Contribution of Transboundary Ozone to the Policy Relevant Background of the San Joaquin Valley: Preliminary Field Research Findings

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United States Air Quality

OZONE

Frequency of Exceeding the 8-hour National Standard 2000-2002

Standard = 0.08 ppm - 8 hour average concentration
Only sites not meeting the standard (40 CFR 50.10) are shown.
Based on 2000 thru 2002 data from US EPA's AQS database.
"How is your Thursday looking?"
Before he was king, Sisyphus was a Gym Teacher.
MY HEELS ARE TOO TIGHT!
THERE'S A STRANGE HAIR
ON MY LOLLIPPOP. DID YOU
SEE HEROES LAST NIGHT?
ARE WE THERE YET?
WHERE ARE WE GOING?

SISYPHUS
HAD IT
EASY!

MT. HOPE
HOSPITAL
(CASH ONLY)
Structural Elements of the San Joaquin Valley’s Ozone Challenge

1. Topography and met = efficient $\text{O}_3$ formation;
2. Substantial biogenic emissions;
3. Inter-basin transport;
4. Rapid growth of sources and VMT;
5. High VMT precursor load due to high poverty and diesel VMT fraction;
6. NOx-limited = dependence on vehicle fleet turnover and ultimate demise of the ICE.
Population Growth in the San Joaquin Valley: 2000-2005

- **Medera County**: 142,788
- **Kings County**: 143,420
- **Merced County**: 241,706
- **Tulare County**: 410,874
- **Stanislaus County**: 505,505
- **San Joaquin County**: 664,116
- **Kern County**: 756,825
- **Fresno County**: 877,584
- **Total Population**: 440,026
Milk Cows in Tulare County: 1987 to 2007

Source: US Census of Agriculture
Regional Carrying Capacity Comparison: Per Unit NOx and ROG load

South Coast AQMD: 15.7 Tons per sq. mile
Bay Area AQMD: 8.8 Tons per sq. mile
San Joaquin Valley APCD: 2.0 Tons per sq. mile
Regional Carrying Capacity Comparison
Annual Avg. 8 Hr. Ozone Violations 2002-2004

San Joaquin Valley APCD: 122.7
South Coast AQMD: 97.7
Bay Area AQMD: 4.7
Ozone Violations in the San Joaquin Valley:
1990—2007  (1997 Standard of 0.84 ppb)
Nox vs. VOC at Valley Design Value Site
Source: SJVAPCD 2007 Ozone Plan

Figure 3-5  Arvin Monitoring Location Carrying Capacity, 2020
NOx Reductions Required for Meeting 85 ppb 8 hr (1997) NAAQS

- 2002: 650 tpd
- 2023: 150 tpd

Source: SJVAPCD 2007 Ozone Plan
Policy Relevance of TBO

- Section 179B of the CAA: “Notwithstanding any other provision of law, any State that establishes to the satisfaction of the Administrator that, with respect to an ozone nonattainment area in such State, such State would have attained the national ambient air quality standard for ozone by the applicable attainment date, but for emissions emanating from outside of the United States, shall not be subject to the provisions of section 181(a)(2) or (5) or section 185.”
Operationalization of Section 179B

1. Can we achieve sufficient empirical certitude given complexity of processes and physical parameters in the SJV?

2. How to capture full synergy between sources of inference?

   - Campaigns, e.g. CCOS, CalNEX;
   - Remote sensing and attendant models;
   - Sustained field observation studies;
   - Ambient monitoring.
The Monterey Institute for Research in Astronomy (MIRA) Observatory on Chews Ridge

Chews Ridge: 1450 masl, measuring meteorology, O$_3$, SMPS Rotating Drum Impactor (aerosol size & composition)

View to NW

View to SE
Diurnal Cycles on Chews Ridge

- $O_3$ is typically 6-12 ppb lower during the daytime;
- Specific humidity rises and winds slacken;
- These diurnal trends indicate a summertime convective boundary layer on the ridge: stomatal uptake, evapotranspiration, and increased drag during daytime surface heating.
CalNex Pt. Sur $O_3$ sonde vs. Fresno Surface $O_3$ (May/Jun 2010 14:00 PST launches)
O₃ correlation for May/Jun 2012 (r=0.45) is similar to that observed during CalNex (May/Jun 2010) at 1.5 km.

O₃ correlation during the “O₃ Season” Jul/Sep 2012 (r=0.36) is reduced and appears to have a longer correlation time scale.
Highest FT O₃ Occurs in Westerly Flow

O₃ Nighttime Pollution Rose, May

O₃ Nighttime Pollution Rose, July
(Monthly) Aircraft Sampling: Scientific Aviation, Inc.

Scientific Aviation Flight 13–Sep–2012: $O_3$ (ppb)

1 Hz T, RH, CO$_2$, CH$_4$, O$_3$, & wind

SE winds aloft
Ozone Rose: Mid-Feb--June
Diurnal Profiles for Oceanic and Terrestrial Wind Directions
Wish List

1. Continued Chews Ridge and aircraft observations;
2. New fixed site at S-K National Park;
3. Expanded flights focusing on transport mechanisms suggested by CalNEX research;
4. Analytical integration with CalNEX and related remote sensing efforts towards more robust modeling outcomes;
5. Weight of evidence sufficient for Section 179B.