Long-term air quality trends and an evaluation of VOC measurements in the District of Columbia

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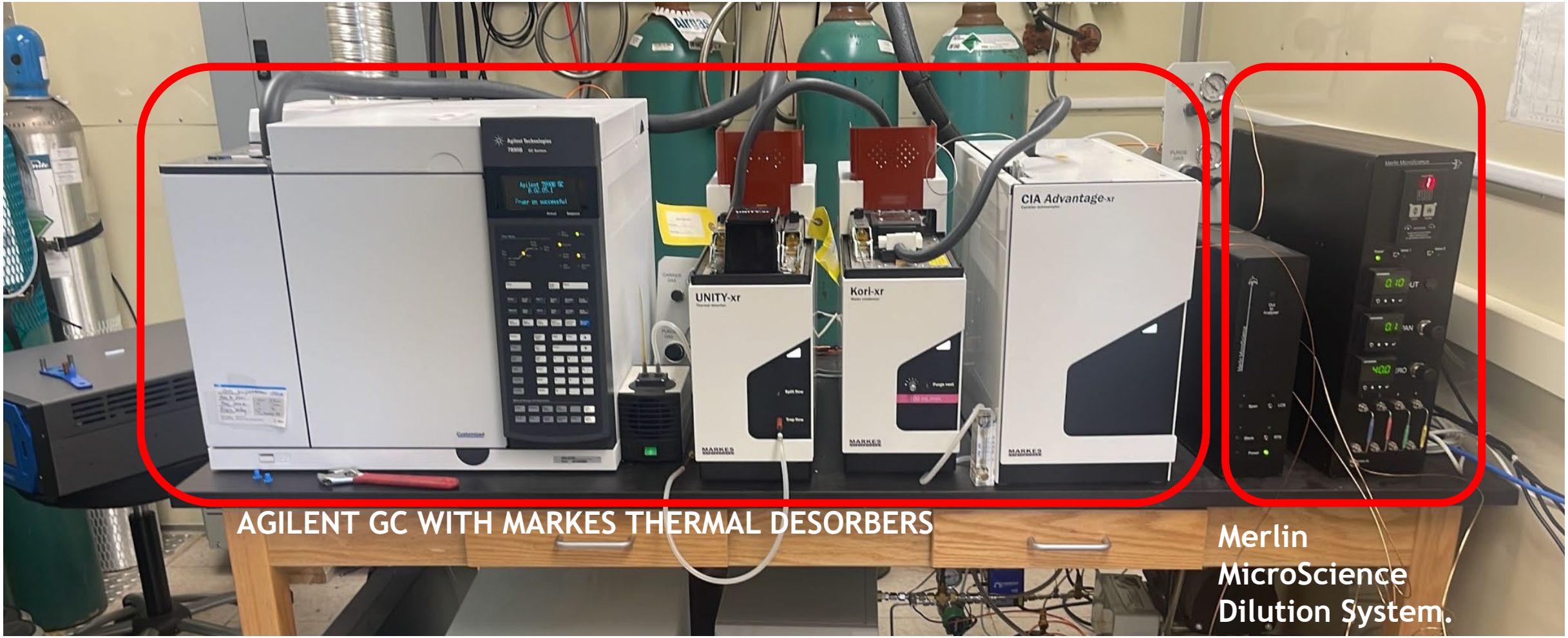
DEPARTMENT OF ENERGY & ENVIRONMENT

GOVERNMENT OF THE DISTRICT OF COLUMBIA
MURIEL BOWSER, MAYOR

DOEE PAMS Overview

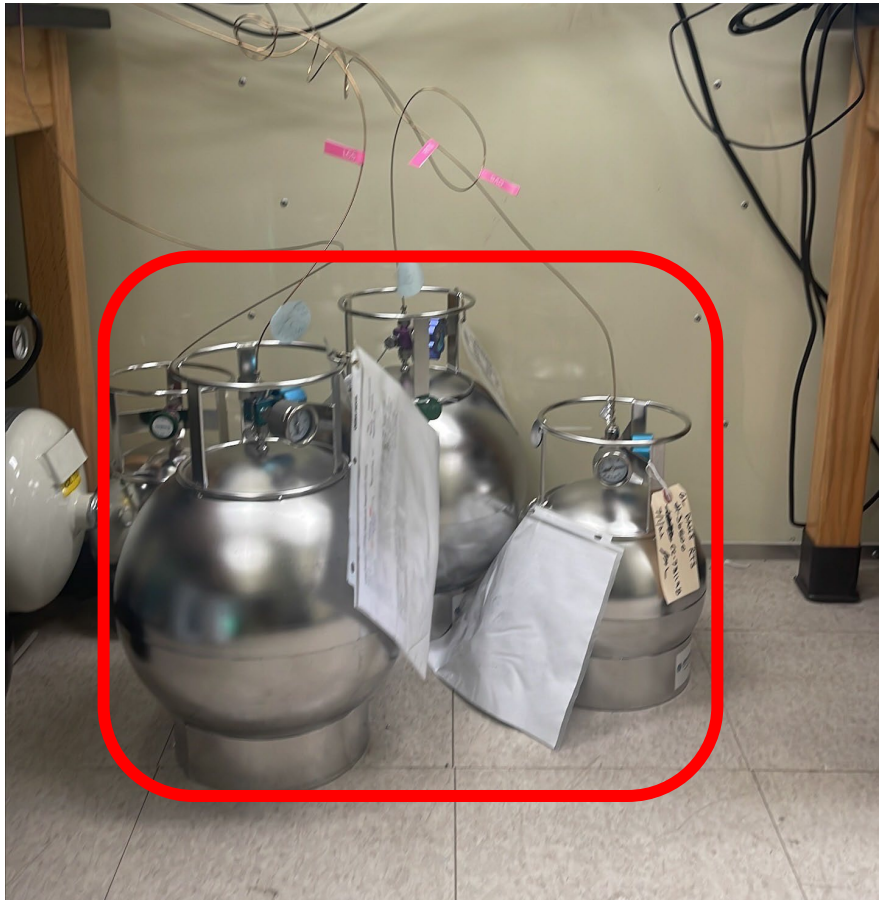
- PAMS program measurements run for April/May-September period with focus on June-August core ozone season
- PAMS re-engineering new equipment suite installed in April 2019 (ahead of EPA's earlier deadline of June 2019 which subsequently changed to June 2021)
- Continuous Monitoring
  - PAMS auto-GC requires constant monitoring to ensure quality data (daily calibrations/checks); DOEE recruited a contractor for O&M
  - Good performance of new Markes/Agilent auto-GC and better than average data retrievals since 2019 deployment
    - Minor issues in current ozone season (equipment starting to show normal deterioration due to continuous sampling, needed to change heated valves)
  - Also measures true NO2, NOy and O3
  - Hourly VOC data is uploaded to AirVision and Orsat MAX cloud database and preliminary data available within few hours, though not validated and corrected
  - Mixing height measurement and PAMS meteorology measurements
- Non-continuous Monitoring
  - Carbonyls sampling: three 8-hr samples on a one-in-three-day schedule

