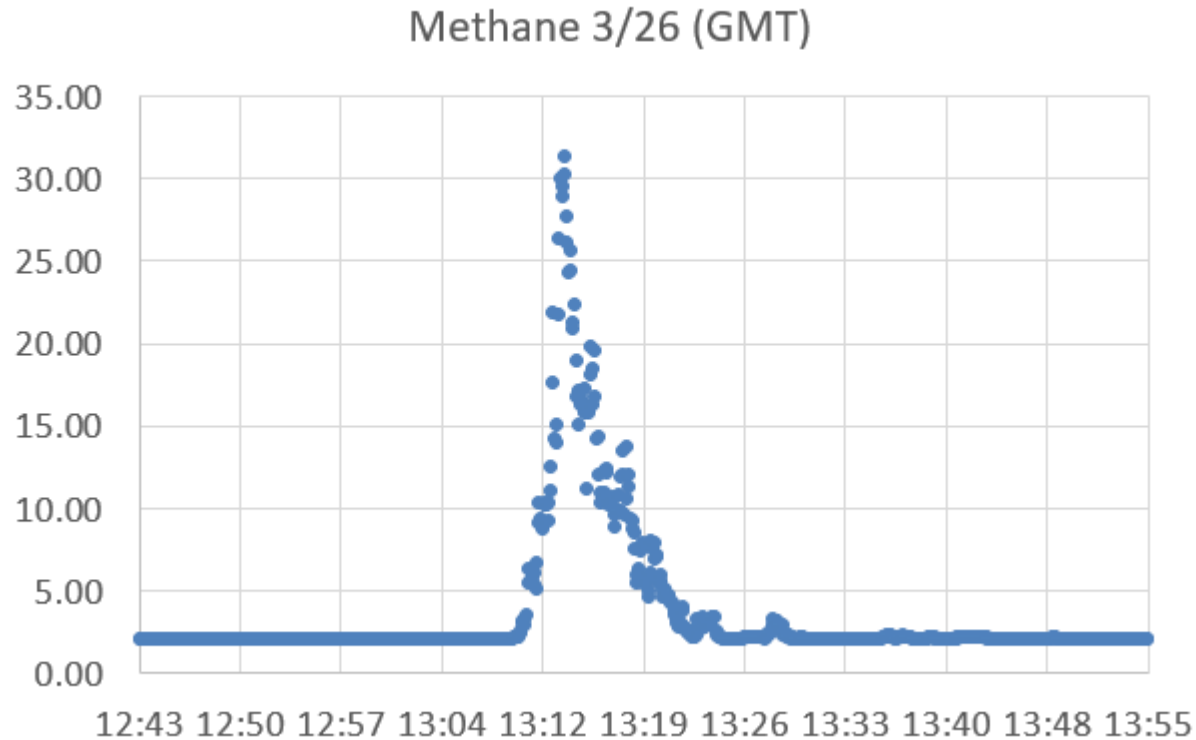
LUR – Longmont Union Reservoir

Site Locations in Relation to current Oil and Gas Wells



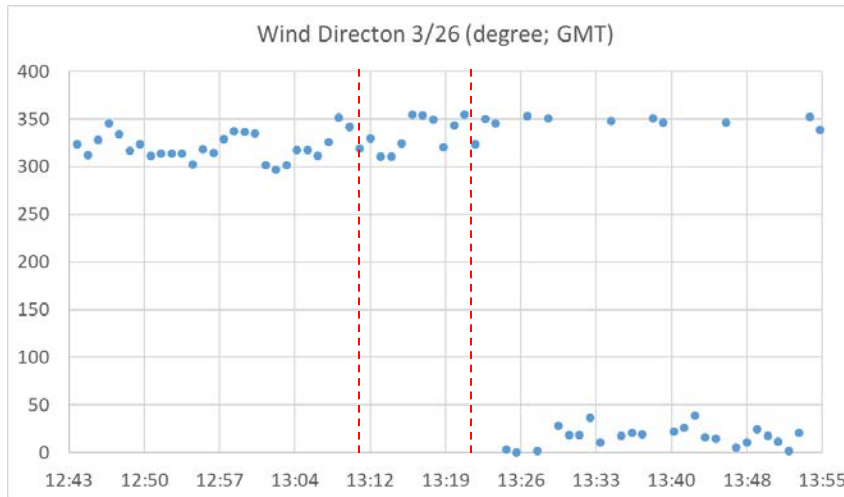
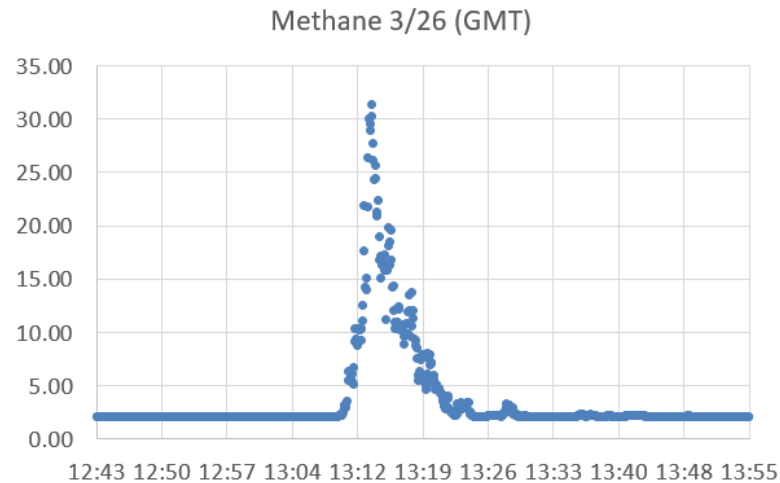
LUR Methane Spike 3/26/2020

(5 second data)

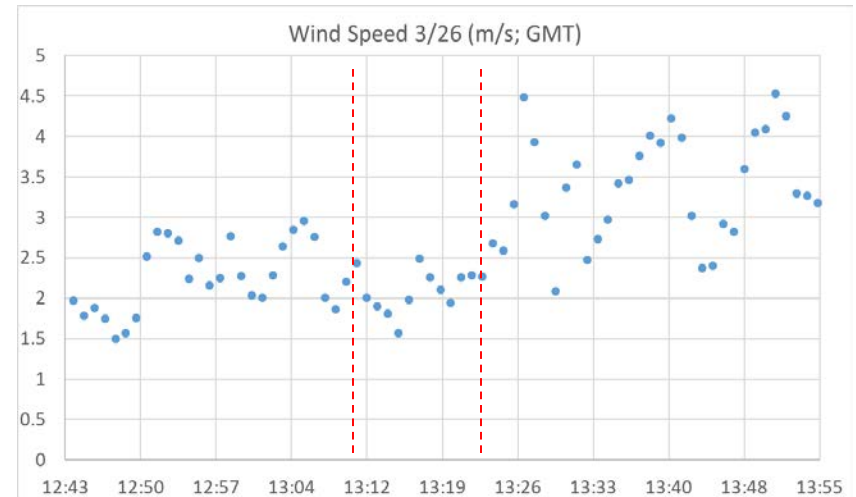


Duration: 13:10 to 13:24 (~ 14 minutes)

LUR Methane Spike Event Analysis, 13:15 hrs GMT (7:15 a.m.) on March 26

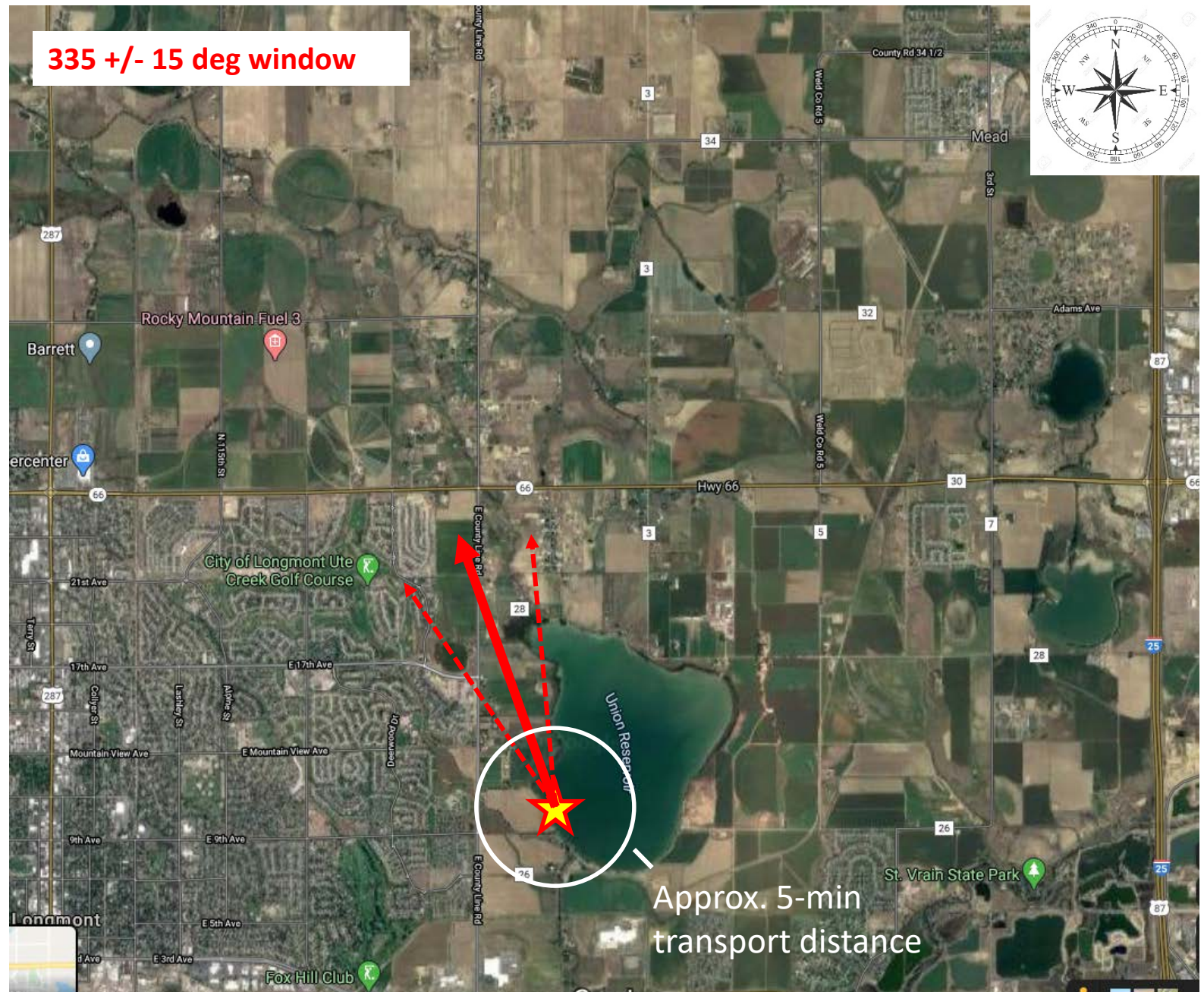
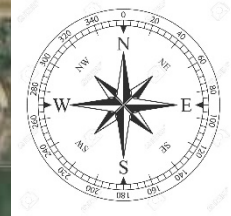


Average Wind Direction: 335 deg



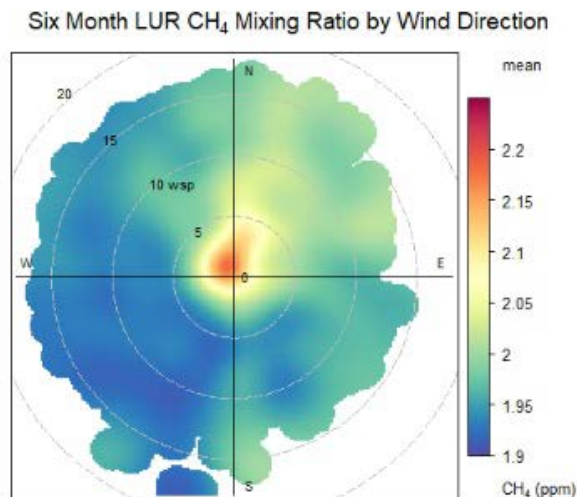
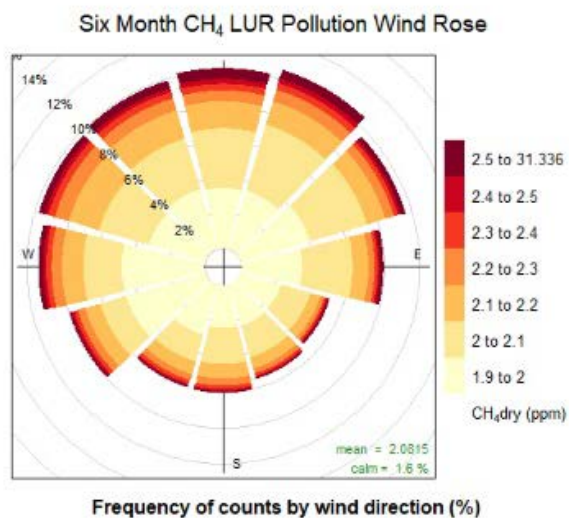
Average Wind Speed: 2.1 m/s

335 +/- 15 deg window

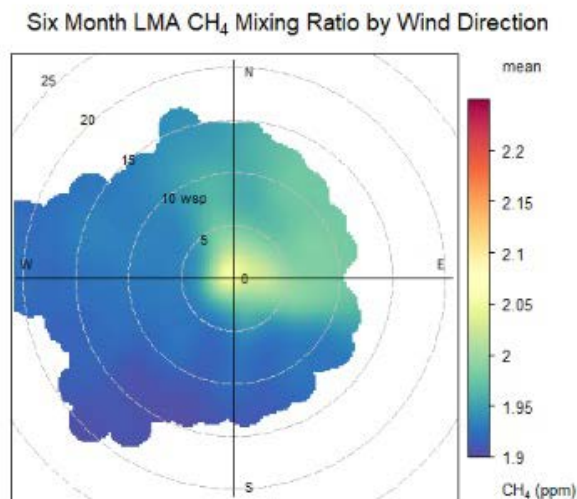
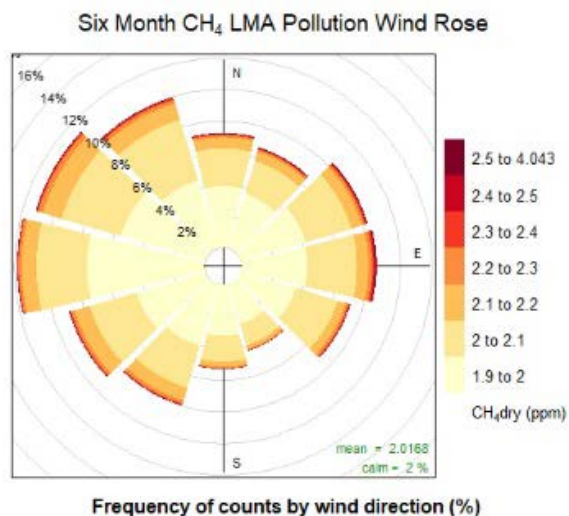


Methane – 6 months of data

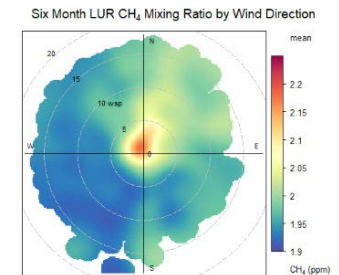
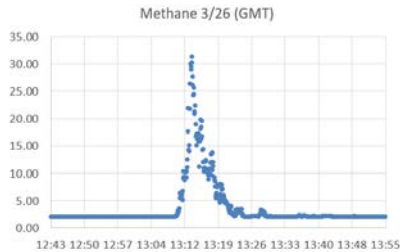
LUR



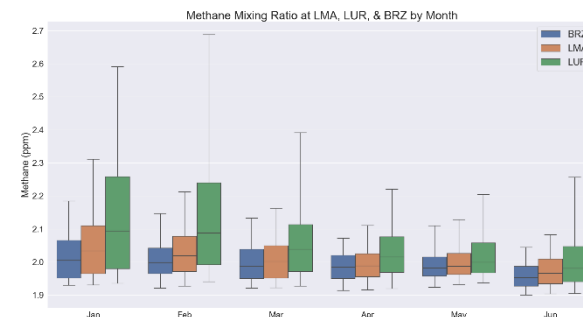
LMA



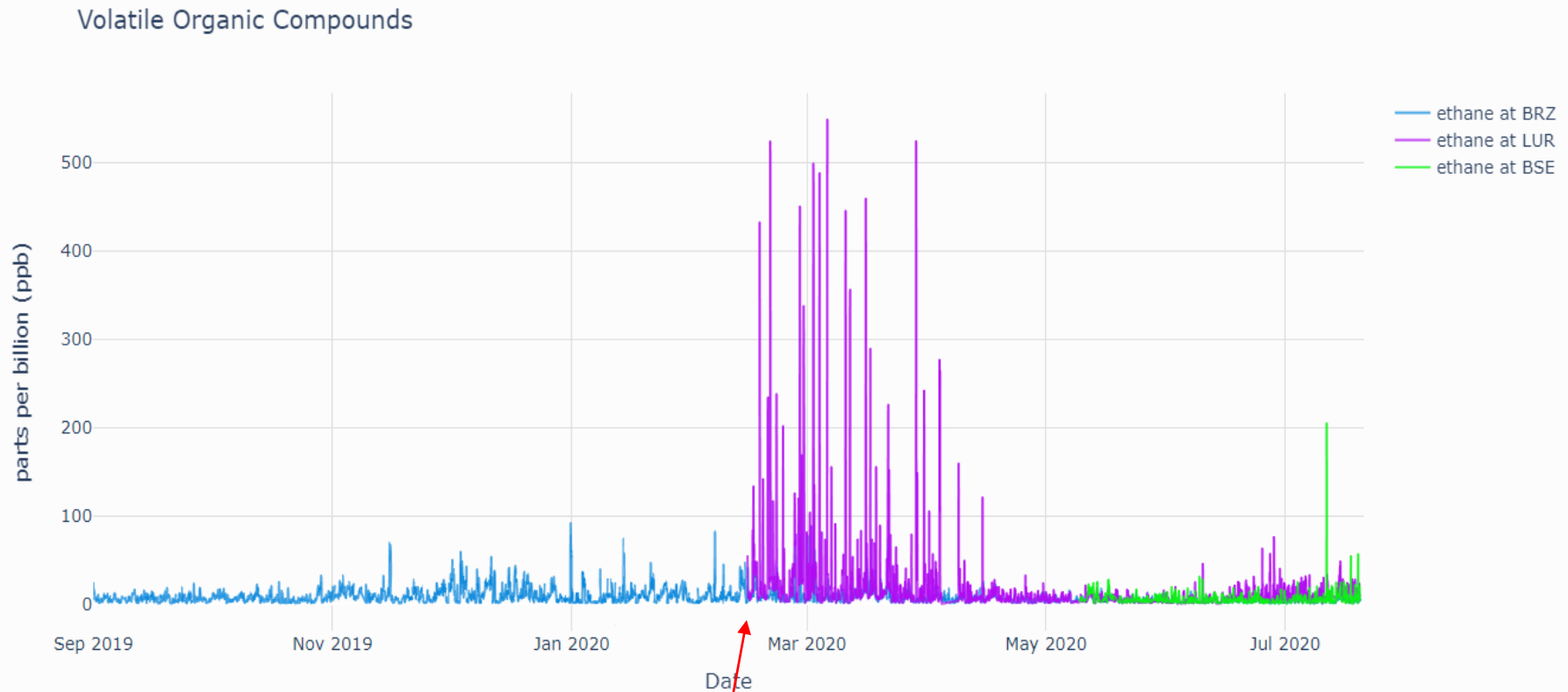
Methane Summary



- Collecting 5 seconds high resolution data at LMA and LUR
- Seeing a high abundance of spikes, often very short in duration at LUR
- Mean, median, and variability highest at LUR
- Elevated concentrations are mostly associated with northerly to easterly winds



Data Examples and Interpretation – VOCs: Ethane



BRZ – Boulder Reservoir

LMA – Longmont Municipal Airport

LUR – Longmont Union Reservoir

BSE – Broomfield Soaring Eagle

Start of VOCs
monitoring at LUR

Ethane

March 20

Longmont Air Quality Now

View Realtime | View a Historical Report

Monitored Sites
Longmont Monitoring Station

Parameter	Unit	Value	Limit
PM ₁₀	µg/m ³	150	150
PM _{2.5}	µg/m ³	40	40
O ₃	ppb	100	100
CO	ppm	1.0	1.0
SO ₂	ppb	10	10
NO ₂	ppb	10	10
NO	ppb	10	10
HC	ppb	10	10

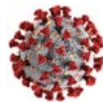
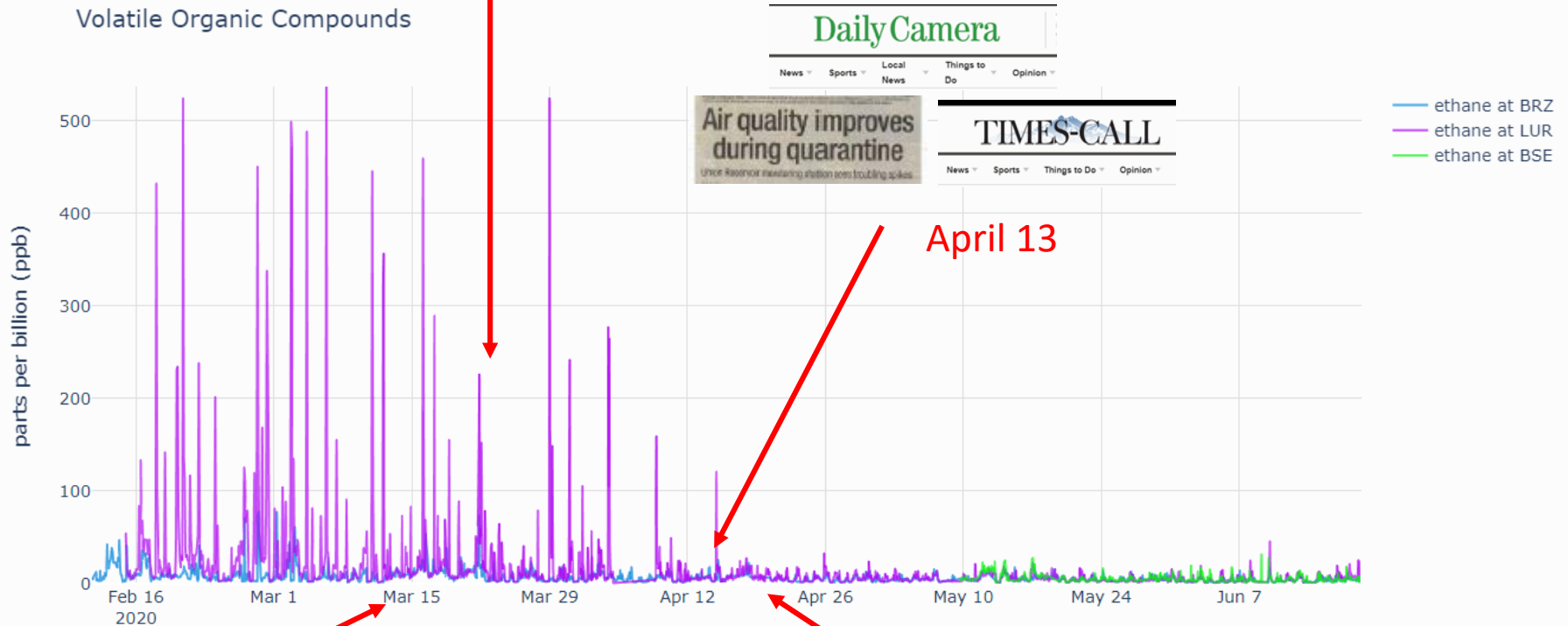
Chemical Measurements
Longmont Monitoring Station

Parameter	Unit	Value	Limit
PM ₁₀	µg/m ³	150	150
PM _{2.5}	µg/m ³	40	40
O ₃	ppb	100	100
CO	ppm	1.0	1.0
SO ₂	ppb	10	10
NO ₂	ppb	10	10
NO	ppb	10	10
HC	ppb	10	10

Monitored Sites
Longmont Monitoring Station

Parameter	Unit	Value	Limit
PM ₁₀	µg/m ³	150	150
PM _{2.5}	µg/m ³	40	40
O ₃	ppb	100	100
CO	ppm	1.0	1.0
SO ₂	ppb	10	10
NO ₂	ppb	10	10
NO	ppb	10	10
HC	ppb	10	10

Volatile Organic Compounds 

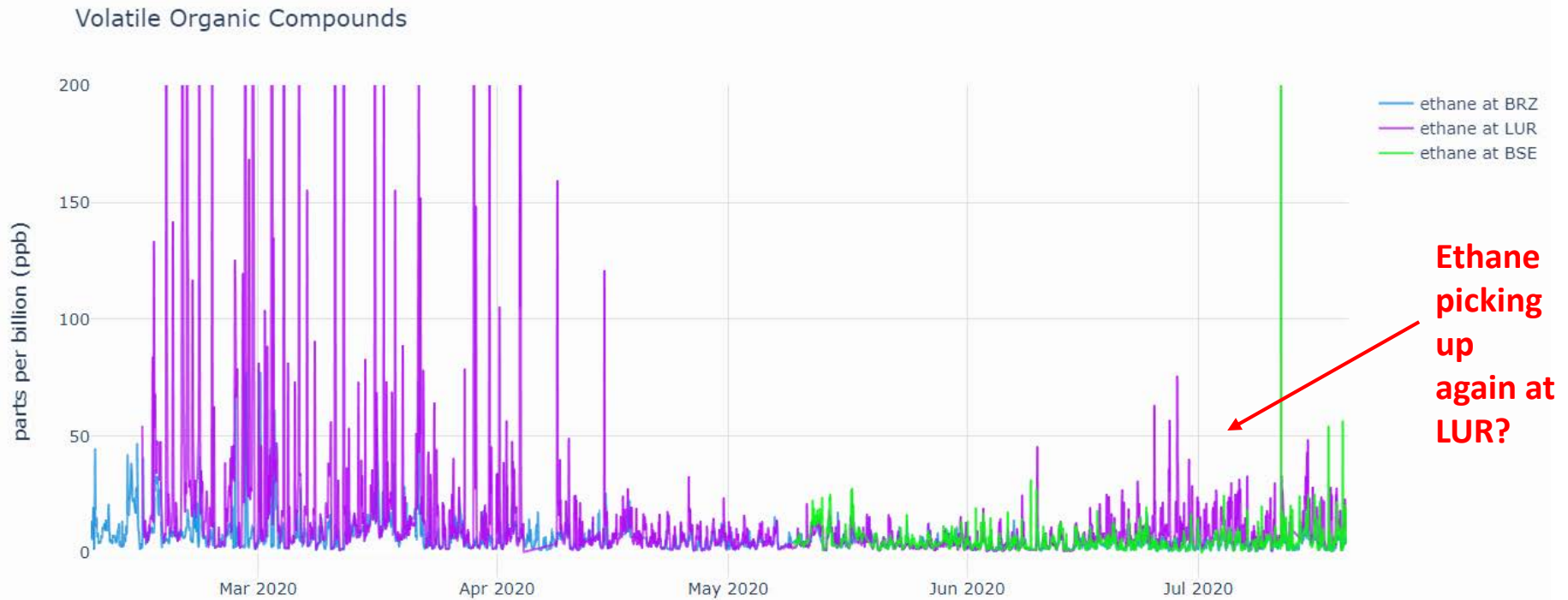


March 12



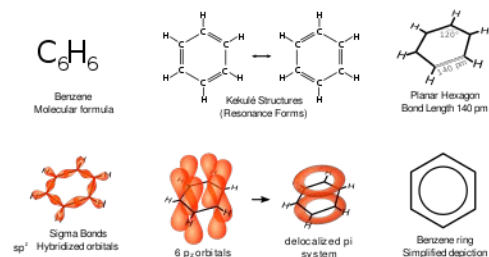
April 20

Data Examples and Interpretation – VOCs: Ethane



BRZ – Boulder Reservoir
LUR – Longmont Union Reservoir
BSE – Broomfield Soaring Eagle

Data Examples and Interpretation – VOCs: Benzene



Benzene Health Standards

9 ppb

1 ppb

0.94 ppb

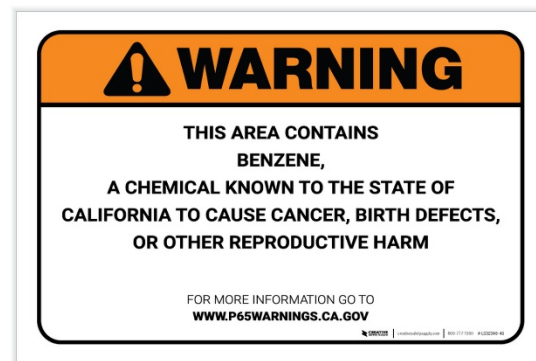
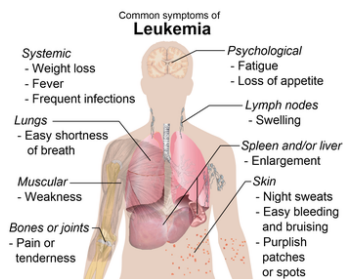
No safe limit

- EPA 24-hour standard

- CA continuous long term

- EPA 8-hour for schools etc.

- World Health Organization





A drilling site operated by Extraction Oil and Gas sits just 1,300 feet from Bella Romero Academy in Weld County. / Anthony Camera

Bella Romero Benzene Levels Worse Than Reported, Analysis Claims

CHASE WOODRUFF | MARCH 11, 2020 | 12:11PM

When Colorado air-quality regulators notified the public of an **elevated benzene reading near Greeley's Bella Romero Academy** last November, they emphasized that the state's air-monitoring equipment had only **detected a single violation** — one 45-minute sample that exceeded health standards out of more than 85 days of testing.



HOME COLAB COVID-19 GREENE BRIEGO LITTAIIN GUEST POSTS

Home > The local > Environment/Energy > Report: Diesel-exhausting benzene spiked more than once at Bella Romero

Report: Cancer-causing benzene spiked more than once at Bella Romero

The report, commissioned by the environmental group 350 Colorado, uses California's more stringent thresholds

By John Hennek | March 11, 2020

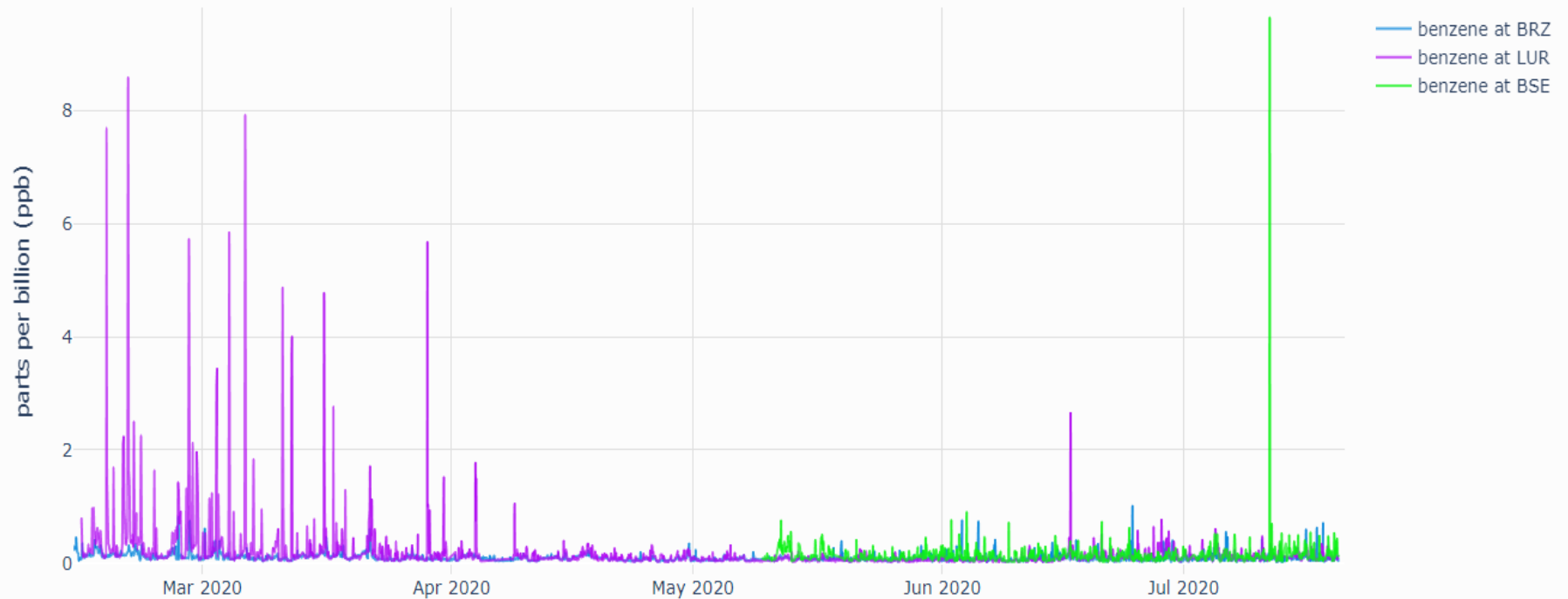


CDPHE Measurement:

One 45-min data value first reported at 10.2 ppb, later revised to 14.7 ppb (CDPHE, 2020)

Data Examples and Interpretation – Benzene

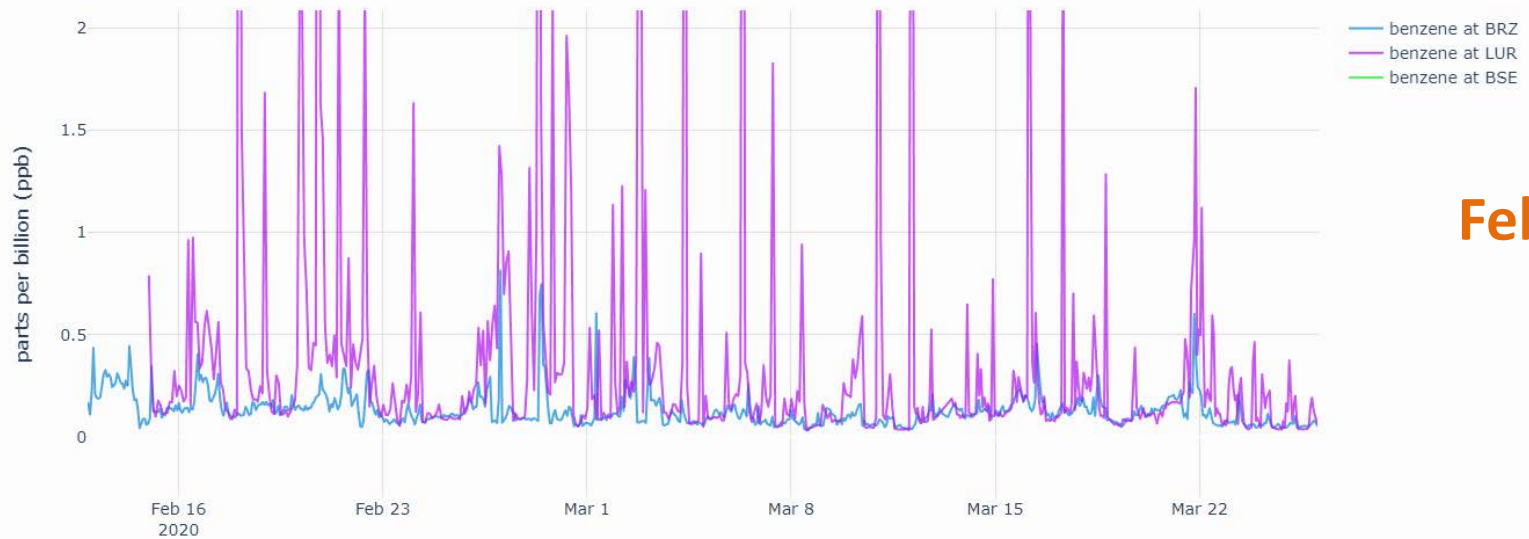
Benzene



BRZ – Boulder Reservoir
LUR – Longmont Union Reservoir
BSE – Broomfield Soaring Eagle

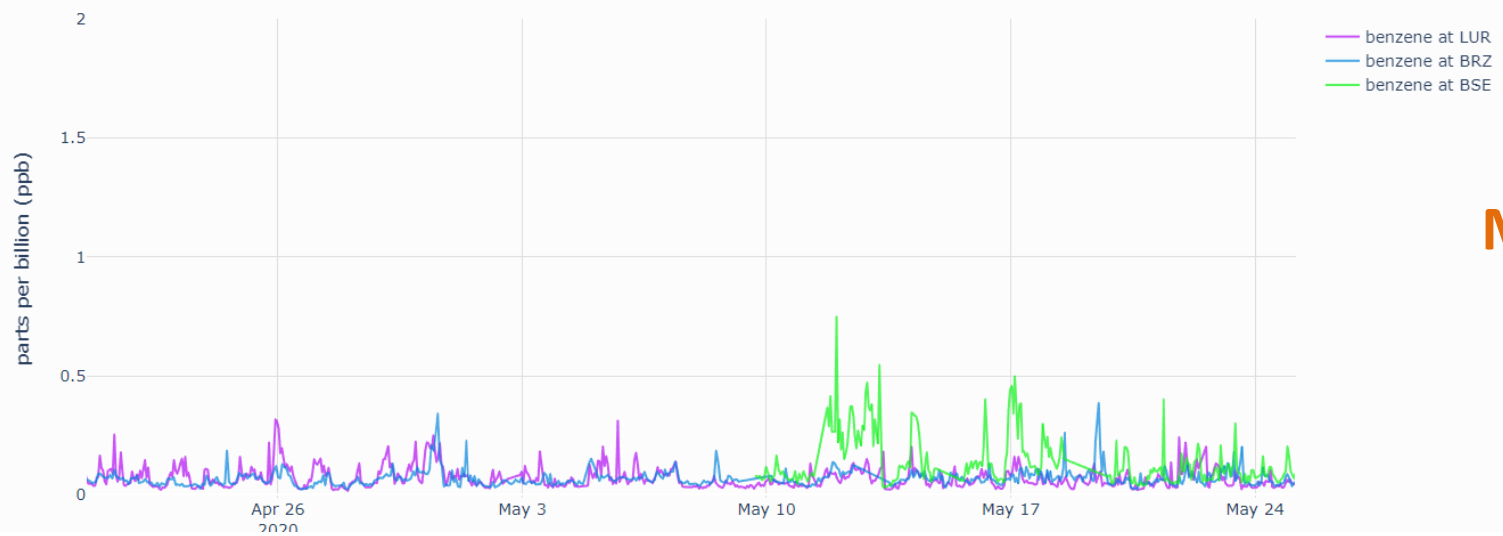
Benzene

Benzene



February

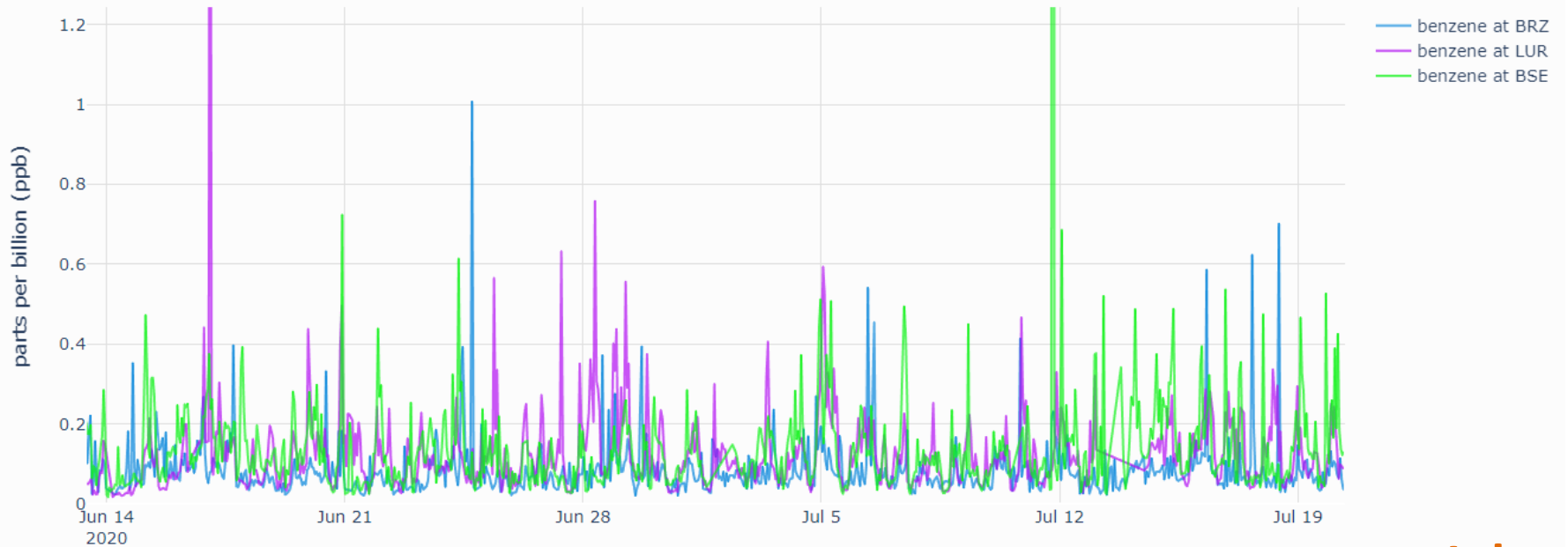
Benzene



May

Benzene

Benzene

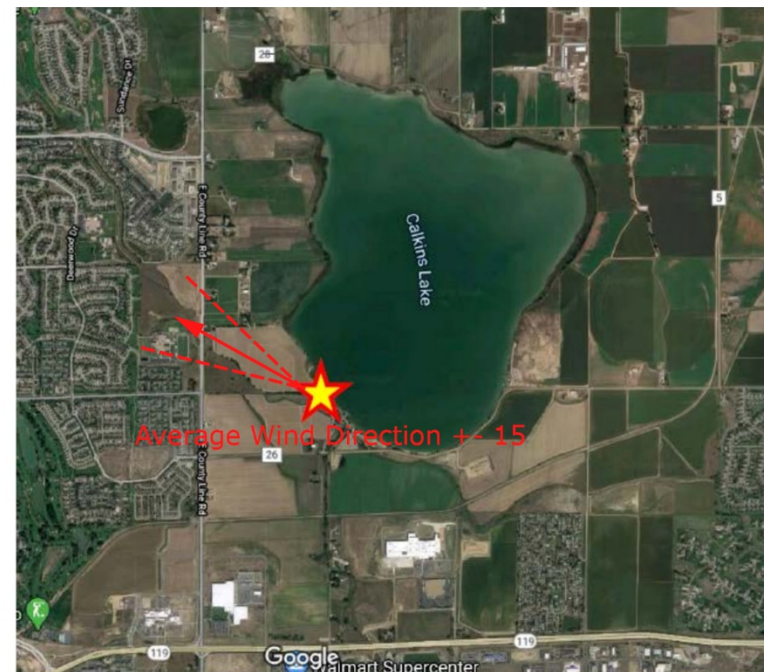
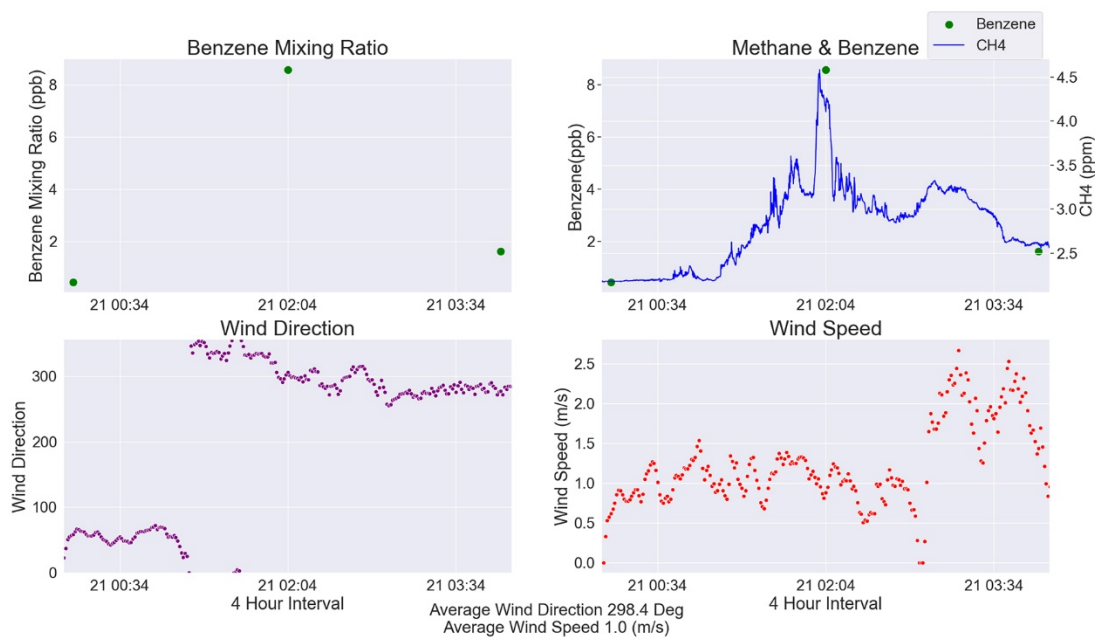


July

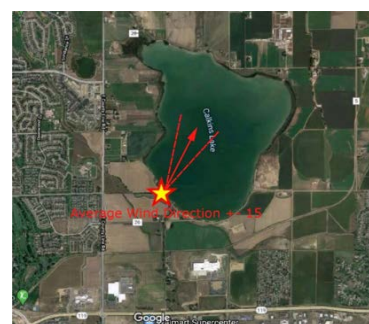
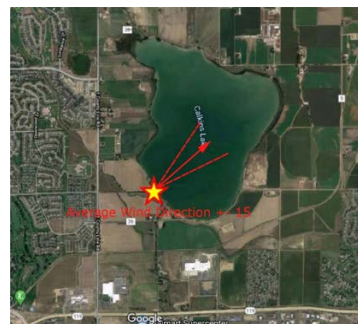
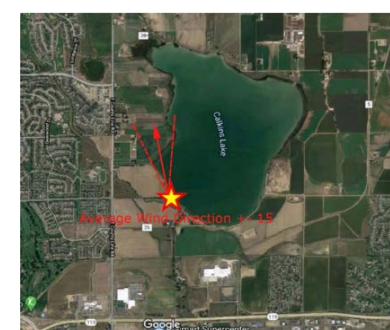
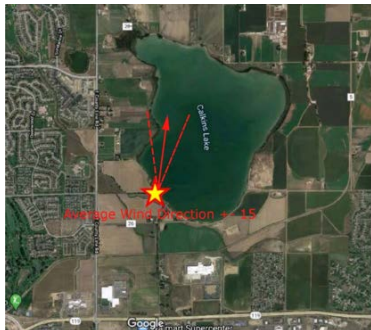
BRZ – Boulder Reservoir
LUR – Longmont Union Reservoir
BSE – Broomfield Soaring Eagle

Where is the Benzene coming from?

Benzene Peak #1



Approximate Wind Sector for ten highest Benzene Occurrences (~ 4 – 8 ppb)

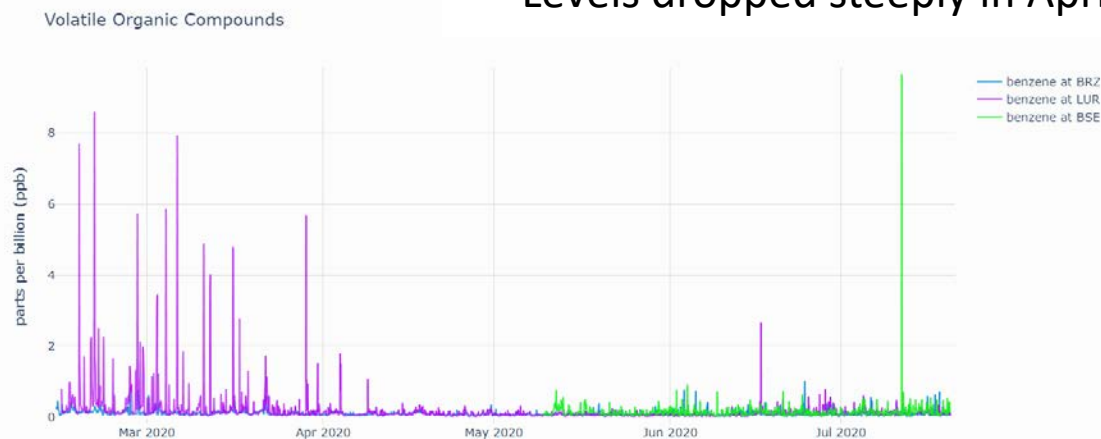


VOCs/Benzene Summary



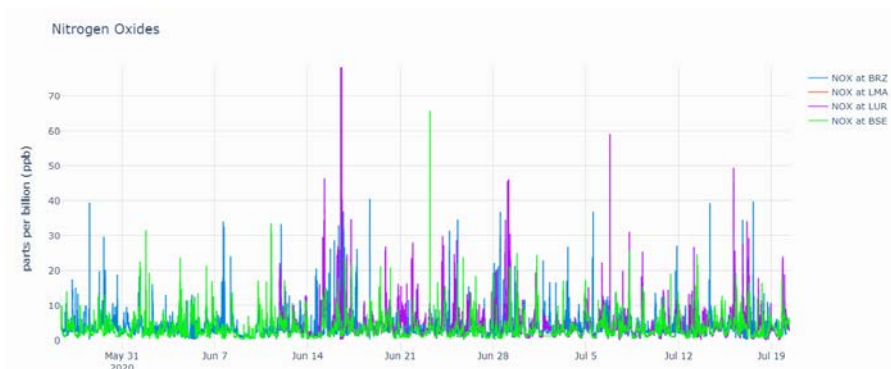
- Hourly VOCs/benzene measurements at LUR
- High abundance of elevated VOCs/benzene during February – March
- Many benzene observations between 1-10 ppb
- Much higher than at all other comparison sites (except one measurement at BSE)
- Elevated levels mostly associated with northwest to easterly winds
- Correlation of benzene with methane indicates oil and gas source
- Levels dropped steeply in April – May – June

VI

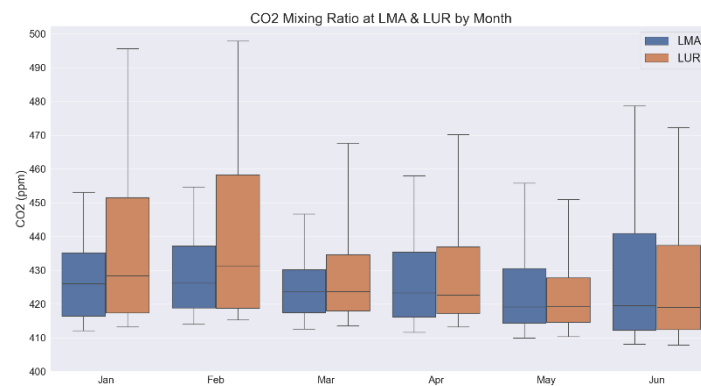


Other monitored variables not covered in today's presentation

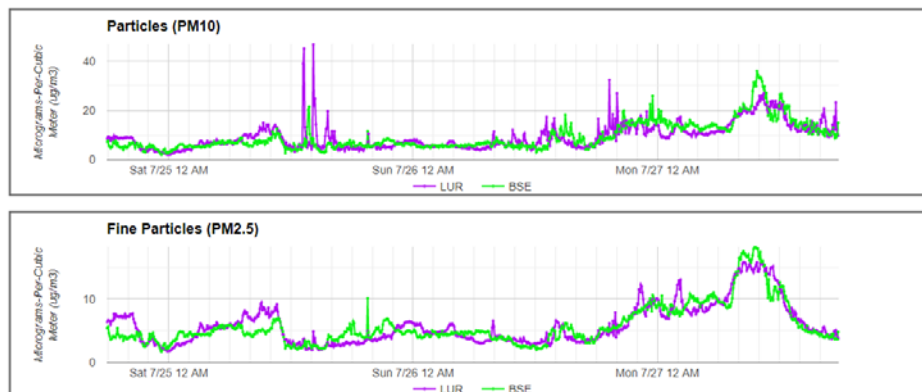
Nitrogen Oxides



CO₂



Particulate Matter



Year 1 Summary



- Completed installation of two monitoring sites

LMA

LUR

- All proposed measurements are up and running

LMA since September 2019

LUR since December 2019 – January 2020

- > 95% data coverage

- Public web portal became live in September 2019

- Developed two additional data analysis web portals

> 4000 Visits; increasing visit counts

- Stark differences in data between both sites

- High frequency of oil and gas related emissions at LUR

- Concentration spikes are relatively short

- Numerous high benzene occurrences, mostly during northerly winds

- Steep drop in concentrations of oil and gas emissions tracers throughout the spring

