Changes in air pollution from the COVID-19 lockdown as revealed from TRAX-based monitoring

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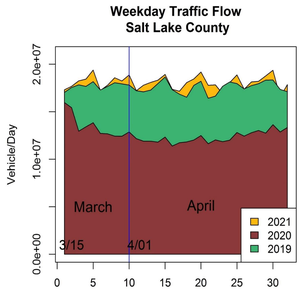
1. Introduction

- Project

The TRAX-based air quality project leverages public transit operations to obtain spatial and temporal measurements of air pollutants across the Salt Lake Valley and has been successfully operating since late 2014.



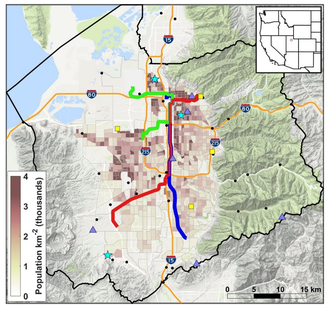
- COVID-19

We are assessing COVID-19 lockdown resulted in severe economic impact but also produced a reduction in road and non-road traffic and diminished factory production in 2020. The assessment was comparing concentrations using statistical and special analysis. We will present the air quality observations during 2019/2020/2021 spring for carbon dioxide (CO_2), methane (CH_4), particle matter ($PM_{2.5}$), nitrogen dioxide (NO_2), and ozone (O_3).

2. Experimental Setup

Operates on the Utah Transit Authority (UTA) TRAX light rail system:

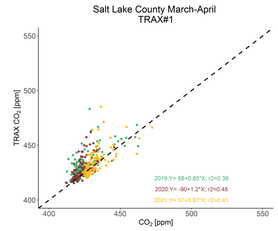
- Red Line: traverses the entire Salt Lake Valley (northeast to southwest, including a symmetric elevation profile). Passes by the Univ. of Utah, through downtown, and out to the far margin of the city.
- Green Line: runs from the SLC airport to West Valley with two legs perpendicular to the dominant north-south transport providing plume characterization opportunities.
- Blue Line: goes across the Salt Lake Valley (north to south) from downtown SLC to Draper Town Center.

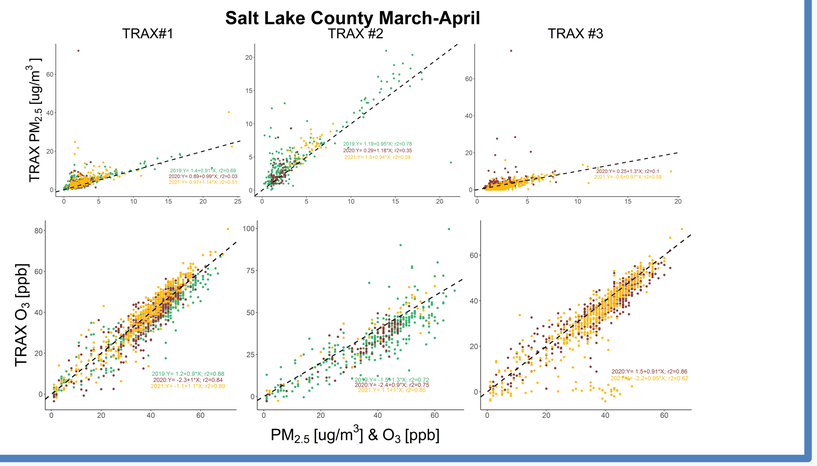


- Measures CO_2, CH_4, $PM_{2.5}$, and O_3, Dec 2014 to present. Currently, mobile deployments include three TRAX cars.
- Sensors and sampling on the roof, ~4m above ground.

3. Mobile-Stationary comparison

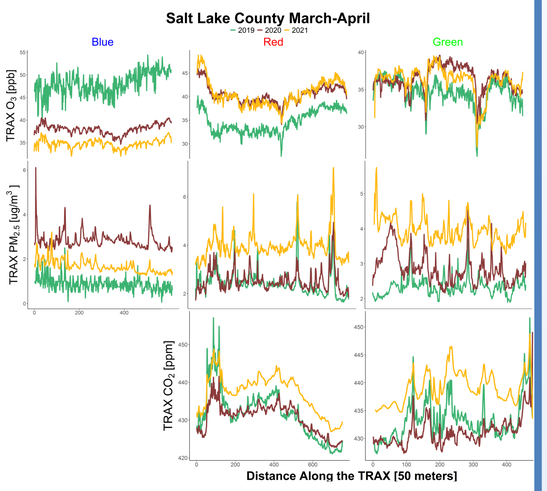
- Reference for O_3 and $PM_{2.5}$ is the Hawthorne air monitoring station, RAIL1 for $PM_{2.5}$,and the reference for CO_2 is the instrument on the roof of the Department of Atmospheric Sciences, University of Utah.
- High R^2 with O_3 TRAX sensor and the reference in TRAX#1, TRAX#2, and TRAX#3.
- $PM_{2.5}$ TRAX sensors R^2 in 2021 range 0.5-0.59 and in 2019 0.69-0.78 for TRAX#1, TRAX#2, and TRAX#3. R^2 in 2020 range 0.03-0.45.
- The R^2 for CO_2 from TRAX#1 and University of Utah sensor is between 0.39 and 0.48.



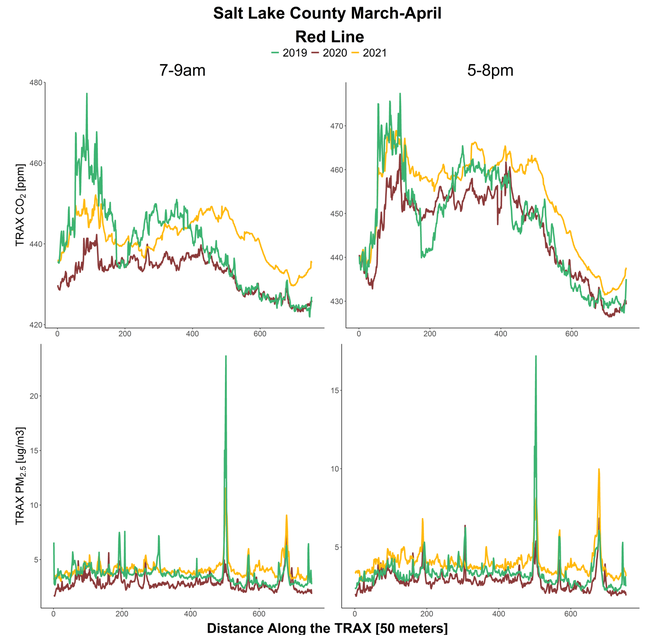


4. Preliminary Results by Location

- Red and green lines lower O_3 concentrations in 2019. Similar concentrations in 2020 and 2021. In the blue line highest O_3 concentrations are in 2019.
- Red and green line highest $PM_{2.5}$ concentrations in 2021. Similar concentrations in 2019 and 2020. In the blue line the highest concentrations, surprisingly, are in 2020.
- Meteorological conditions should be included in the analysis.
- Red and green lines lower CO_2 concentrations in 2019 and 2020. Highest concentration in 2021 for the red and green lines.



5. Preliminary Results by Hour



6. Conclusions & Future Directions

- Traffic flow reduction in 2020 compared to 2019 and 2021 in Salt Lake County.
- The lockdown (2020) might cause an O_3 increase. Here, in red and green lines the O_3 increased from 2019 to 2020. This has been observed in other cities in Europe and China.
- The traffic flow reduction is not appreciated, clearly, in the $PM_{2.5}$ concentrations during lockdown compared to 2019 and 2021.
- The CO_2 concentration during lockdown is lower than in 2019 and 2020. However, the local level might not represent a change in the trend of global CO_2 and its impact on climate change.
- During rush hour traffic $PM_{2.5}$ and CO_2 concentrations are lower in 2020 compared to 2019 and 2021.

7. Salt Lake Measurement Programs

(a) TRAX light rail network (http://utahaq.chpc.utah.edu/)
(b) Urban CO_2 network (https://air.utah.edu/)
(c) MesoWest (http://mesowest.utah.edu/)
(d) Utah Div. of Environmental Quality (http://air.utah.gov/)

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Real Time TRAX Data: