Large Area Emission Survey, Result Summary

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August 16 2021

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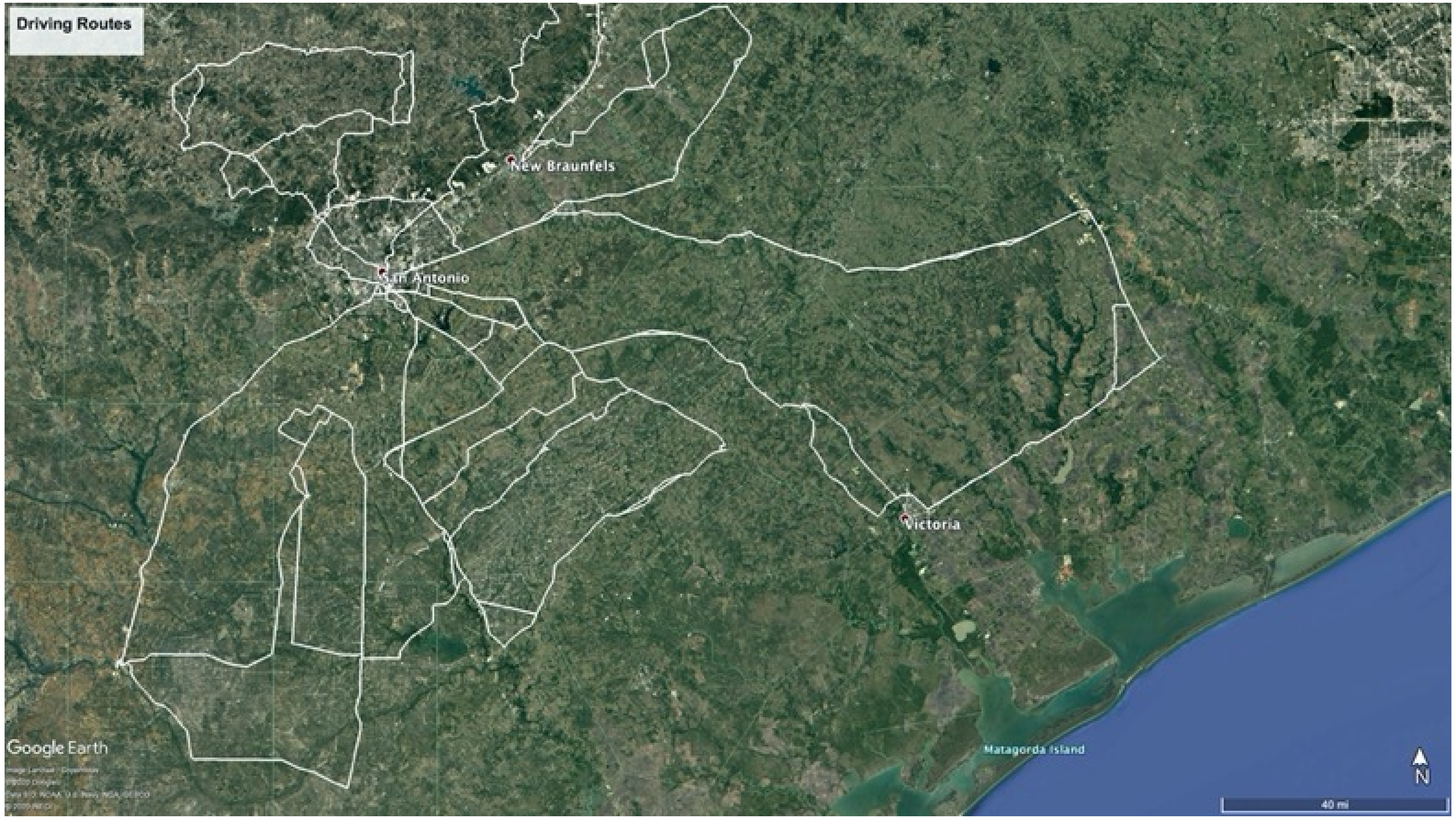
Outline

- Project Summary
- Methodology
- Key Findings
  - Source Attribution
  - Flux Estimation



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Project Goals

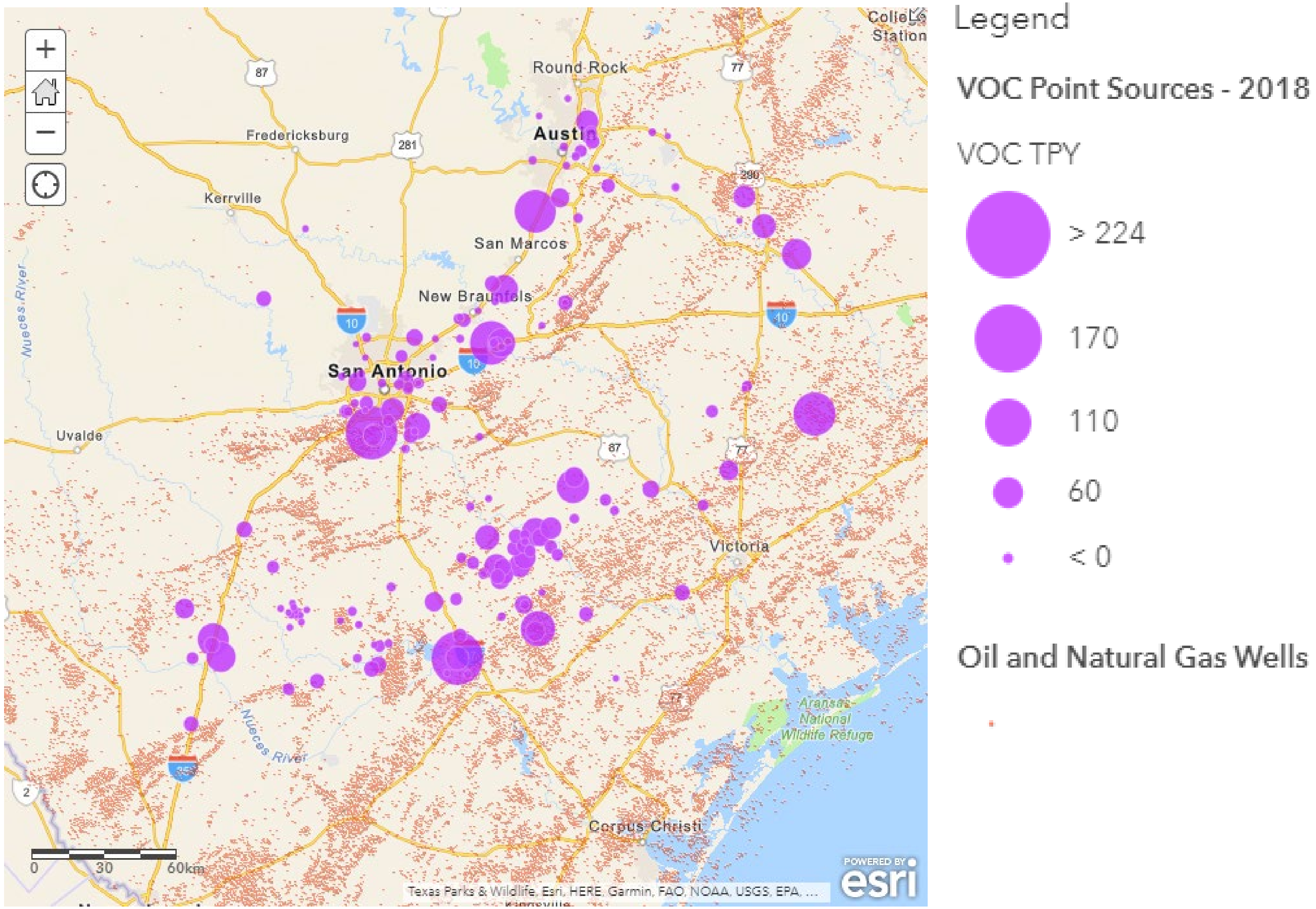
- The goal of this study is to add measurement data to assist in the determination of outside influences on the formation of Ozone within Bexar County
- Identify if any regions are increased emitters
- Evaluate the region NW of Bexar county for possible source of enhanced emissions

Project Summary

- Data was collected in the regions adjacent to Bexar County over the course of 10 days on the road.
- VOC and NOx data was collected primarily in the morning and evening
- Routes were selected to collect data transverse to wind current wind conditions
- Data was analyzed to identify local concentrations, most likely source types, and to generate flux estimates of measured compounds.

Route Selection Source Inventory

VOC sources for consideration in route planning are VOC point sources (as identified by the Point Source Emissions Inventory in 2018[1]), oil and natural gas wells[2]. These are clustered to the south, southeast, and northeast of San Antonio.



Meteorological and Back Transport Sources

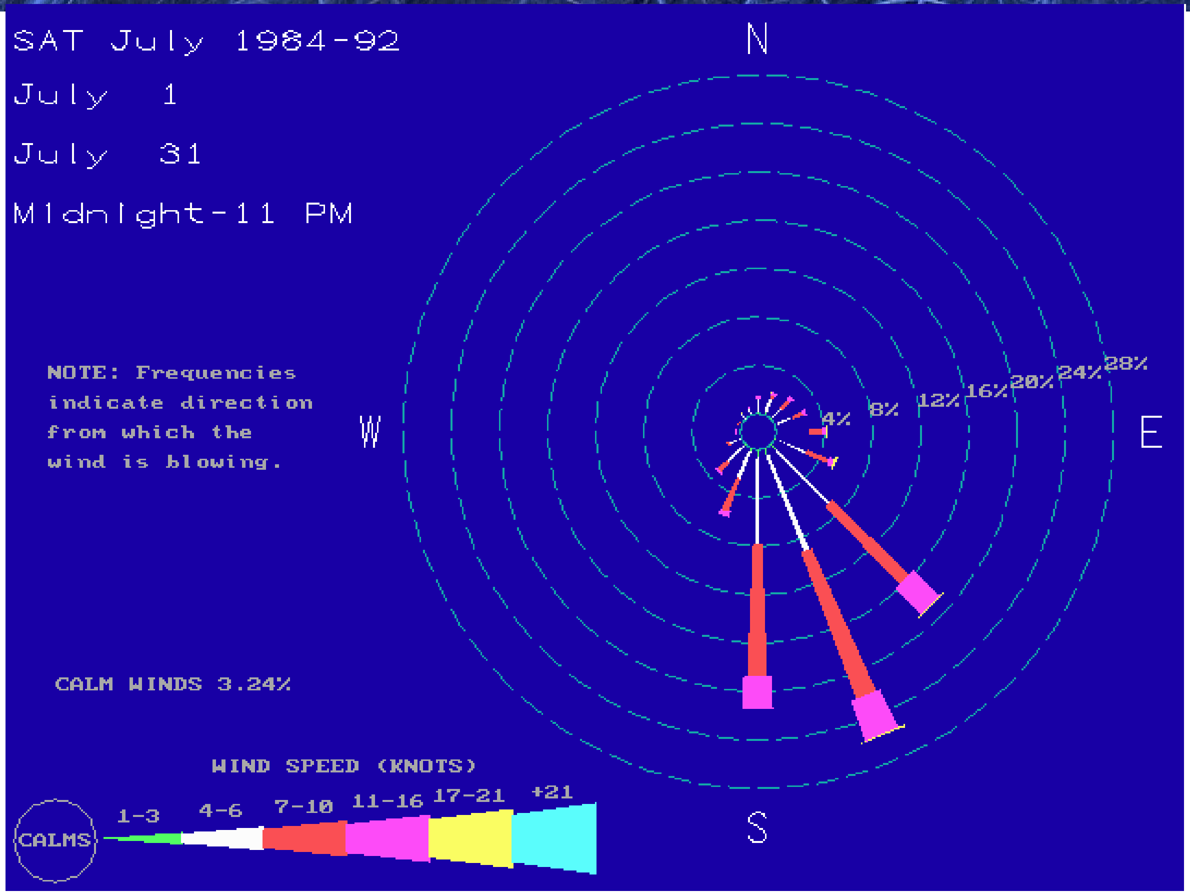
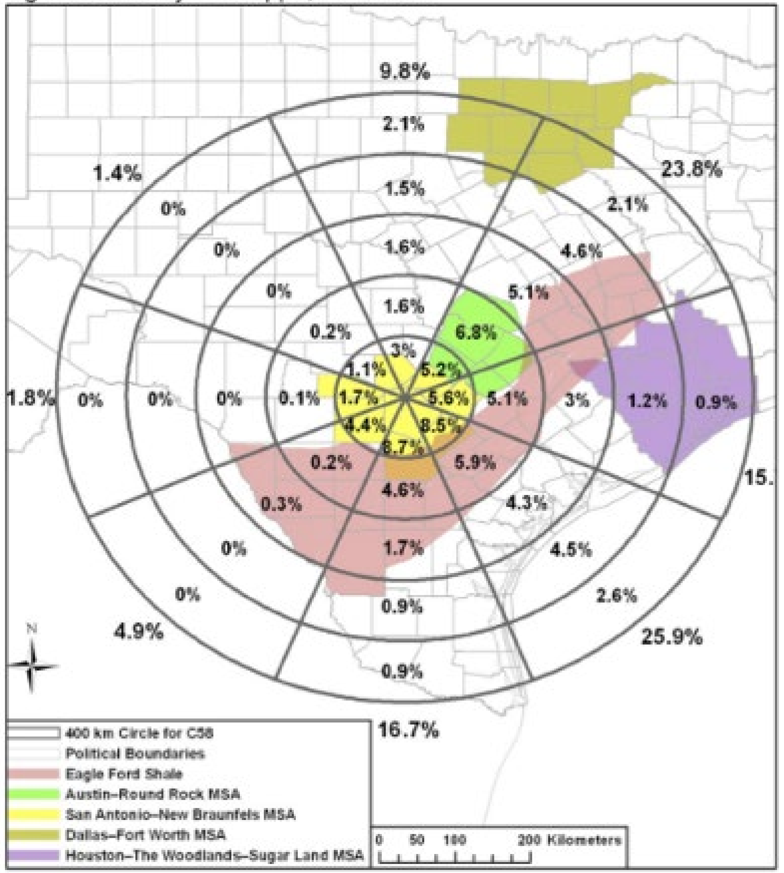


Figure 5-11: Back Trajectory Percentages by Directional Octant on High Ozone Days > 65 ppb, 2009-2014



We also consider historical wind data[3], regions identified by back trajectory analysis on high ozone days[4], and the work of Jeffries 2019[7]. In July, wind tends to originate from the south/southeast. On high ozone days, areas to the south, southeast, and northeast are identified as potential regions of ozone contribution.

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Data Sources and Tools

The following Data Sources have been incorporated into the ET Route Planning Tool developed for this deployment and will be available for online route planning.

1. Static Layers
   a. TCEQ 2018 "Point Source Emissions Inventory". Data has been scraped and made available to real-time planning tool.
   b. Homeland Infrastructure Foundation-Level Data (HIFLD), "Oil and Natural Gas Wells," 2019. Data Layer available for real-time planning
   c. Results and summary data from AACOG "Conceptual Model Ozone Analysis of the San Antonio Region Updates through Year 2014. Technical Report. 582-14-40051," 2015
   d. Results and summaries from Jeffries 2019.
   e. TCEQ monthly Wind Roses.
2. Dynamic Layers:
   a. National Oceanic and Atmospheric Administration (NOAA), Real-Time Environmental Applications and Display sYstem (READY).
   b. Real-time Traffic (Google Maps)
   c. Daily Back-Trajectories (NOAA HYSPLIT ONLINE)
   d. National Weather Service National Digital Forecast Database.

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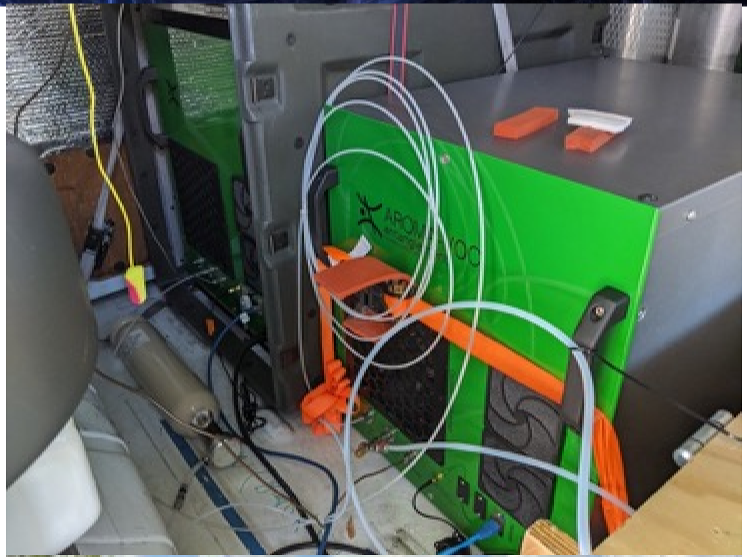
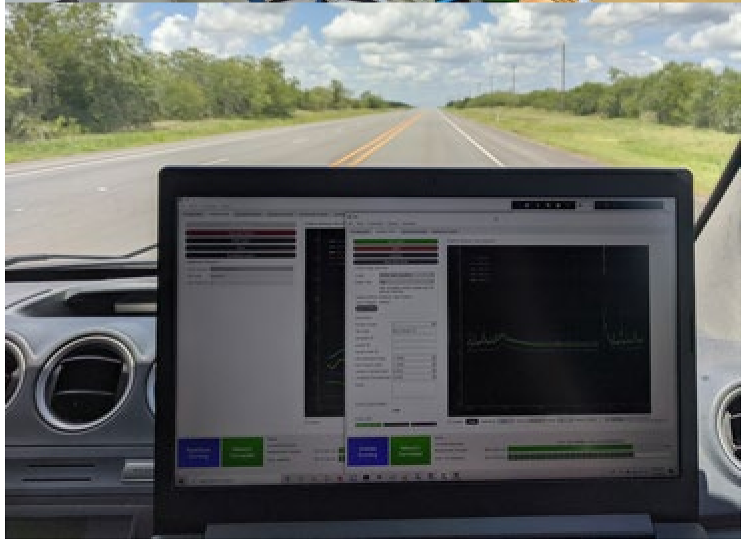
Methodology

Tools

- VOC data was collected with an ARVOC-181_RSO analyzer.
- NOx data was collected with a Thermo Fisher 42i Analyzer.
- Tools were mounted in a Ford Transit connecter outfitted with
  - 2000W power via batteries and alternator
  - Roof-mounted sample collection and anemometer
  - Carrier Gas
  - Co-pilot instrument monitoring and route planning





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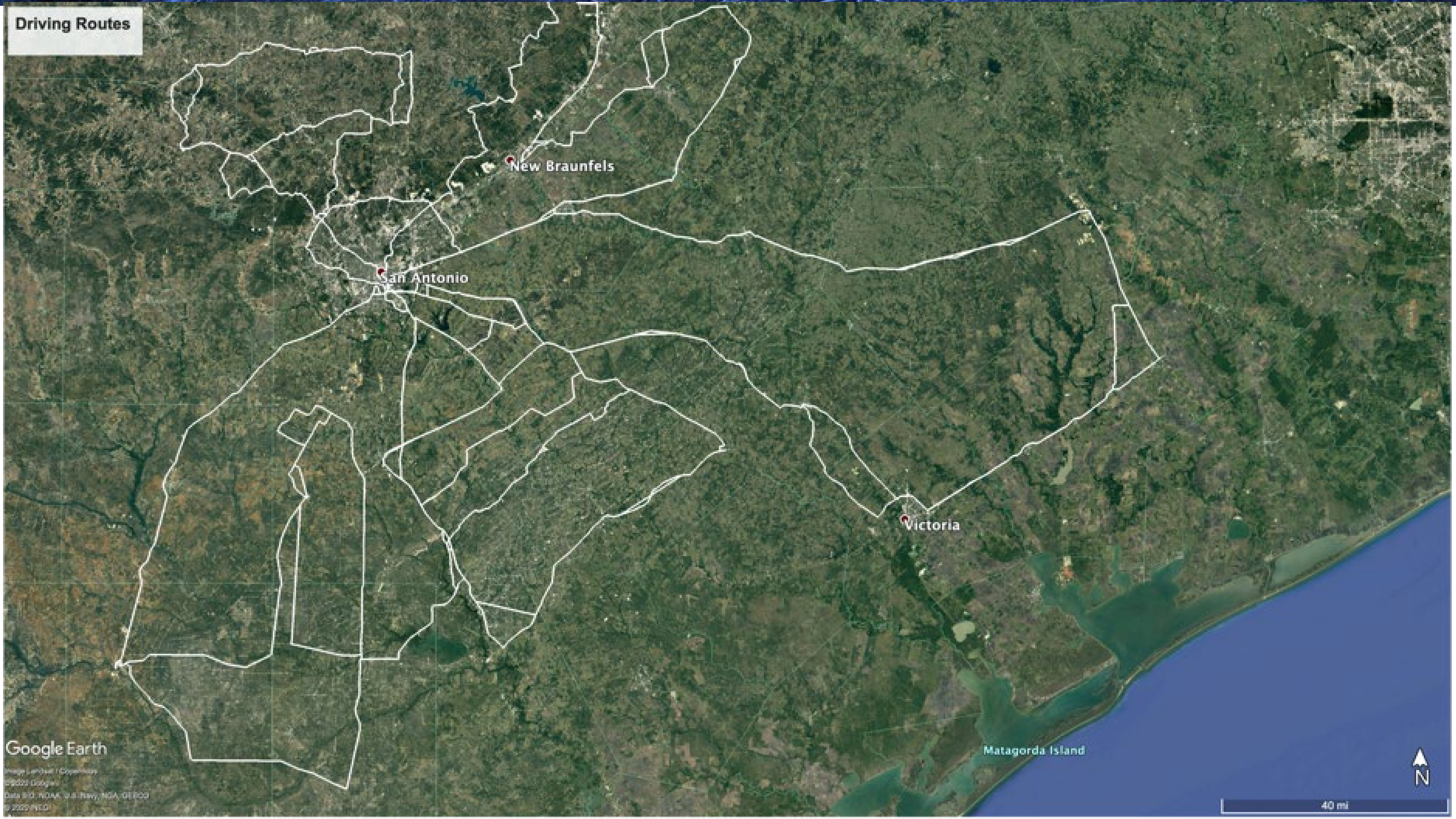
Driving Routes



GPS traces from all routes covered during the course of the study. All routes were driven twice (with minor variations caused by traffic and ambient conditions) over the course of the study.

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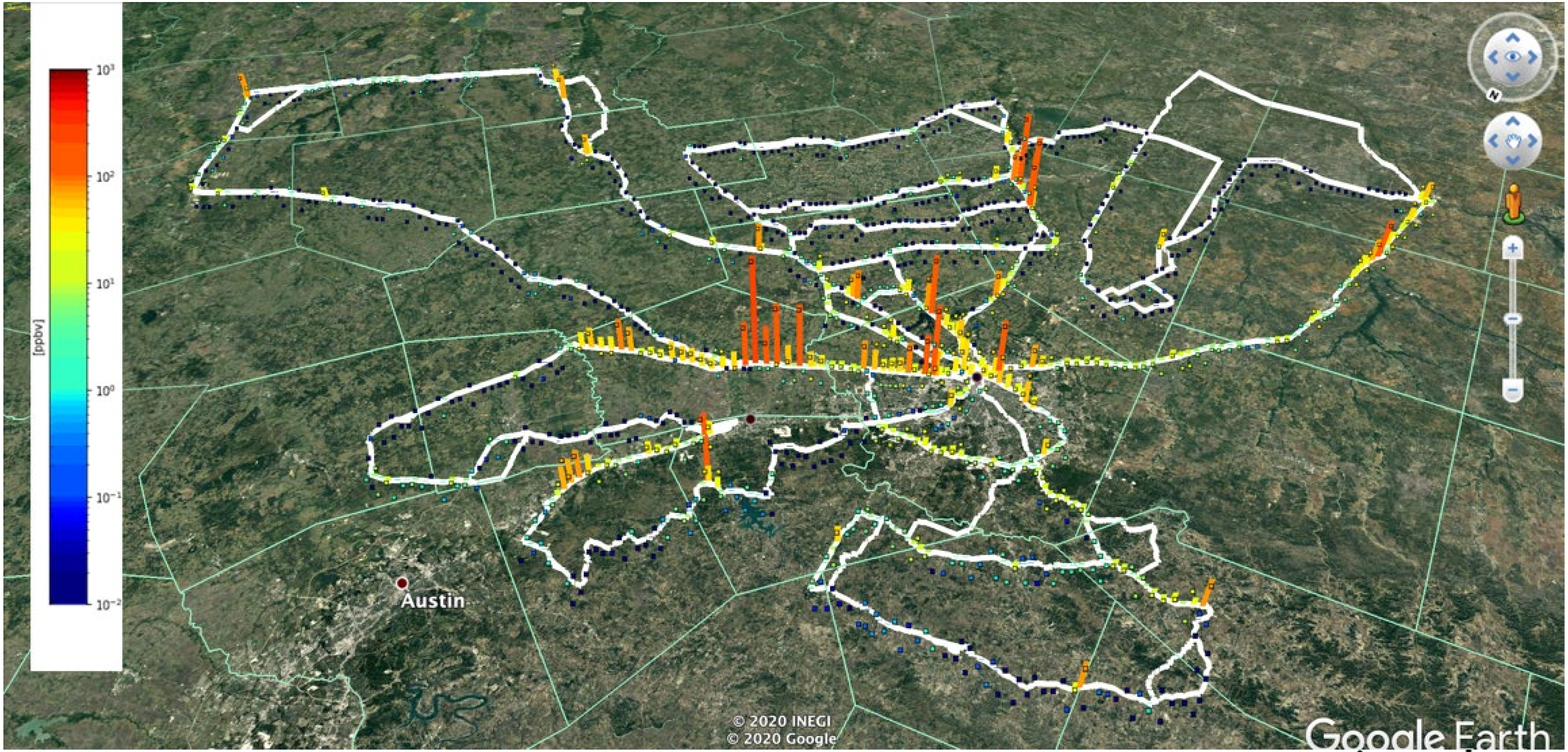
Results

Daily Data Example

NO



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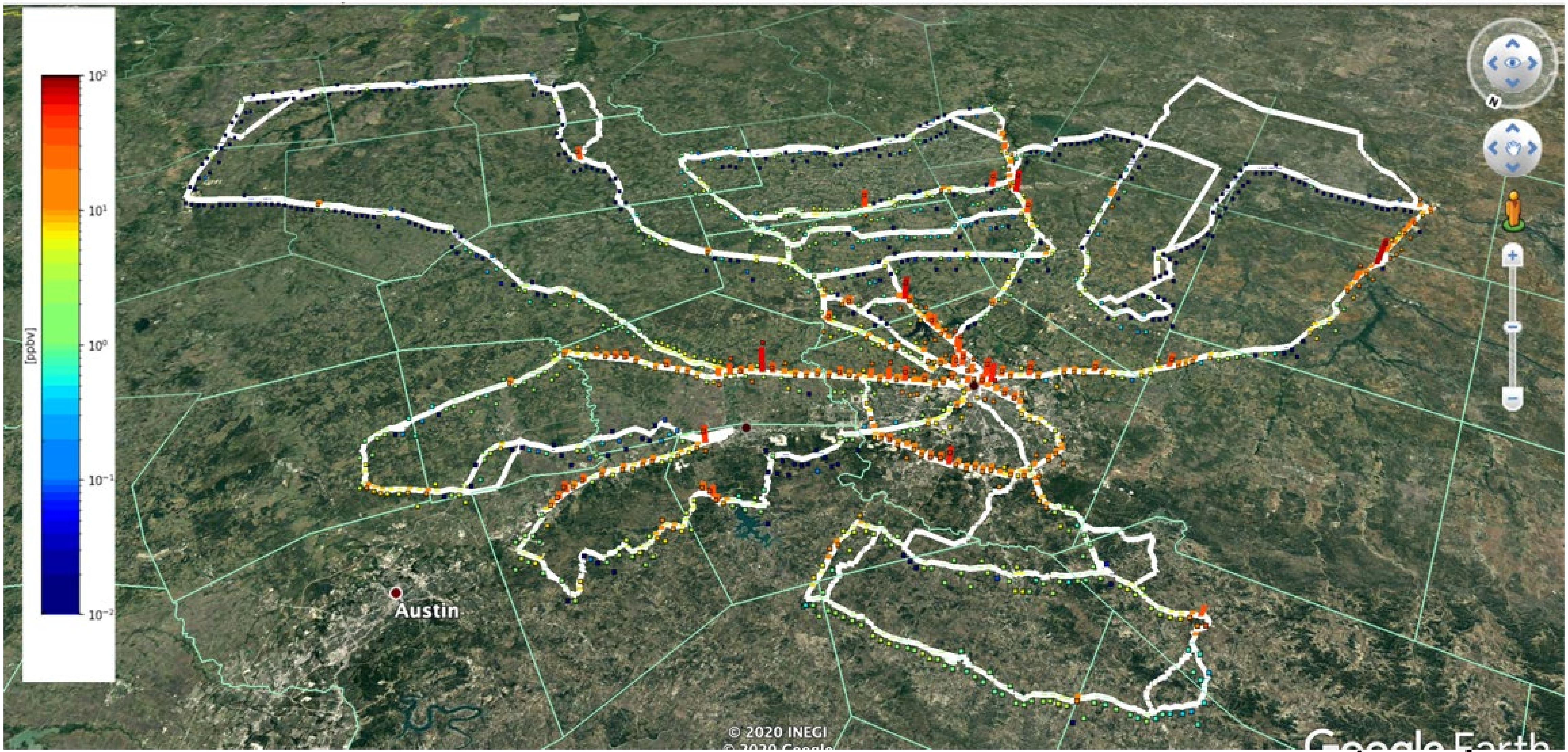
NO_2



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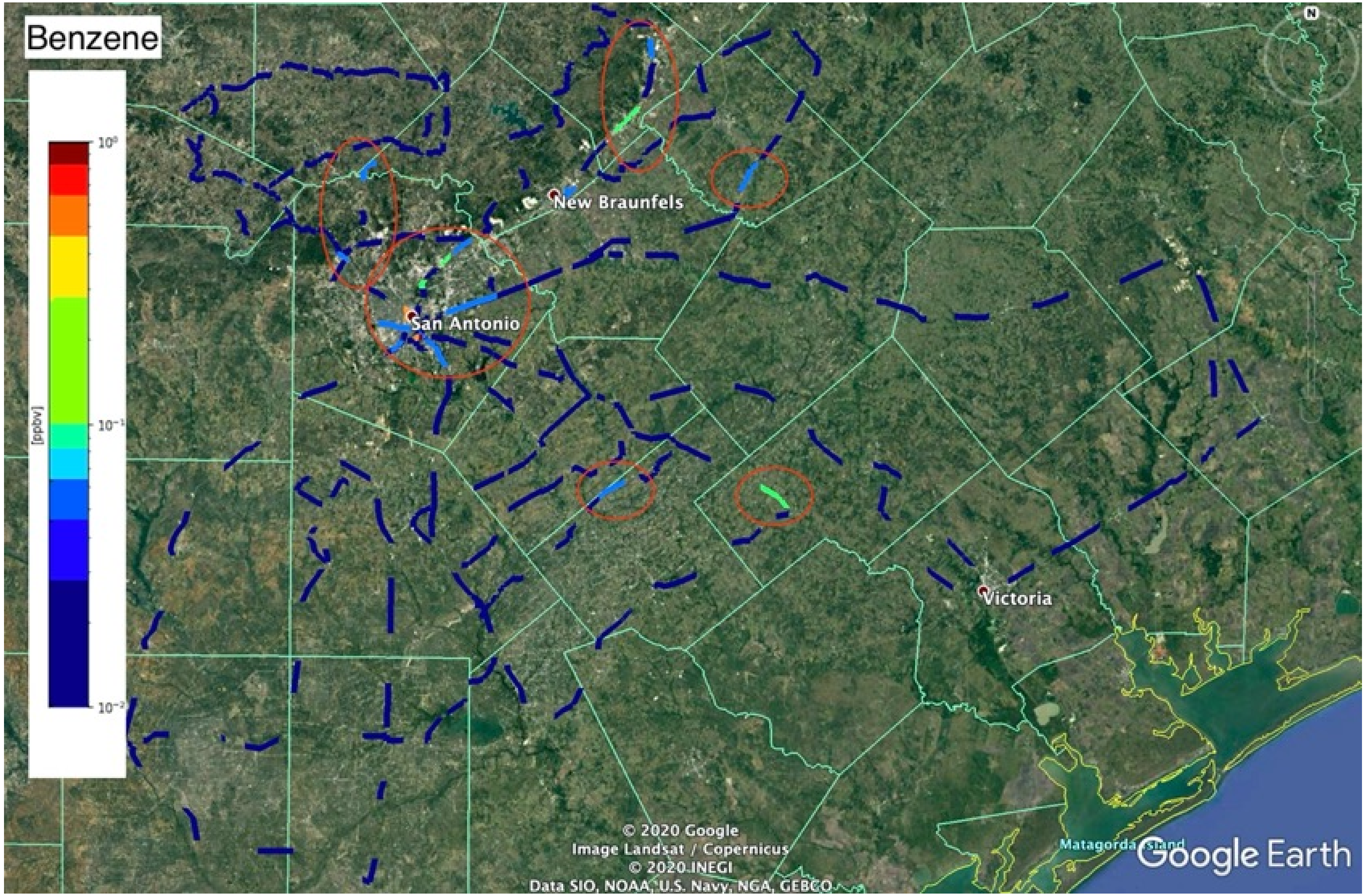
Benzene



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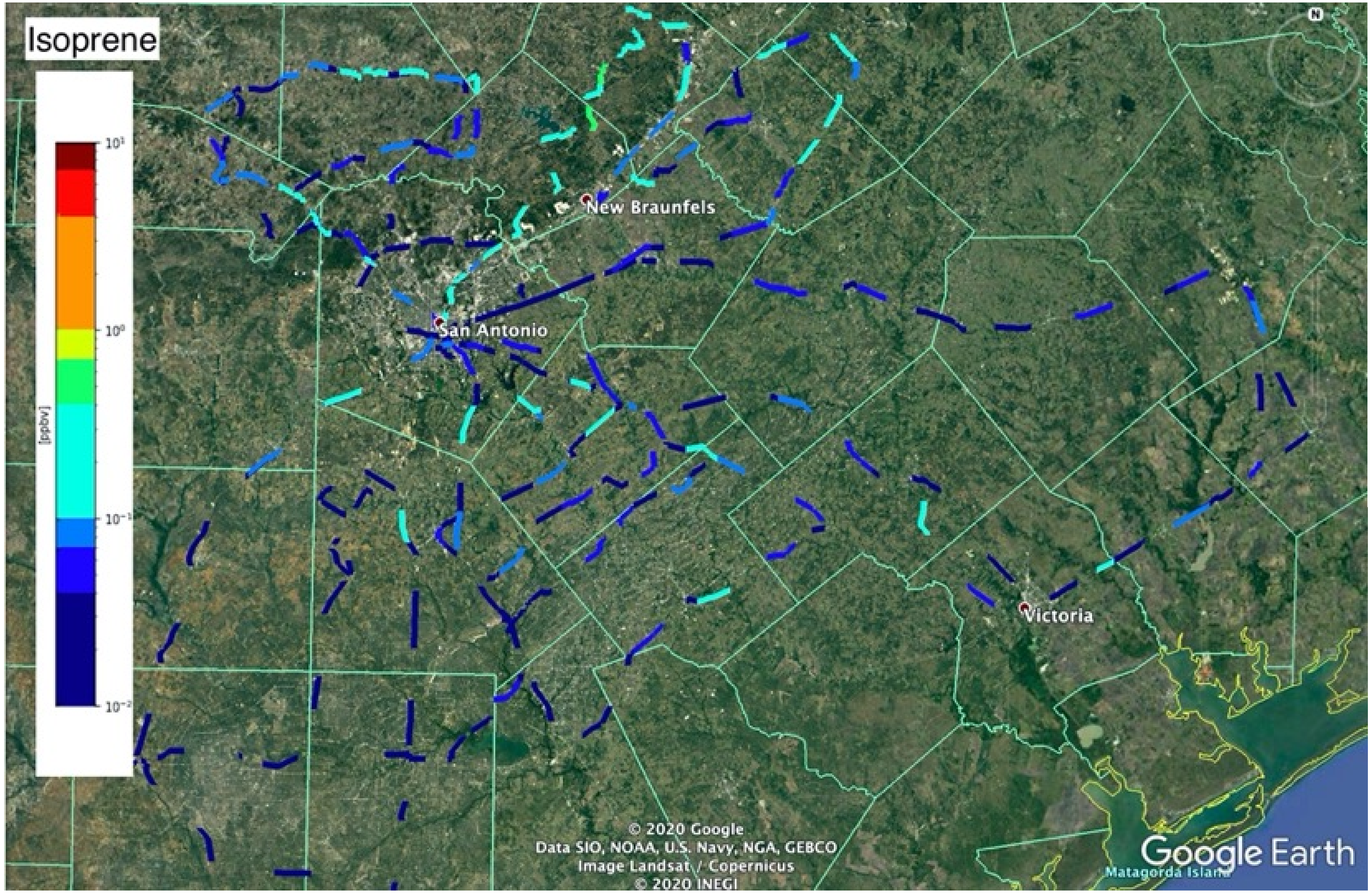
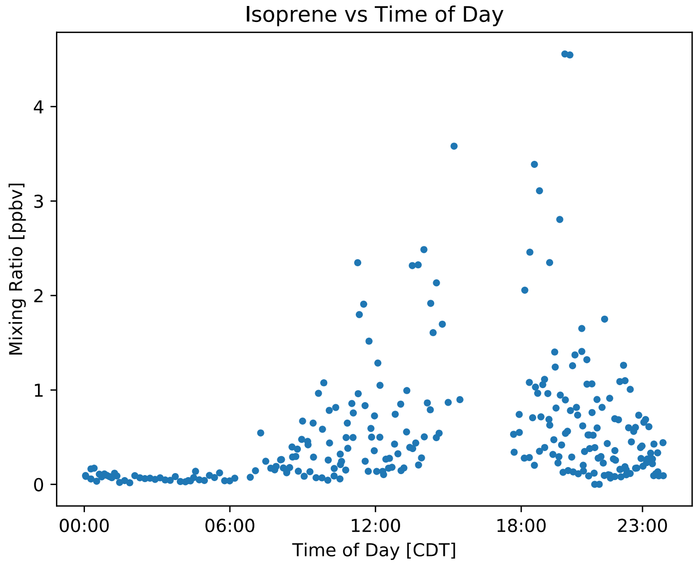
Isoprene





- Isoprene is an HRVOC that is strongly associated with photosynthetic activity.
- Concentration was strongly correlated with time of day and degree of plant life
- Peak concentrations detected to the north and north-east of Bexar County

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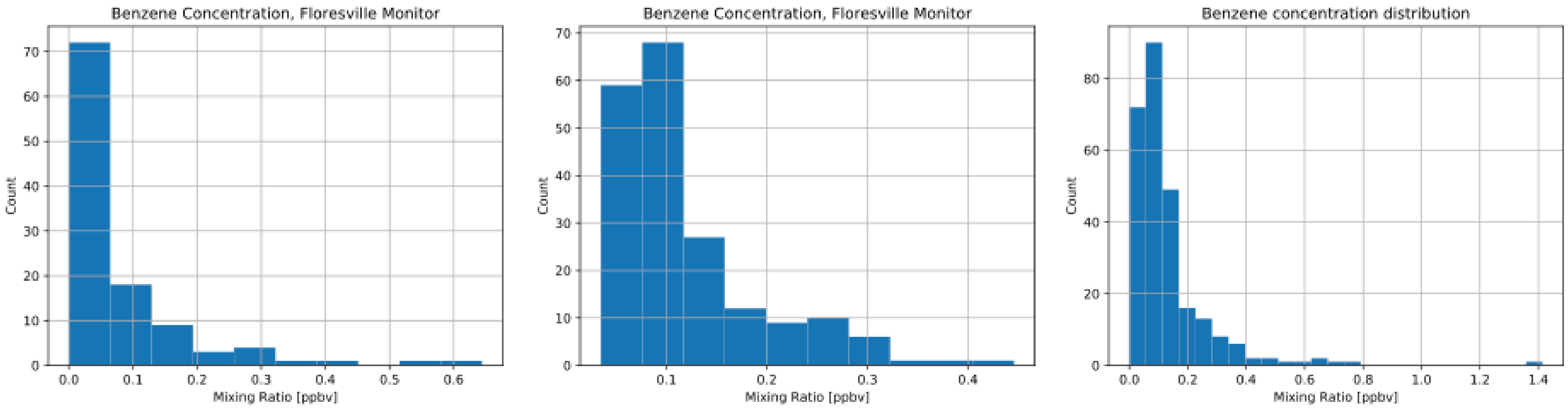
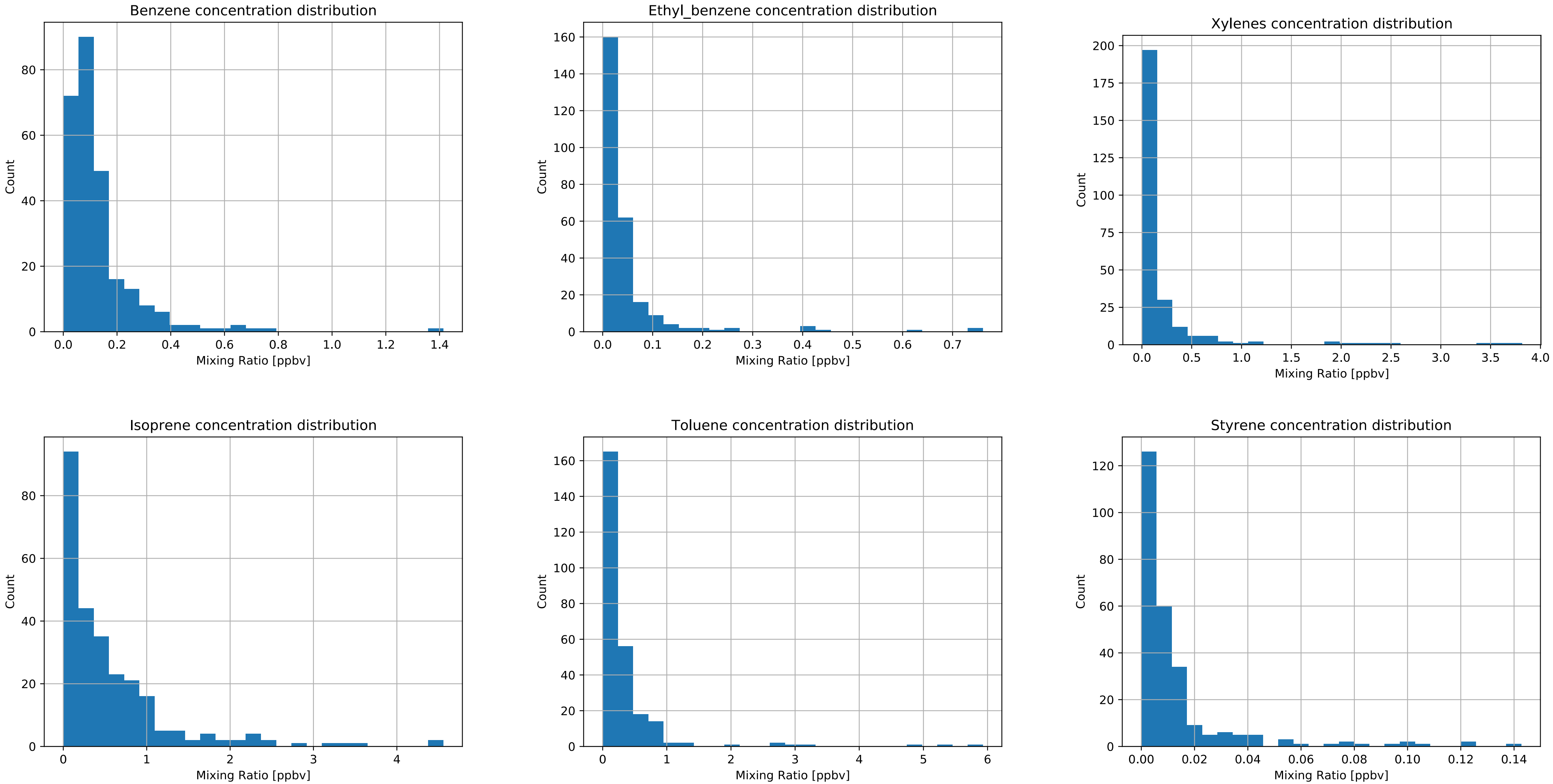
VOC Summary

All compounds, excepting 1,3-Butadiene, ethylbenzene, 1,2-cisDichloroethylene and Trichloroethylene were detected above the instrument noise floor. 1,3-butadiene was detected at three locations. All other compounds were consistently detected. Concentrations of VOCs were consistent with non-industrial urban areas, and general concentration ranges were similar to those detected at regional fixed monitors (e.g. Floresville and Karnes).



Floresville (left) and Karnes (center) TCEQ monitors show very similar concentration distributions to the mobile monitor (right), although the mobile monitor did show elevated concentrations for some measurements. Data was retrieved over the same time window through the TCEQ portal. TCEQ data is unverified.

Concentration Summary



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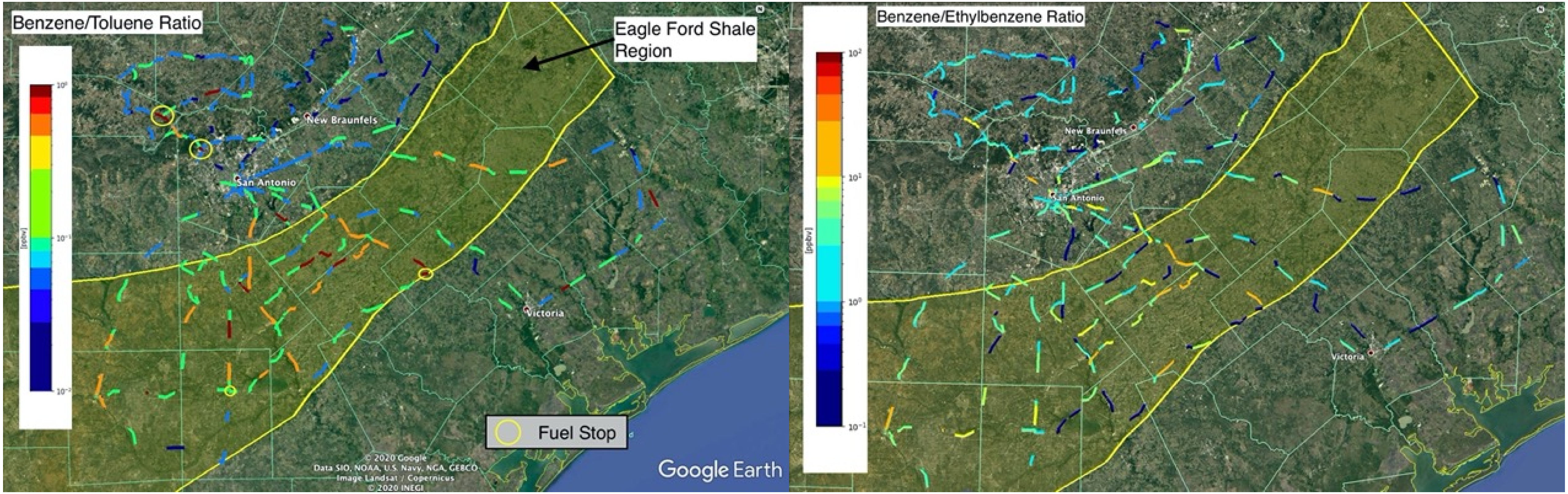
Source Attribution



Compound ratios provide a straightforward means of preliminary source attribution. Of the compounds measured, the benzene/toluene ratio provides the highest sensitivity. A B/T ratio ~1 is consistent with a variety of oilfield emissions (including evaporative emissions, flaring, and general oilfield activity) [Schade 2018]. Over the course of the study, the B/T ratio varied from 0.06 to 2.3. B/T ratios varied across regions

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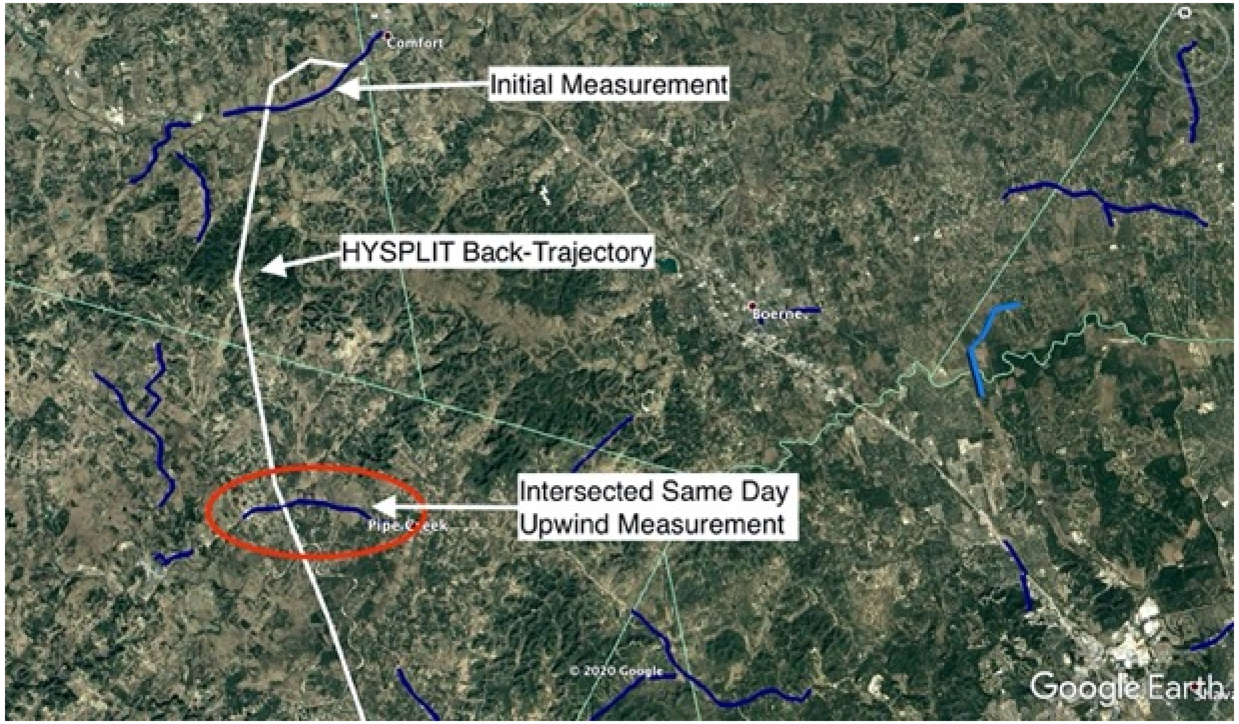
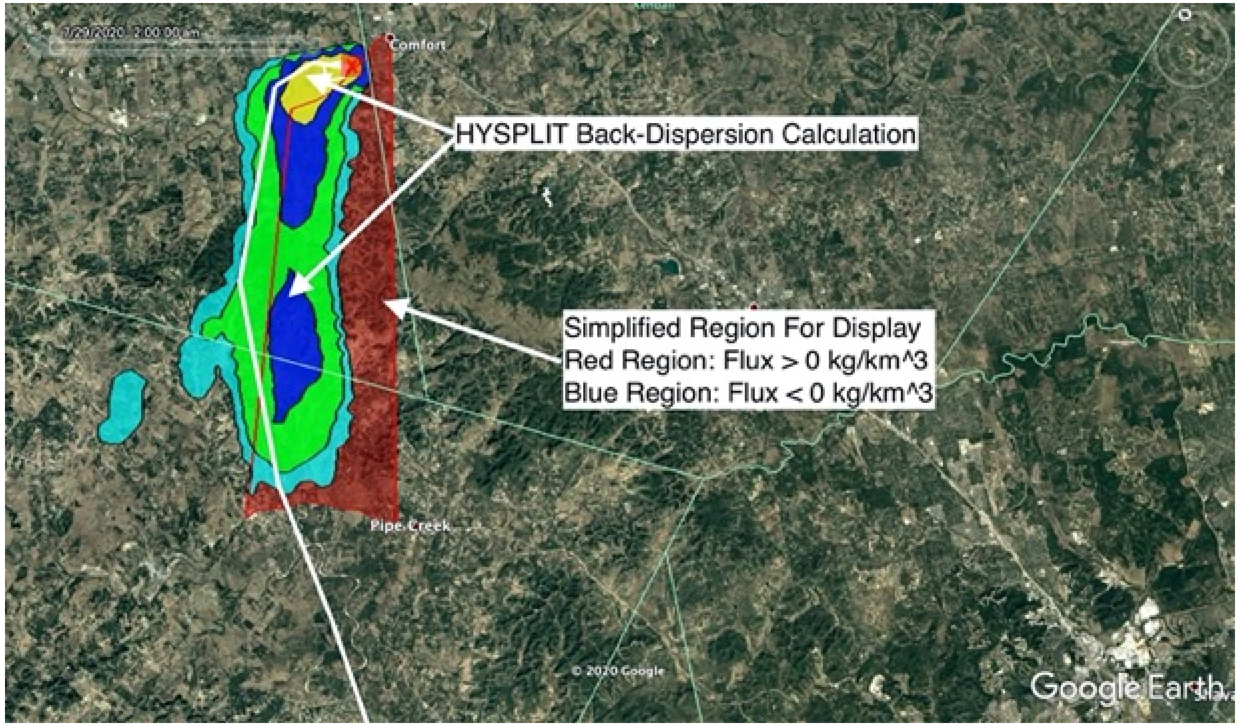
Flux Analysis

Measurement Pair Identification



Back-Dispersion Calculation and Display



Assumptions:

1. The upwind concentration is attributable solely to uniform background concentrations of target compounds.
2. Sources are distributed uniformly over the back-dispersion region

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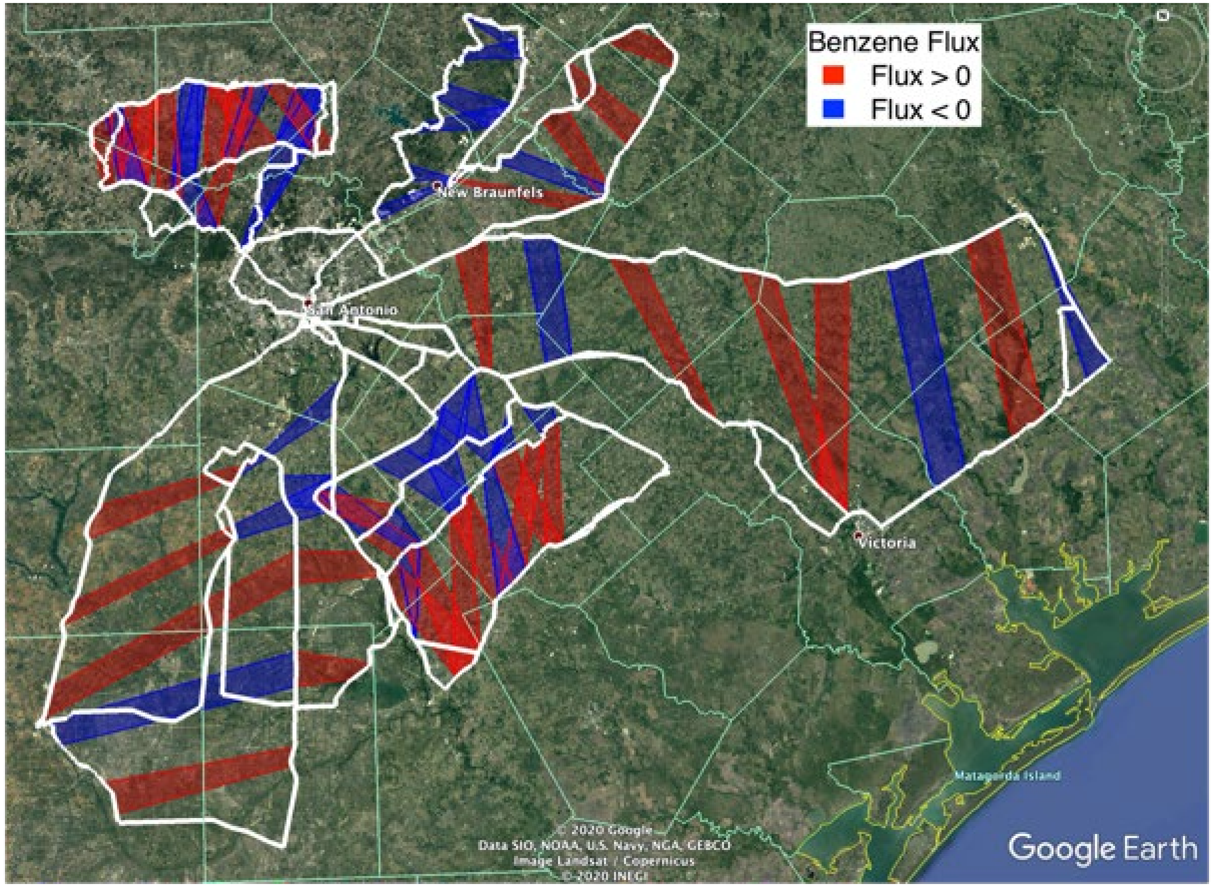
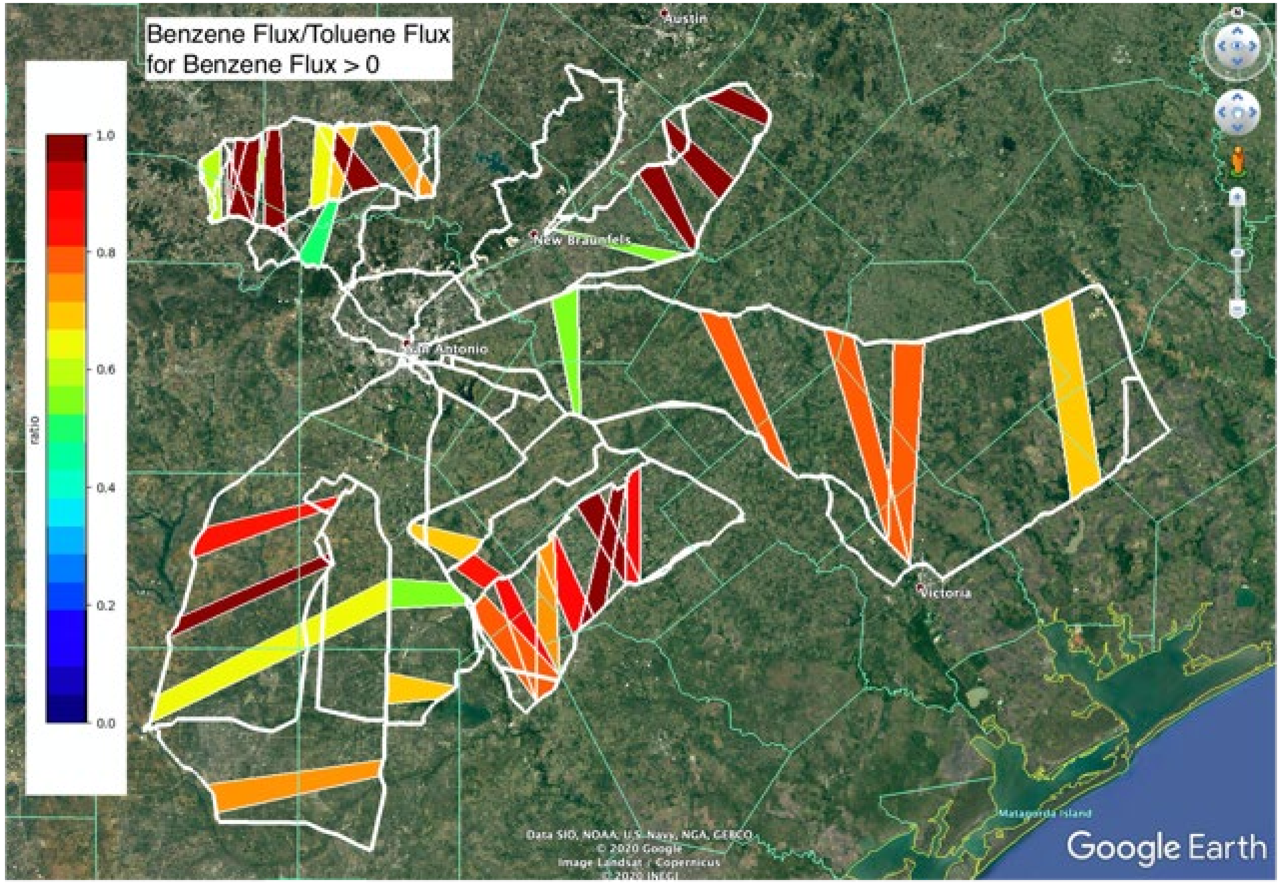
Flux Analysis (2)



Benzene flux estimate overview. Regions showing red displayed net increases in benzene, while regions shown in blue displayed net decrease between up- and down- wind regions.



Benzene Flux ratios for regions with net benzene flux.

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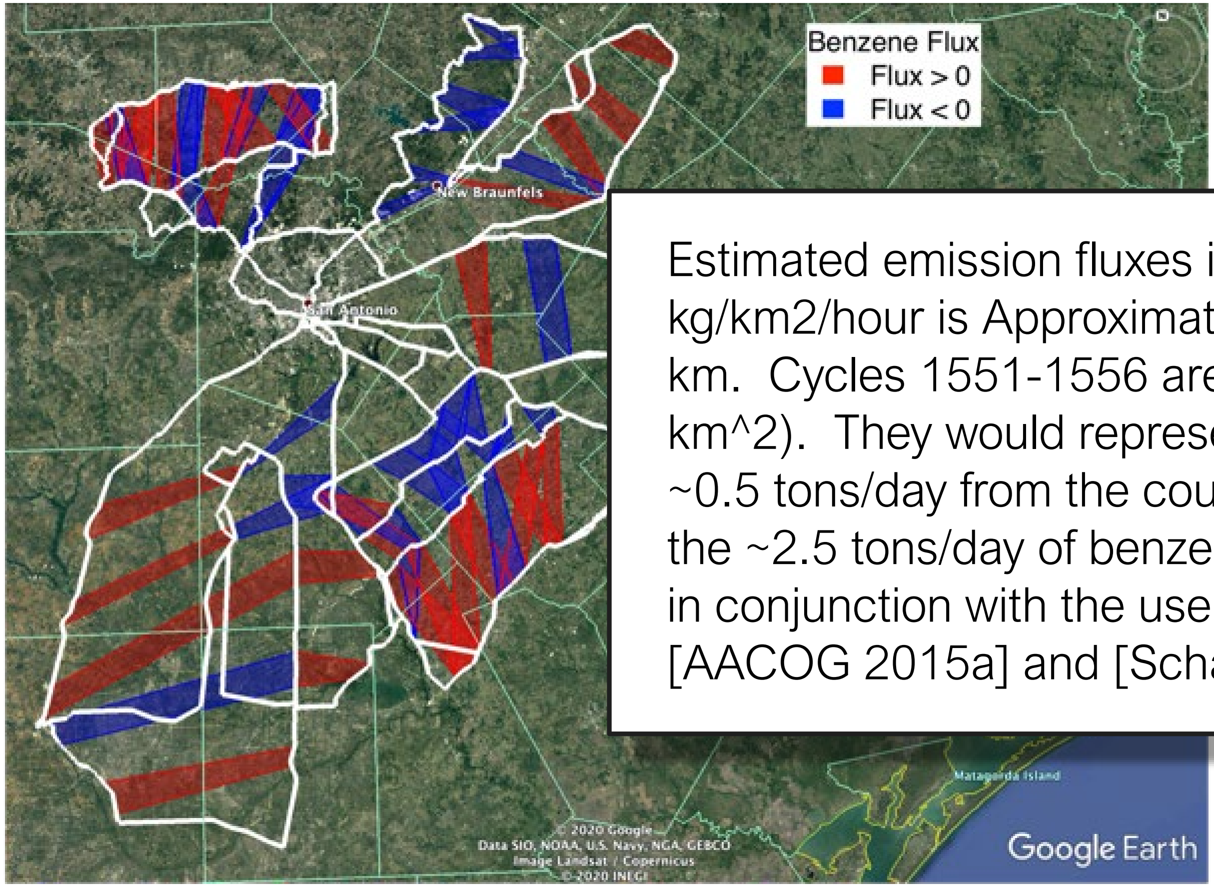
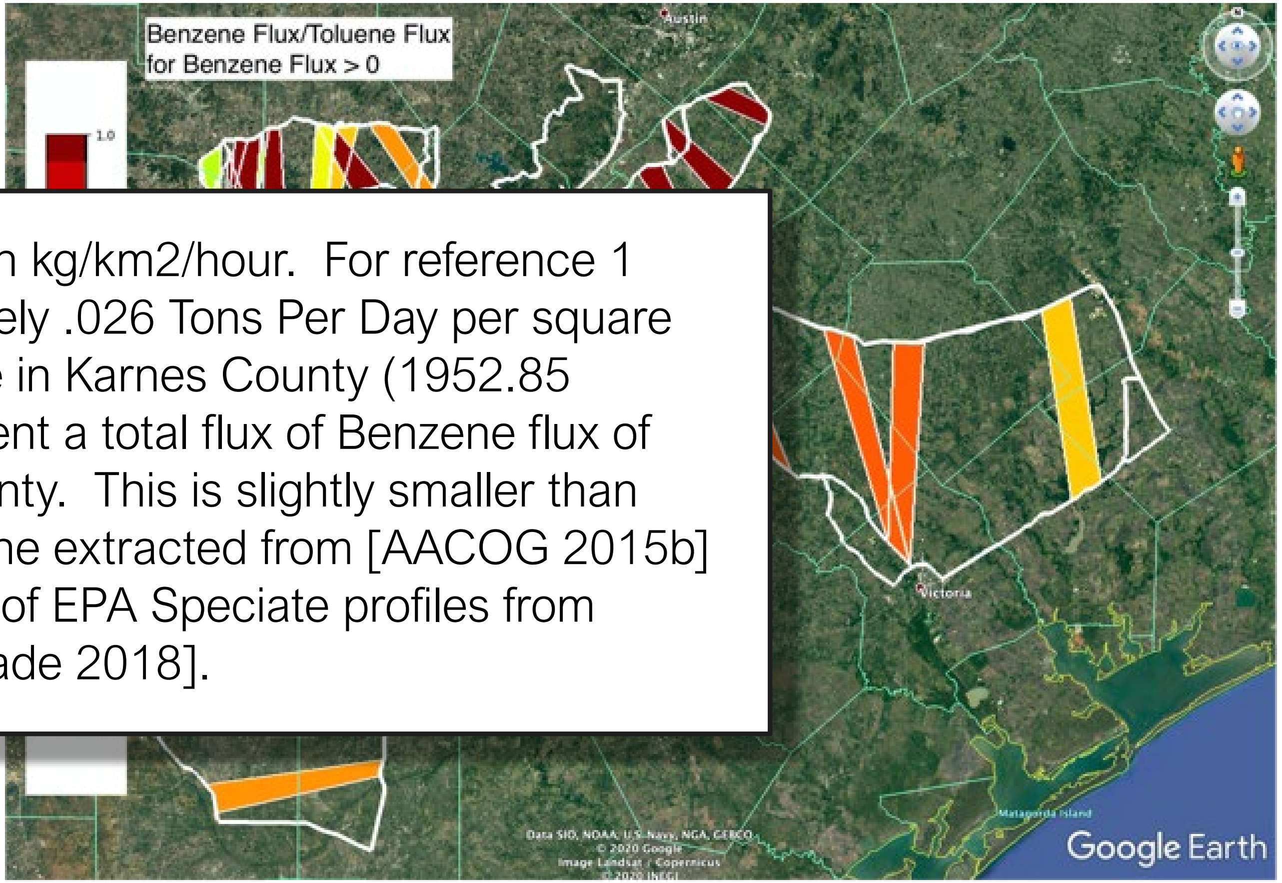
Flux Analysis (3)





Estimated emission fluxes in kg/km2/hour. For reference 1 kg/km2/hour is Approximately .026 Tons Per Day per square km. Cycles 1551-1556 are in Karnes County (1952.85 km^2). They would represent a total flux of Benzene flux of ~0.5 tons/day from the county. This is slightly smaller than the ~2.5 tons/day of benzene extracted from [AACOG 2015b] in conjunction with the use of EPA Speciate profiles from [AACOG 2015a] and [Schade 2018].

Benzene flux estimate overview. Regions showing red displayed net increases in benzene, while regions shown in blue displayed net decrease between up- and down- wind regions.

Benzene Flux ratios for regions with net benzene flux.

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Sources

1. Texas Commision on Environmental Quality (TCEQ), "Point Source Emissions Inventory", 2018. https://www.tceq.texas.gov/airquality/point-source-ei/psei.html
2. Homeland Infrastructure Foundation-Level Data (HIFLD), "Oil and Natural Gas Wells," 2019. https://hifld-geoplatform.opendata.arcgis.com/datasets/oil-and-natural-gas-wells
3. Environmental Protection Agency (EPA), Wind Rose Plot (WRPLOT), 1984-1992. https://www.tceq.texas.gov/airquality/monops/windroses.html
4. AACOG Natural Resources/ Transportation Department, "Conceptual Model Ozone Analysis of the San Antonio Region Updates through Year 2014. Technical Report. 582-14-40051," 2015.
5. National Weather Service, "National Weather Service Wind Forecast", National Digital Forecast Database, 2020. https://www.arcgis.com/home/item.html?id=33820e818ebc4661b01bcd47e5f2a57e
6. National Oceanic and Atmospheric Administration (NOAA), Real-Time Environmental Applications and Display sYstem (READY), 2020. https://www.ready.noaa.gov/READYcmet.php
7. Harvey Jeffries, "Observational Analysis To Improve Understanding of Ozone Formation in San Antonio, Texas," 2018.

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Questions?

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