PAMS Markes/Agilent Auto-GC



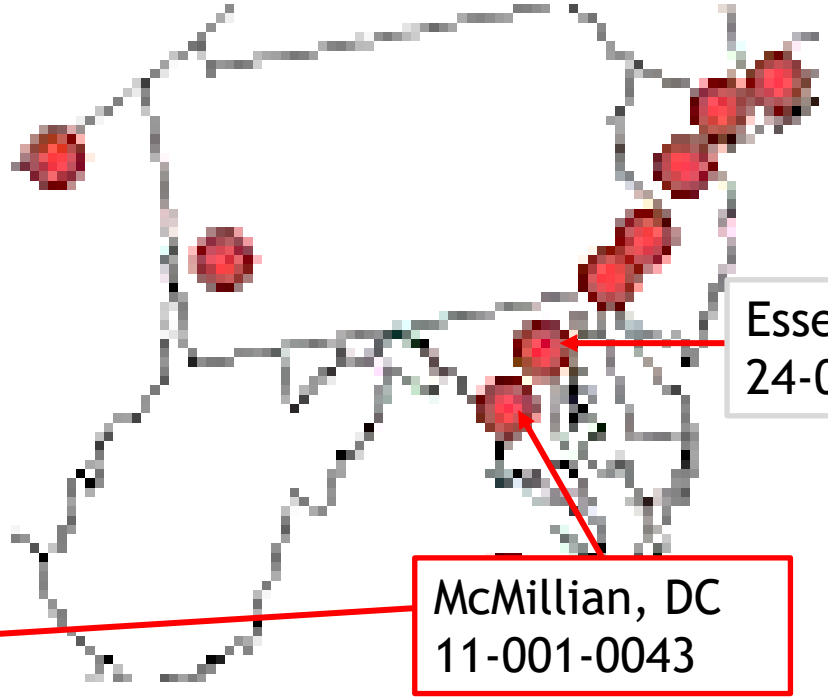
PAMS Equipment…

Real-time read out from Orsat software



Calibration gas canisters

DC's PAMS Station - McMillan Reservoir



Essex, MD
24-005-3001

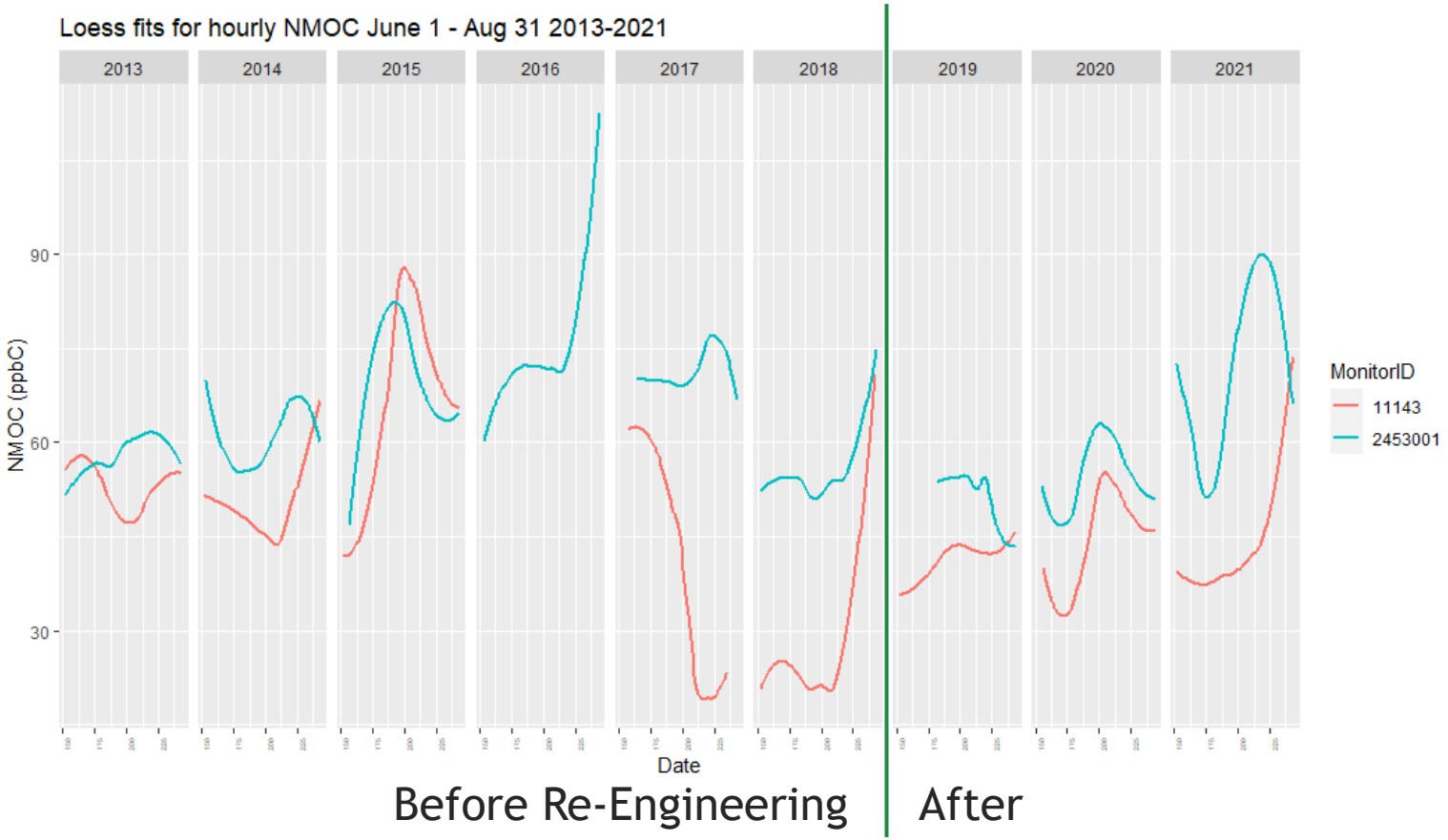
McMillian, DC
11-001-0043

Comparison of nearby PAMS: Essex, MD vs. McMillan

Essex in Baltimore metro area reads higher than McMillan but follows similar patterns for the most part.

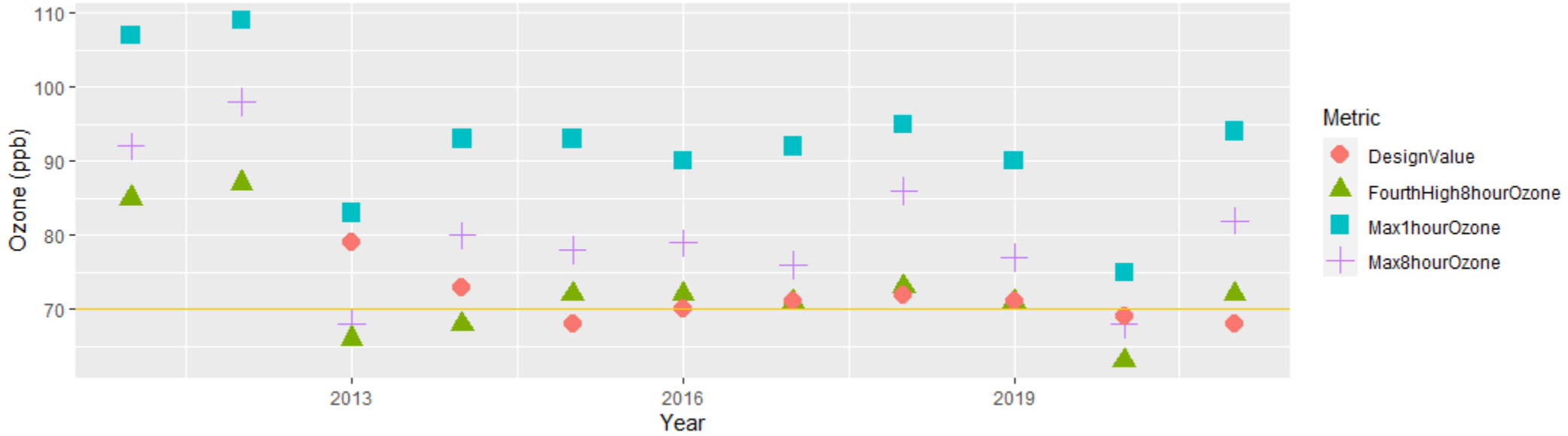
McMillan did not report 2016 to AQS.

Mid-2017 through mid-2018 saw a substantial difference in the monitors, this was likely due to malfunctioning equipment.



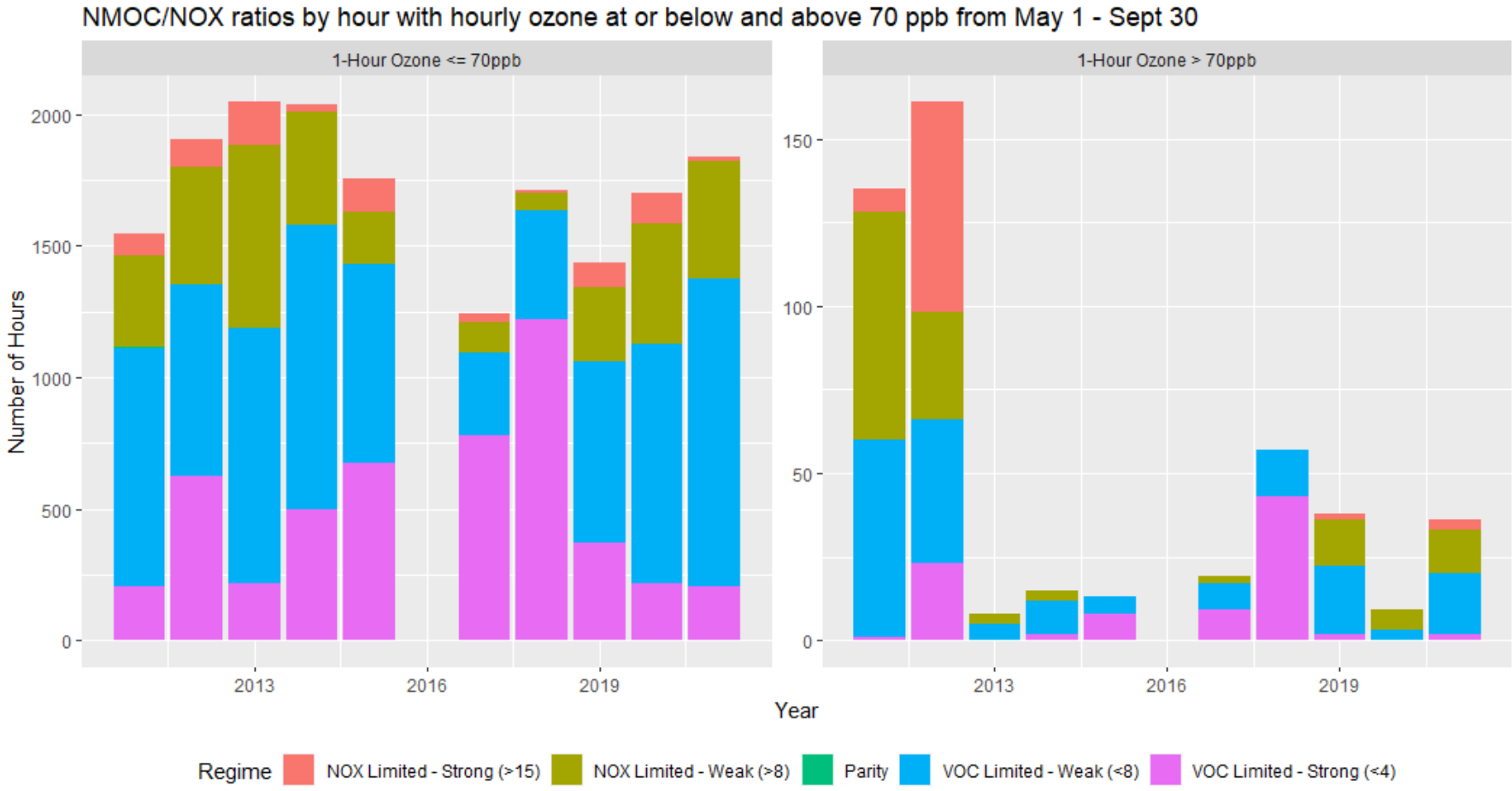
Ozone NAAQS

- McMillan is the lead ozone monitor in the District
- While not accepted by EPA as an exceptional event, 2020 was abnormally low
- Besides 2020, 4th highest ozone levels remain above 70 ppb and are a focus of analysis

