Ozone Formation in the San Antonio Area

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Introduction to Ozone Formation in the San Antonio Area

- Conceptual models:
  - Describe ozone formation within an area;
  - Are required by the EPA; and
  - Contain information on ozone, ozone precursors, meteorology, and transport.

- Bexar County was designated as nonattainment for the 2015 eight-hour ozone standard of 70 parts per billion (ppb) on July 17, 2018.

- The San Antonio area conceptual model investigates the following topics:
  - Ozone concentrations and trends;
  - Ozone precursor concentrations and trends;
  - Ozone chemistry; and
  - Meteorology and its affect on ozone.
Ozone Concentrations and Trends
Eight-Hour Ozone Design Values

*Data from EPA's AQS as of May 17, 2021.*
Eight-Hour Ozone Design Values by Monitor

![Map comparison of ozone levels in the San Antonio area for 2009, 2013, and 2018. The maps show the concentration levels of ozone across various locations in the region, with different shades representing varying levels of ozone concentration.](image-url)
Fourth-Highest Eight-Hour Ozone Values by Monitor

*Data from EPA's AQS is marked with a (*). All other data from TCEQ. Data as of May 17, 2021.
Eight-Hour Ozone Exceedance Days by Month

Days

- Days > 70 ppb and ≤ 75 ppb
- Days > 75 ppb and ≤ 84 ppb
- Days > 84 ppb

*Data from 2009 through 2018. Data from EPA's AQS.*
Regional Background Ozone During the Ozone Season

*Data from TCEQ.*
Ozone Precursor Concentrations and Trends
Ozone Season Average Daily-Maximum Nitrogen Oxide (NO$_x$) Trends

*Data from TCEQ.
Camp Bullis Volatile Organic Compound (VOC)  
June 1, 2016 – February 28, 2017

Mean Concentration (ppbC)

Mean MIR Weighted Concentration

*Data from TCEQ.
Old Hwy 90 24-Hour VOC Trends

Mobile Source VOC

- Ethylene
- Propylene
- Toluene

Oil and Gas VOC

- Propane
- n-Butane
- n-Hexane
- n-Pentane

- Ethane
- Isobutane
- Isopentane

*Data from TCEQ.
On-Road Vehicle Summer Emissions

*Data from on-road mobile source trend emissions inventories for all 254 counties in Texas for 1999-2050, August 2015.

Maximum Emissions (tons per day):
- 174.49 tpd NOx in 2000
- 67.15 tpd VOC in 1999
- 97.01 tpd CO/10 in 1999

Minimum Emissions (tons per day):
- 12.21 tpd NOx in 2040
- 9.11 tpd VOC in 2042
- 13.13 tpd CO/10 in 2042
Electric Generating Unit (EGU) Summer NO$_x$ Emissions

*Data from EPA Air Markets Program Data (AMPD).
Point Source Summer VOC Emissions for Sources > 15 Tons/Year

*Data from TCEQ’s PSDB.
Ozone Chemistry
San Antonio Northwest One-Hour Ozone and NO$_x$ Weekdays vs Weekends 2013 – 2018

*Data from TCEQ.*
Meteorology and its Affect on Ozone
Ozone Season Prevailing Winds

*Data from Midwestern Regional Climate Center.
Ozone Exceedance Day Surface-Level Five-Hour Back Trajectories 2009 – 2018

*Data from TCEQ.
Average Daily-Maximum Eight-Hour Ozone and 500 Meter 56-Hour Back Trajectory Clusters for Ozone Season, 2009 – 2018

*Meteorological data from NOAA; Ozone data from TCEQ.*
San Antonio Northwest and Calaveras Lake
One-Hour Ozone by Wind Speed and Direction

*Data from TCEQ.
San Antonio Area Ozone Formation

- Eight-hour ozone design value trends have been flat over the last ten years.
- Ozone formation peaks from April through June and then again from August through October, with a “mid-summer minimum” occurring in July.
- High ozone typically occurs on hot sunny days with dry conditions and slow winds out of the southeast.
- Emissions located south and southeast of the area combine with urban mobile emissions to create ozone and slow winds transport it to the monitors located in the northwest.
San Antonio Area Ozone Formation

- Ozone accumulation is further exacerbated by recirculating wind directions throughout the day.
- These conditions also create high levels of regional background ozone, which combines with the local ozone and emissions to produce high ozone levels.
- The air mass appears to be NO$_X$ limited to transitional.
- The dominant VOC are either naturally occurring or have low ozone formation potential, meaning NO$_X$ controls may be more effective in reducing ozone compared to VOC.
Questions?

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Link to full Conceptual Model for the San Antonio area: