Supplementary Materials

Figure S1. Sampling methods

1. Harvard Impactor

10 µm cutpoint impactor

2 37mm quartz filter filters, coated in ground XAD-4

Flow direction

1. Chemcomb Model 3500 Speciation Sampling Cartridges

10 µm cutpoint impactor

3 47mm quartz filter filters, coated in ground XAD-4

3 glass honeycomb denuders, coated in ground XAD-4

Flow direction

Figure S2. Annual average particle-bound PAH concentrations from the ARB Daily toxics program at First Street Fresno site, ng/m3.



Table S1. Summary of the burn-related rules and relevant amendments in effect in the SJV air basin during or before the time period of data collection.

|  |  |  |  |
| --- | --- | --- | --- |
| Rule number and title | Date of Amendment | Date of enforcement (if relevant) | action |
| 4103 Open burning | June 18, 1992 |  | Permitting required for open burning. |
| June 21, 2001 |  | Amended rule to remove prescribed burning and hazard reduction burning from Rule 4103 and make a new rule, Rule 4106, Prescribed and Hazardous Reduction Burning. Removal of exemptions on “no-burn” days for ceremonial, cooking, and recreational fires. |
| January 1, 2003 |  | Reminder issued that chemically treated grape stakes cannot be burned and inspection requirement added to reinforce this part of the rule. |
| May 19, 2005 | June 1, 2005 | Prohibit burning for Field Crops, Prunings, and Weed Abatement per SB705. |
| May 17, 2007 | June 1, 2007 | Prohibit burning for Orchard Removals per SB705. |
| April 15, 2010 | June 1, 2010 | Prohibit burning for Vineyard Removals, Prunings from Surface Harvested Crops and Other Materials per SB705. |
| 4901 Wood burning fireplaces and wood burning heaters | July 15, 1993 |  | Adopted Rule 3040, Agricultural/Open Burn Fees charging uniform fees for agricultural burning through the SJV Air Basin. |
| July 17, 2003 | November 1, 2003 | Ban on wood burning in residences below 3,000ft elevation, with natural gas heating service, and when AQI over 150 in the District (i.e. 65 μg/m3 24-hour mean). |
| October 16, 2008 |  | Lowered the mandatory curtailment level to 30μg/m3, included outdoor residential burning devices in the mandatory curtailment, removed the elevation exemption, and added a contingency plan should SJV Air Basin fail to meet 1997 PM2.5 standards. |
| September 18, 2014 |  | Incorporated a tiered approach to mandatory curtailment, based on projected PM concentrations; established a registration program for qualified wood burning heaters; added a program for wood burning heater professionals to perform inspections on qualified wood burning heaters. |
| CCR Title 17,  Subchapter 2. Smoke Management Guidelines for Agricultural and  Prescribed Burning | March 14, 2001 |  | CARB began declaring burn and no-burn days for agricultural burning.   * SJV Air Basin was divided into 3 large regions:  1. SJV North (San Joaquin, Stanislaus, and Merced Counties) 2. SJV South (Madera, Fresno, Kings, and Tulare Counties, and   the San Joaquin Valley Air Basin portion of Kern County) High – elevation above 3,000 ft   1. SJV South (Madera, Fresno, Kings, and Tulare Counties, and   the San Joaquin Valley Air Basin portion of Kern County) High – elevation below 3,000 ft   * Meteorological conditions used were:  1. Temperature 2. 500 mb 3. Wind speed  * 200 acres of agricultural material per county per day was still allowed to burn on a declared No burn day |
|  | Nov 18, 2002 |  | SJVAPCD took over responsibility for declaring burn, marginal burn & no-burn days.   * SJV Air Basin was still divided into 3 large regions * Meteorological data reviewed was expanded to include reviewing the National Center for Environmental Predictions (NCEP) model prognostications, the uncertainty of those forecasts, surface and aloft temperature trends including ARB aircraft soundings, lower air profile data, local transport winds, marine air intrusion, subsidence and vorticity conditions, current and forecasted PM and ozone concentrations, current smoke complaints, and quantitative forecast parameters to derive the general agricultural burn declaration. * Stipulation for 200 acres of burning allowed per day per county on no burn days was removed and a waitlist procedure took its place. |
|  | May 18, 2004 |  | SJV Air District began allocating emissions for VOC or PM for SJV, based on over 100 small regions called “agricultural burn allocation zones.” |