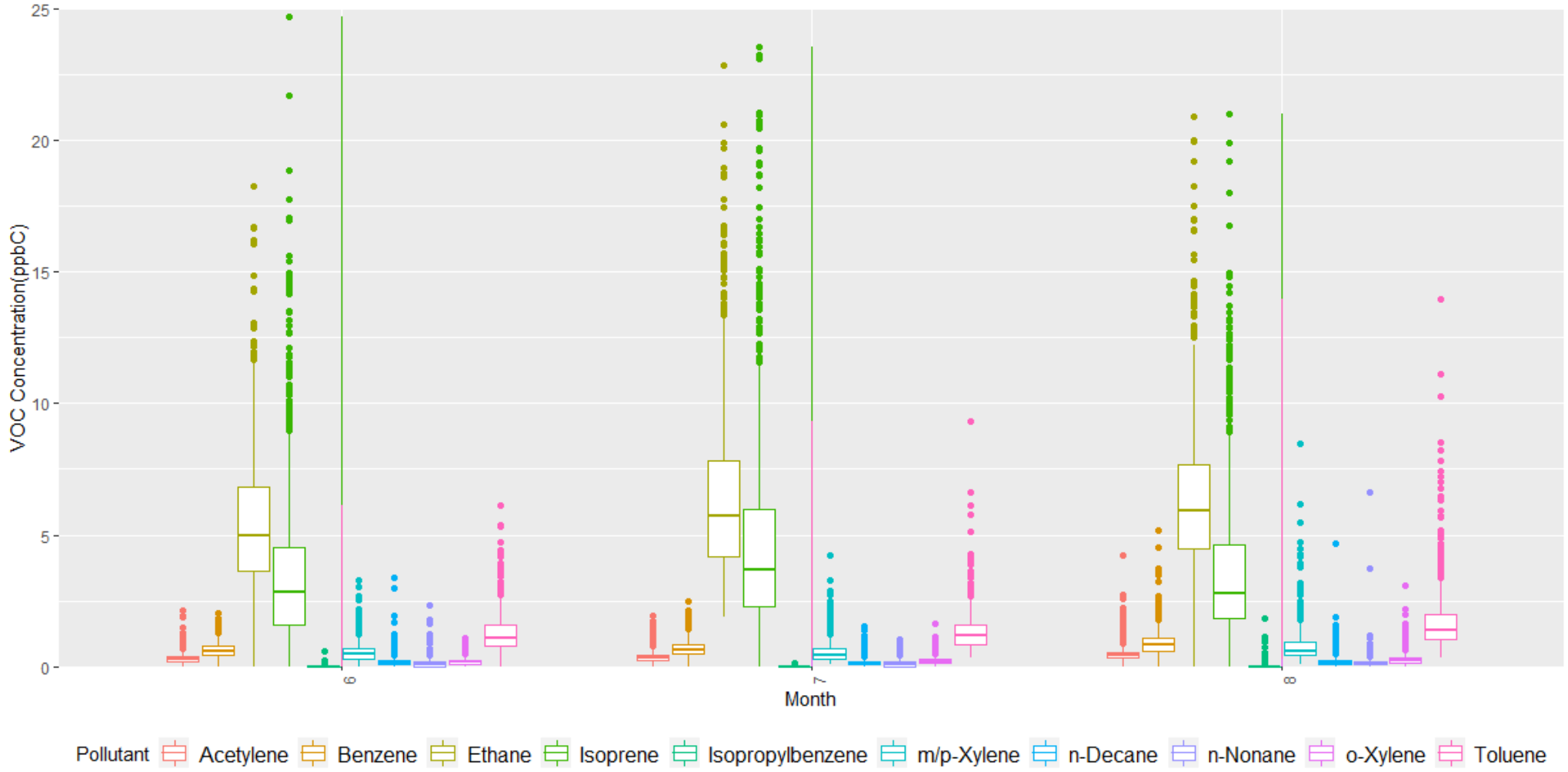


Ozone Production Regime

- Drop in number of hours with high ozone corresponds with drop in the percent of NOX limited days.
- Ozone below 70 ppb more often than not VOC limited.
- Results caveat:
  - 2016 are missing
  - 2017 and 2018 questionable due to operational issues



Hourly Concentrations of 10 VOCs from 8AM-8PM from 2019-2021 at McMillan Reservoir

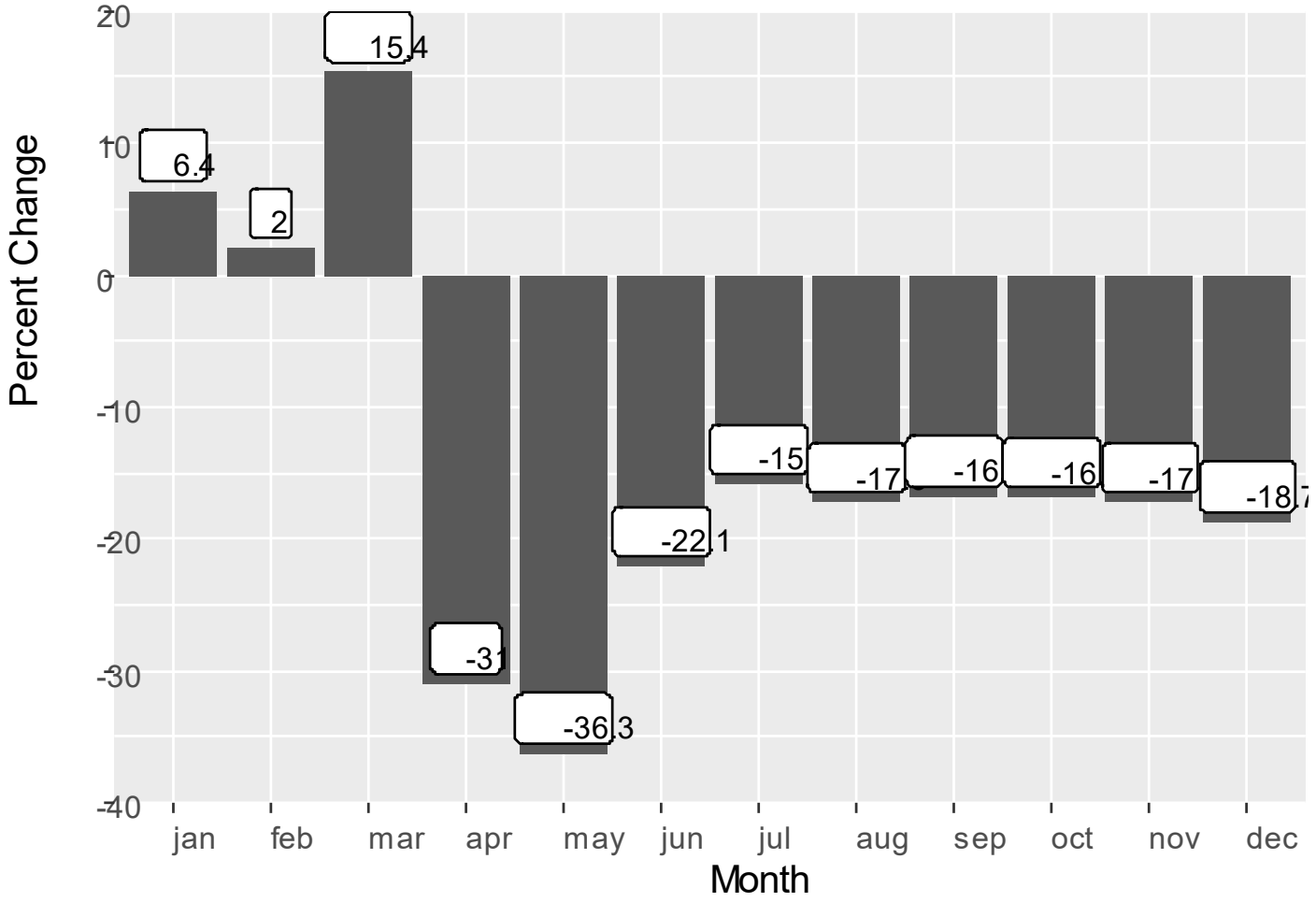


*Concentrations greater than 25 ppbC not shown

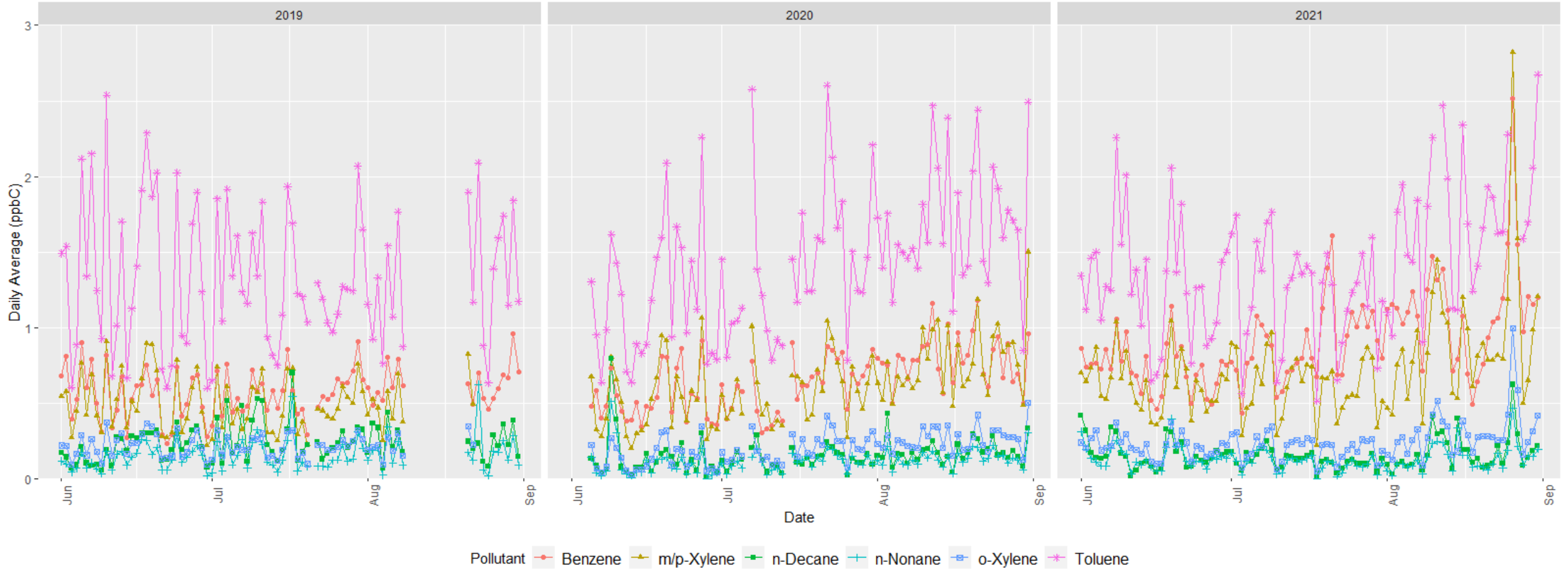
Monthly Change in VMT from 2019 to 2020 (FHWA)

District wide 2020 saw decreases in VMT starting in April with a more consistent reduction during the summer.

Reduction largely in light-duty vehicle travel due to Covid-19.

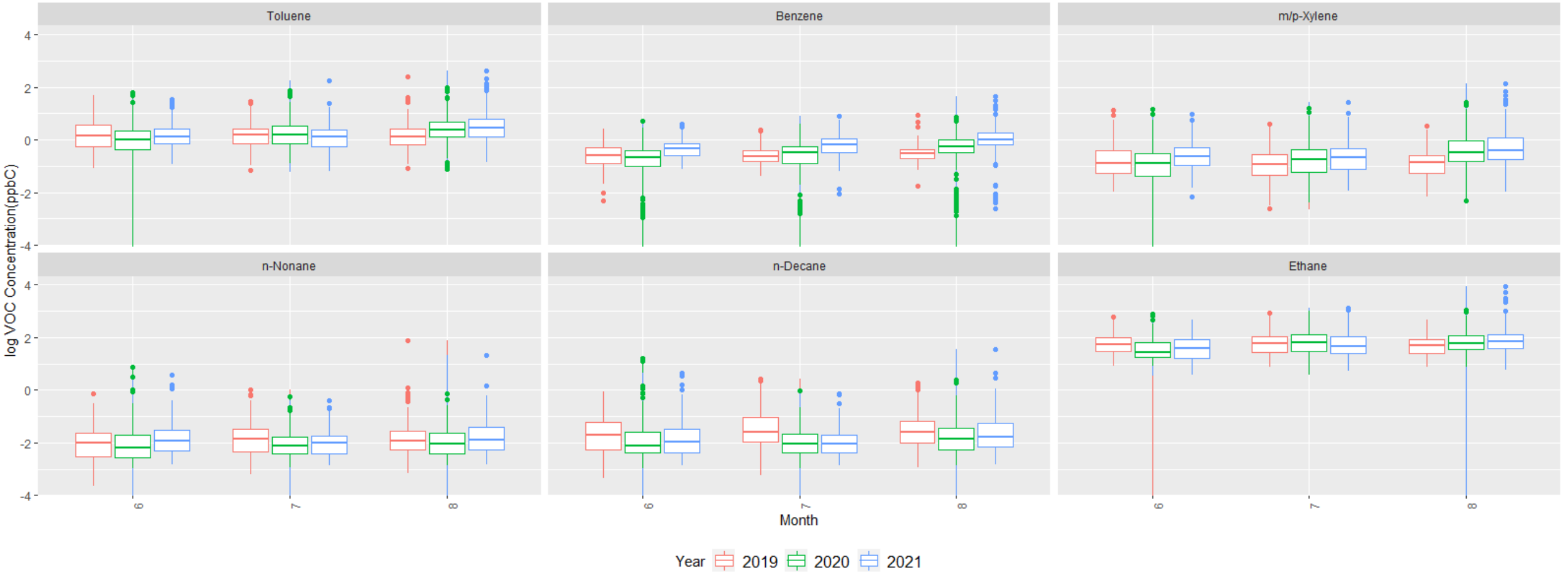


Daily average concentrations (ppbC) for 6 VOCs from 2019-2021 (June-August)

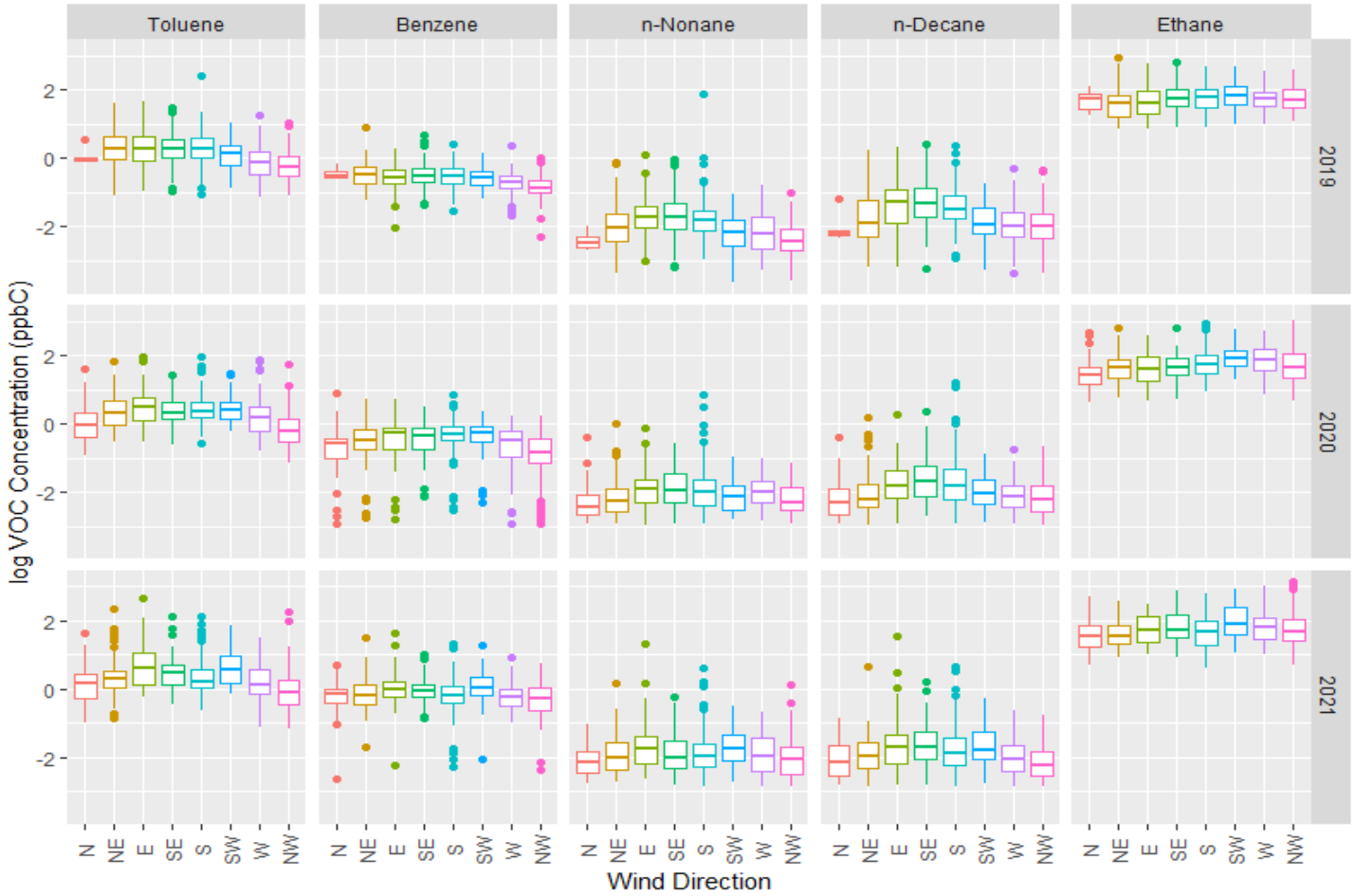


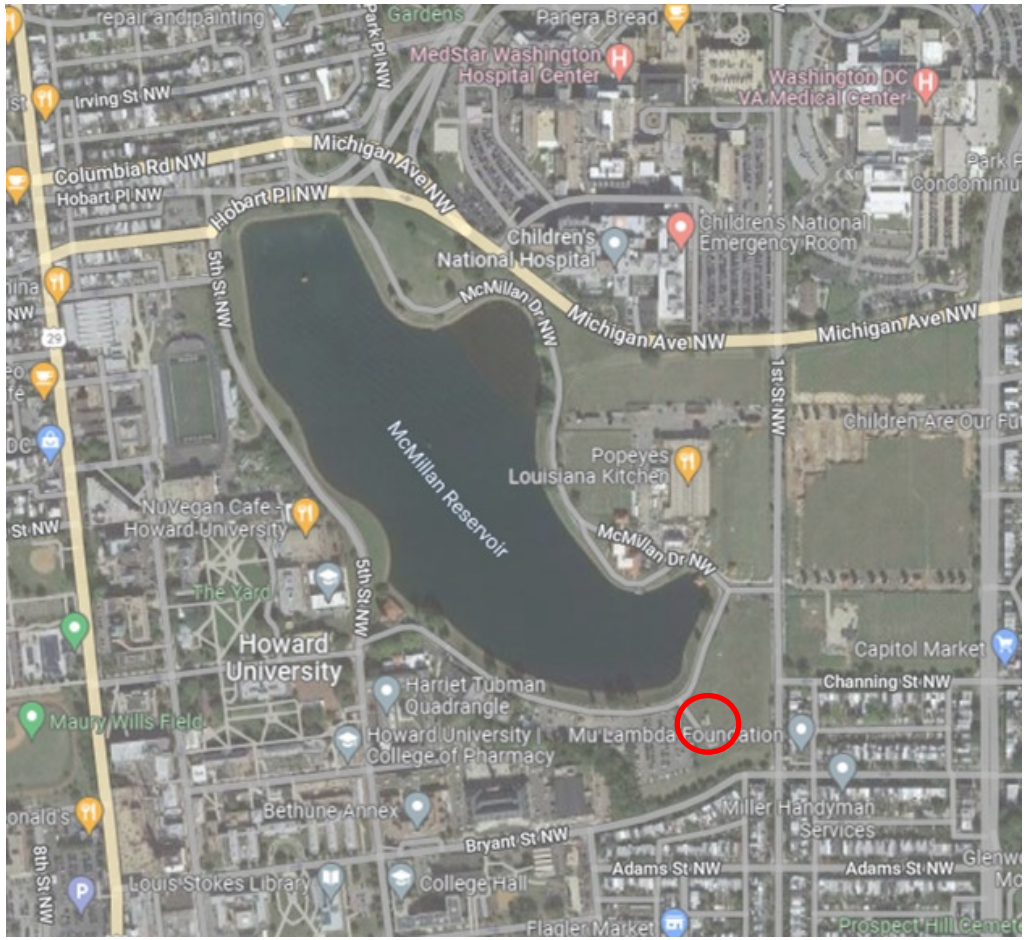
*Concentrations greater than 3 ppbC not shown

Concentrations by month (log ppbC) for 6 VOCs from 2019-2021 from 8AM-8PM at McMillan Reservoir



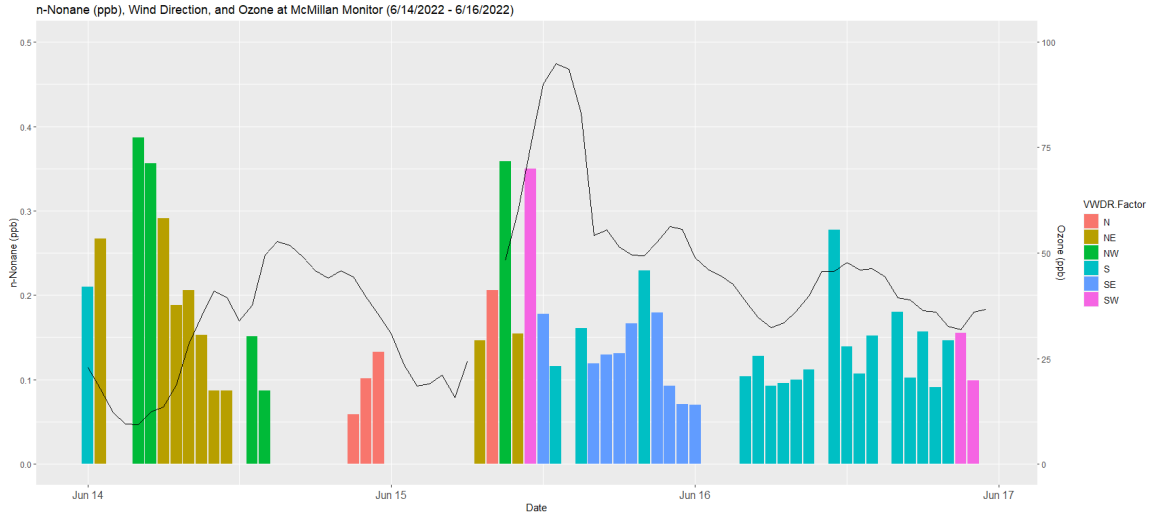
Concentrations (log ppbC) for 6 VOCs from 2019-2021 from 8AM-8PM at McMillan Reservoir broken out by wind direction

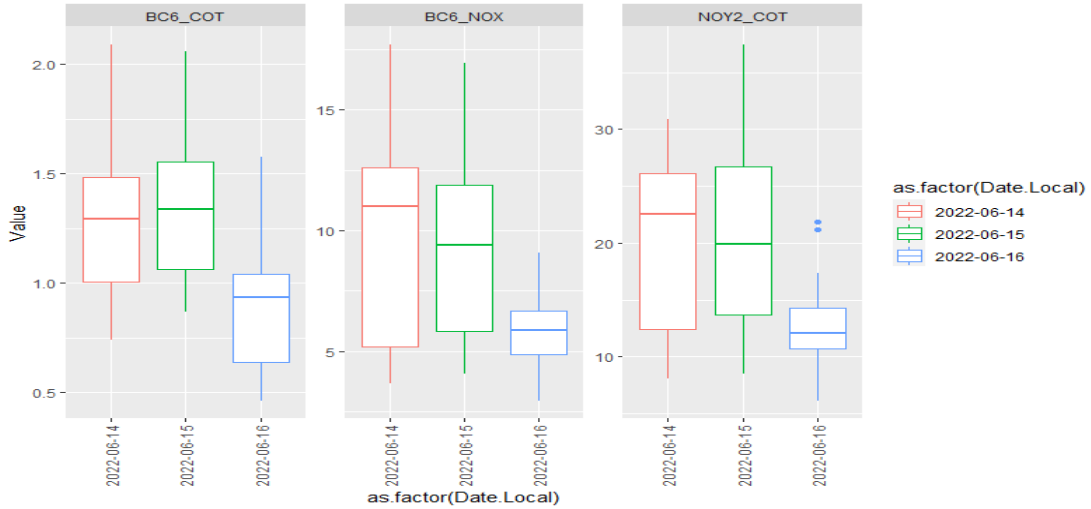


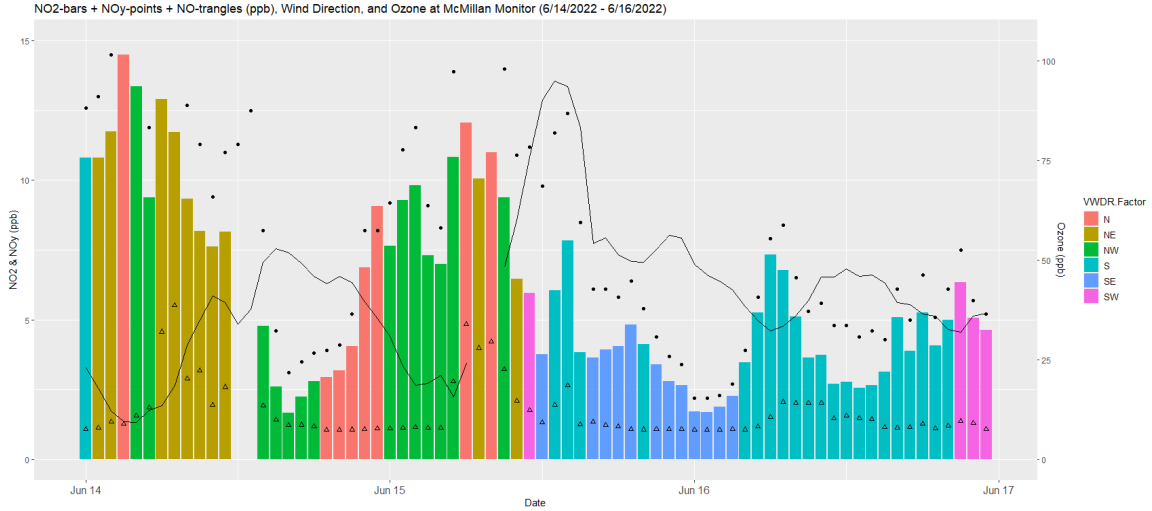


Example June 15, 2022 Ozone Exceedance

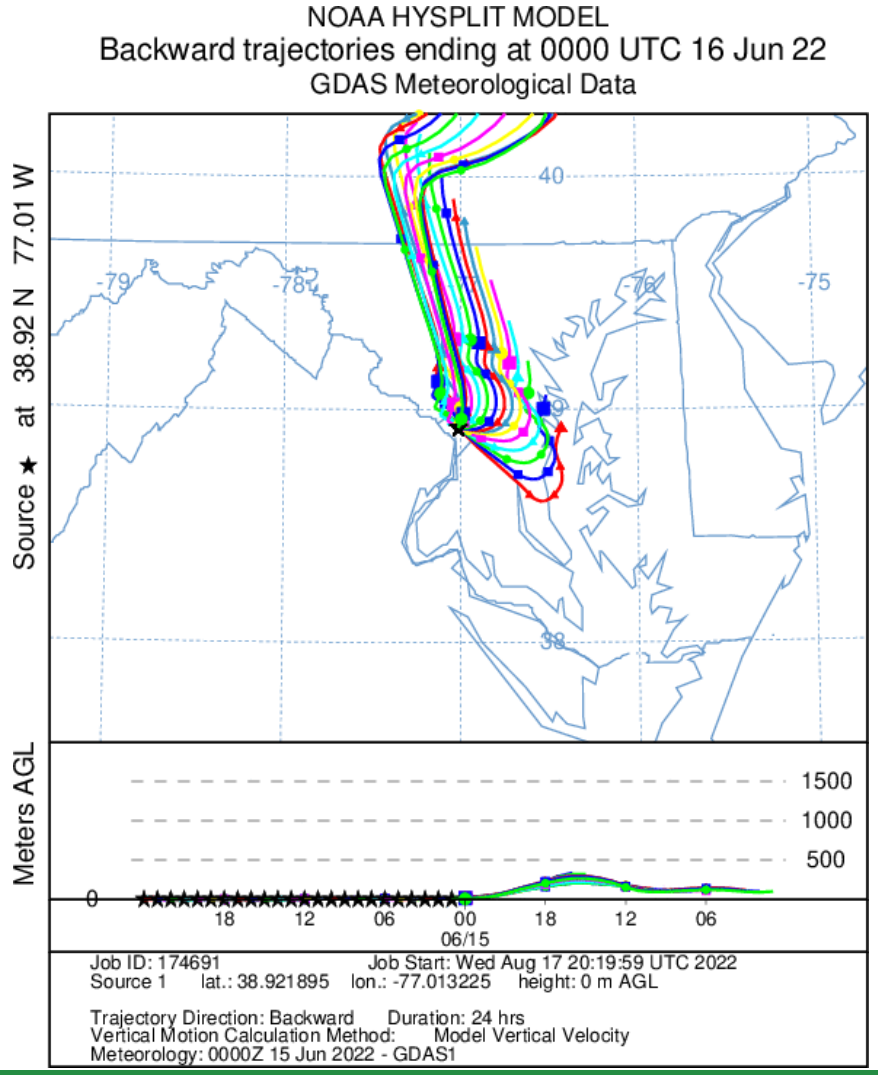
- June 15, 2022, was an isolated ozone exceedance, no other high levels experienced in the Washington area nor Baltimore or up the I-95 corridor
- Examined PAMS, Black Carbon, and Criteria together for a picture of ozone exceedances
- This is just one example, photochemical source apportionment modeling points to different causes of exceedances on different days

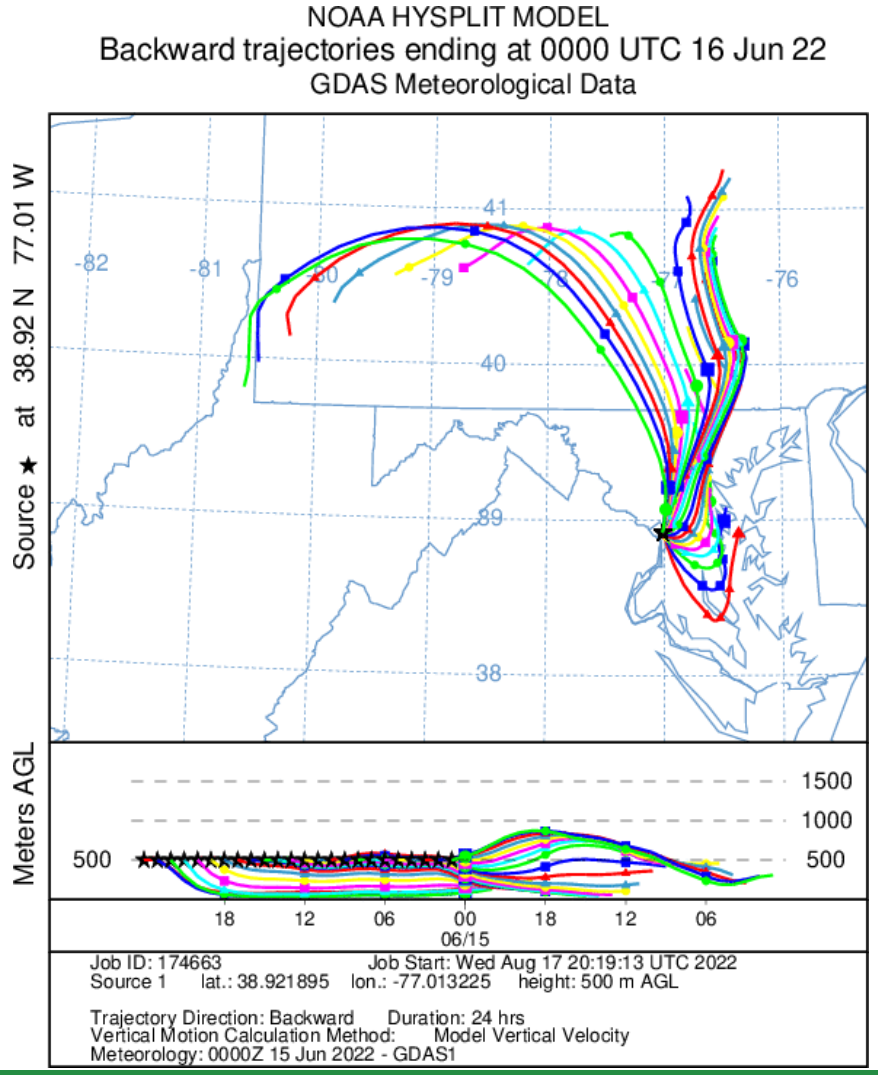




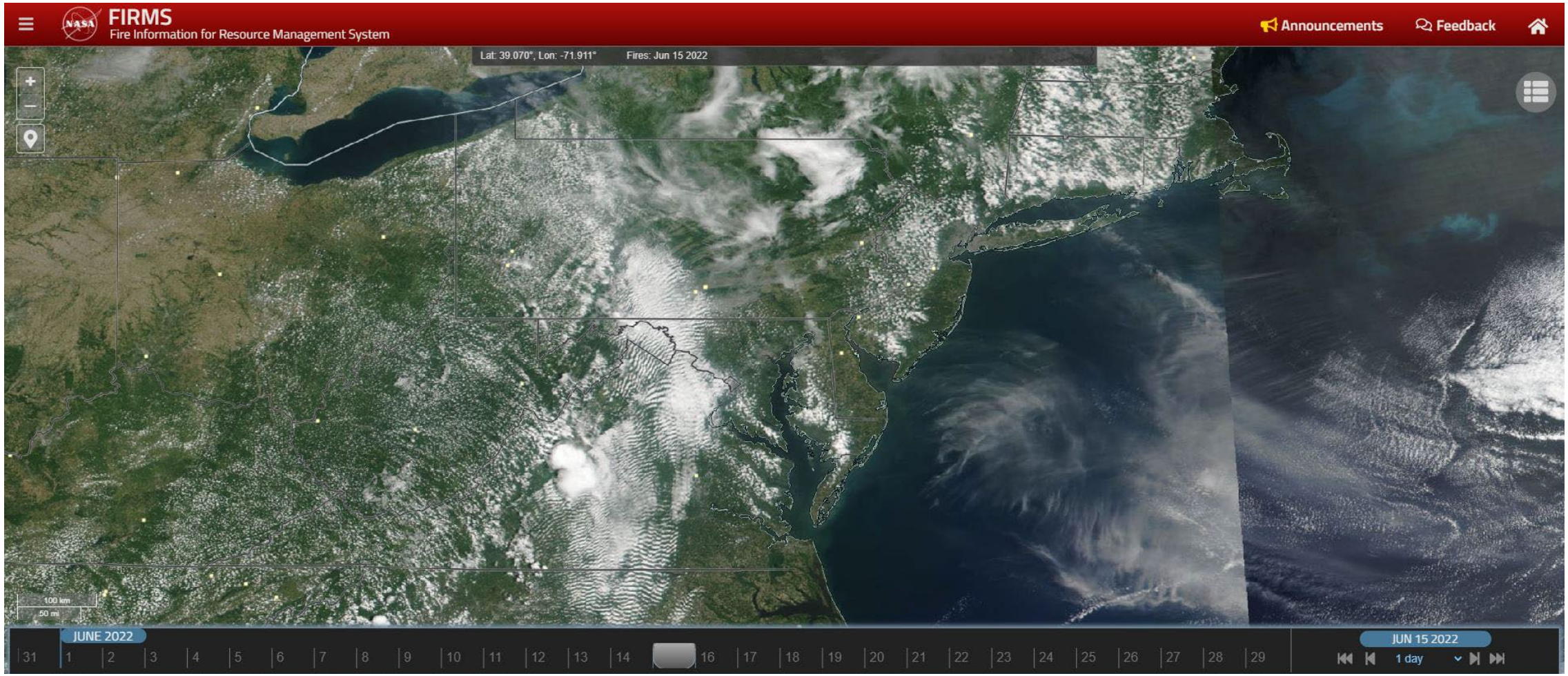


24-hour Back Trajectories for McMillan Reservoir on June 15, 2022 at 0 and 500 m





Fire Information for Resource Management System



VIIRS S-NPP Corrected Reflectance (true color) – June 15, 2022

Future Work

- Analysis
  - Look more closely at other recent ozone events
  - Consider looking at PBL and NOX columns
  - Compare ozone events to non-ozone events with similar meteorology
  - More research into source of ethane
  - Examine the concentrations in regards to SAPRC ozone reactivity
- Policy
  - Develop stronger VOC regulations

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Questions?

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