Supplementary Table S2. The concentrations of PAHs in 2008 Summer/Fall season was exceptionally high, likely because of the California Wildfires that year. The fires were not local, but the smoke plumes extended to Fresno. The high volatility, light weight PAHs exhibited substantially increased concentrations compared to all other years.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2002-2007, 2014-2018 | | | 2008 | | | ratio 2008 : all other years |
|  | N | Mean | Std | N | Mean | Std |
| ACY | 160 | 0.30 | 0.34 | 34 | 6.43 | 7.8 | 21 † |
| ACE | 160 | 0.66 | 0.49 | 34 | 4.02 | 5.75 | 6 † |
| FLU | 160 | 2.16 | 2.31 | 34 | 24.35 | 21.56 | 11 † |
| PHE | 160 | 3.91 | 2.67 | 34 | 35.48 | 21.61 | 9 † |
| ANT | 160 | 0.12 | 0.21 | 34 | 0.06 | 0.00 | 0.5 † |
| FLT | 160 | 0.94 | 0.79 | 34 | 5.38 | 4.65 | 6 † |
| PYR | 160 | 0.79 | 0.91 | 34 | 2.29 | 2.49 | 3 † |
| RET | 160 | 14.34 | 50.91 | 34 | 3.87 | 10.28 | 0.3 † |
| BAA | 160 | 0.12 | 0.20 | 34 | 0.2 | 0.45 | 2 |
| CHR | 160 | 0.15 | 0.15 | 34 | 0.44 | 0.90 | 3 |
| BBF | 160 | 0.34 | 0.63 | 34 | 0.63 | 1.01 | 2 |
| BKF | 160 | 0.21 | 0.58 | 34 | 0.38 | 0.79 | 2 |
| BAP | 160 | 0.15 | 0.18 | 34 | 0.21 | 0.24 | 1 |
| ICP | 160 | 0.21 | 0.22 | 34 | 0.33 | 0.59 | 2 |
| DBA | 160 | 0.11 | 0.14 | 34 | 0.33 | 0.69 | 3 |
| BGP | 160 | 0.38 | 0.44 | 34 | 0.43 | 0.75 | 1 |

**†**The difference between 2008 and all other years is statistically significant using t-test with unequal variances to compare the two means.

Table S3. Distribution of the means for Particle-bound PAHs from the ARB Daily Toxics Program First Street Fresno PAHyear 2000-2005, in ng/m3.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| *PAHyear* | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
| *annual average, ng/m3* |  |  |  |  |  |  |
| Number of samples | 30 | 31 | 30 | 31 | 30 | 10 |
| BAP | 0.46 | 0.62 | 0.43 | 0.40 | 0.29 | \* |
| BBF | 0.53 | 0.71 | 0.44 | 0.44 | 0.32 | \* |
| BGP | 0.73 | 0.88 | 0.53 | 0.61 | 0.46 | \* |
| BKF | 0.23 | 0.3 | 0.2 | 0.21 | 0.15 | \* |
| DBA | 0.08 | 0.09 | 0.08 | 0.08 | 0.06 | \* |
| ICP | 0.56 | 0.73 | 0.5 | 0.46 | 0.3 | \* |
| *winter averages, ng/m3* |  |  |  |  |  |  |
| Number of samples | 10 | 10 | 10 | 11 | 10 | 10 |
| BAP | 1.28 | 1.7 | 1.16 | 1.08 | 0.83 | 0.57 |
| BBF | 1.45 | 1.91 | 1.17 | 1.15 | 0.89 | 0.66 |
| BGP | 1.89 | 2.24 | 1.34 | 1.5 | 1.22 | 1.12 |
| BKF | 0.61 | 0.79 | 0.52 | 0.52 | 0.4 | 0.29 |
| DBA | 0.19 | 0.22 | 0.17 | 0.17 | 0.12 | 0.1 |
| ICP | 1.49 | 1.9 | 1.35 | 1.18 | 0.83 | 0.68 |

\* Insufficient data for a valid mean.

Supplementary Table S4. Correlation between daily particle-bound PAH measurements and potential sources (emissions and materials burned). All correlations are statistically significant.

|  |  |  |
| --- | --- | --- |
| Source | Pearson Correlation Coefficients | |
| All | Winter Season |
| Agricultural waste burning emissions (tons/day) | 0.34 | 0.54 |
| Residential wood combustion (tons/day) | -- | 0.36 |
| On-road vehicle emissions (tons/day) | 0.22 | 0.31 |
| Total tons burned during day before PAH measurement | 0.15 | 0.04 |
| Total tons burned during 10 days before PAH measurement | 0.34 | 0.21 |