ANNUAL REPORT ON VOLATILE ORGANIC COMPOUND EMISSIONS FROM PESTICIDES: EMISSIONS FOR 1990 – 2011

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EXECUTIVE SUMMARY

Preface

This report fulfills the requirements of Title 3, California Code of Regulations (3 CCR), section 6452.4 which requires the Director of Department of Pesticide Regulation (DPR) to issue an annual emissions inventory report for the Sacramento Metro, San Joaquin Valley, South Coast, Southeast Desert, and Ventura ozone nonattainment areas (NAAs). This report presents data reported to or produced by DPR from May 1, 2011, to October 31, 2011, the peak ozone season in California. In addition, data from the same months in 1990 are included for baseline comparisons, and from 2008, 2009 and 2010 for trend analysis.

Background

Under the federal Clean Air Act, California must meet national standards for airborne pollutants and must specify how it plans to achieve these goals in a federally approved State Implementation Plan (SIP). SIPs require the control of emissions of nitrogen oxides and VOCs because they are precursors to ozone. Under California's SIP, approved by the U.S. Environmental Protection Agency (U.S. EPA), DPR must track and control VOC emissions from pesticide products used in agriculture and by commercial structural applicators in five NAAs: the Sacramento Metro area, the San Joaquin Valley, the Southeast Desert region, Ventura County and the South Coast area. Under the SIP, California is expected to reduce pesticide VOCs by 12 percent in the San Joaquin Valley and 20 percent in the other four NAAs, compared to 1990 levels.

DPR's VOC emission inventory database includes only pesticide applications that are made between May 1 and October 31, the peak ozone season in California. The database is updated when annual pesticide use report data from the previous year becomes available, and contains data for every year since 1990. Each year contains about 2.5 million pesticide use records (PUR) and emission potential (EP) values for approximately 5,000 products. The EP is that fraction of a product that is assumed to contribute to atmospheric VOCs.

Beginning in 2008 DPR adopted regulations to reduce VOC emissions from fumigant pesticides. Title 3, California Code of Regulations, section 6452.2, includes specific emission target levels (VOC regulation benchmarks) for each of the five NAAs, equivalent to the SIP obligation of a 12 percent or 20 percent reduction. The regulations reduce VOC emissions by requiring low-emission fumigation methods in certain NAAs. If, in spite of these application method requirements, pesticide VOC emissions exceed 95 percent of the benchmark for a NAA, DPR will, as specified by the regulations, ensure that the benchmark is achieved by establishing a fumigant limit. The fumigant limit is determined by subtracting the estimated nonfumigant emissions from the regulatory benchmark, basing the nonfumigant emissions estimate on VOC emission inventory data from previous years.

Report Summary

VOC emissions in three of the five NAAs increased in 2011, but these remain in compliance with the SIP goals and are below the VOC regulation benchmarks.

- Sacramento Metro NAA: VOC emissions have increased steadily since 2008, by less than one percent in 2009, a further 8 percent in 2010 and another 2 percent in 2011. Pesticide VOC emissions in 2011 were 64 percent lower than the 1990 base year and remain well in compliance with the SIP goal and the VOC regulation benchmark. In 2011, 94 percent of emissions were derived from nonfumigants.
- San Joaquin Valley NAA: VOC emissions decreased between 2008 and 2009 and then increased by approximately 16 percent in 2010, and then by an additional seven percent in 2011. Pesticide VOC emissions in 2011 were 18 percent lower than the 1990 base year and comply with the SIP goal and VOC regulation benchmark. Almost three quarters of pesticide emissions are derived from nonfumigants, the same as in 2010.
- Southeast Desert NAA: VOC emissions decreased slightly from 2008 to 2009, but increased by more than 0.177 tons per day from 2009 to 2010. However, emissions in 2011were reduced to their lowest level since adjusted inventory calculations began in 2004 (0.210 tons per day), 82 percent lower than the 1990 base year and continue to comply with the SIP goal and VOC regulation benchmark. In a marked contrast to previous years, emissions from fumigants account for only about one third of the total.
- Ventura NAA: The SIP goal and VOC regulation benchmark has been phased in over several years for this NAA. VOC emissions increased by 11 percent in 2011 but continue to meet the SIP goal for 2011 as well as the final goal to be met beginning in 2012. Pesticide VOC emissions in 2011 were 24 percent lower than the 1990 base year. Eighty-five percent (85%) of emissions are derived from fumigants.
- South Coast NAA: VOC emissions, that decreased in 2011 by more than 35 percent compared to 2010, fell to their lowest level since adjusted inventory calculations began in 2004 (1.109 tons per day) and continue remain well below the emission targets. Pesticide VOC emissions in 2011 were 90 percent lower than the 1990 base year. More than 80 percent of emissions are derived from nonfumigants.

Abbreviations and Definitions

AI	Active Ingredient
APCD	Air Pollution Control District
AMAF	Application Method Adjustment Factor
ARB	California Air Resources Board
EP	Emission Potential
GIS	Geographic Information System
MUF	Method Use Fraction
NAA	nonattainment area
PUR	pesticide use report
SIP	state implementation plan
TGA	thermogravimetric analysis
tpd	tons per day
VOC	Volatile Organic Chemical

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DISCLAIMER

The mention of commercial products, their source, or their use in this report is not to be construed as either an actual or implied endorsement of such product.

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OVERVIEW

Introduction

The State Implementation Plan (SIP) for pesticides requires the California Department of Pesticide Regulation (DPR) to develop and maintain an emission inventory to track pesticide volatile organic compound (VOC) emissions and to reduce emissions by 20 percent from a base year in four out of five California nonattainment areas (NAA), and by 12 percent in the fifth NAA. These five NAAs are defined as areas that do not meet the National Ambient Air Quality Standards for ozone as designated in the Clean Air Act. The scope of the VOC inventory allows DPR to estimate VOC emissions from agricultural and commercial structural pesticide applications within the state. To do this DPR calculates emissions for each year beginning with 1990, and updates these calculations annually based on most recent data. The inventory focuses on the peak ozone period between May 1 and October 31 for each year.

The VOC emission inventory is estimated based on pesticide use reports (PURs) that are collected by DPR. The inventory includes applications that are made for agricultural and structural use as defined by law. Included are all applications with the exception of home use, industrial use, institutional use, applications made for vector control purposes and veterinarian uses. Production agricultural use covers applications to approximately 400 commodities/crops. Non-production agricultural use includes applications to approximately 20 sites including cemeteries, golf courses, parks, rights of way, etc. Structural use includes all applications by structural pest control businesses, regardless of site treated.

The key pesticide use report data used to calculate VOC emissions is given in Table 1. There are seven counties that are partially within NAAs. Because the locations of non-production agricultural and non-agricultural applications are only given down to the county level, these types of applications need to be allocated to the portions of those seven counties so that their contribution to NAA emissions can be accurately determined. In 2012, a Geographic Information System (GIS) and U.S. Census Bureau 2010 Census data and TIGER/Line shapefiles for roads, railroads and linear hydrography were used to develop surrogate data from which updated proportional estimates for structural/landscape and rights-of-way applications were calculated. Commodity fumigations are allocated based on information provided by the California County Agricultural Commissioners (Neal, 2012).

Table 1. Key information included in pesticide use reports that form the basis of DPR's VOC emission inventory.

Information	**Production Agriculture Report** (Each Application)	**Non-Production Agriculture Report and Non Agricultural Reports** (Monthly Summary of Applications)
Product Applied	Yes	Yes
Crop/Site Treated	Yes	Yes
Amount Applied	Yes – each application	Monthly Total
Date Applied	Date and Time	Month
Application Method	Yes	No
Acres/Units Treated	Yes	Monthly Total
Location of Application	Township/Range/Section	County
Fumigant Method Code	Yes*	No

* fumigant use reports only

California's five ozone NAAs included in the pesticide VOC emission inventory are Sacramento Metro (1), San Joaquin Valley (2), Southeast Desert (3), Ventura (4), and South Coast (5). The boundaries of these NAAs, as defined by CFR 40 Part 81 and a listing of counties that fall within the boundaries are shown in Figure 1 and Table 2, respectively.

In January 2008, DPR adopted 3 CCR section 6452.3 requiring an annual VOC emissions inventory report that includes the following information:

- report total agricultural and structural pesticide VOC emissions for the previous years,
- evaluate compliance with SIP goals (benchmarks specified in section 6452.2),
- establish fumigant emission limits for the upcoming year if necessary, according to section 6452.2, and
- establish an emission rating (or application method adjustment factor, the percentage of fumigant applied emitted to air) for each fumigation method

Section 6452.3 also requires a 45-day public comment period of the draft report. This report contains all of the information specified above, including emission estimates for 1990–2011 and fumigant limits for 2013.

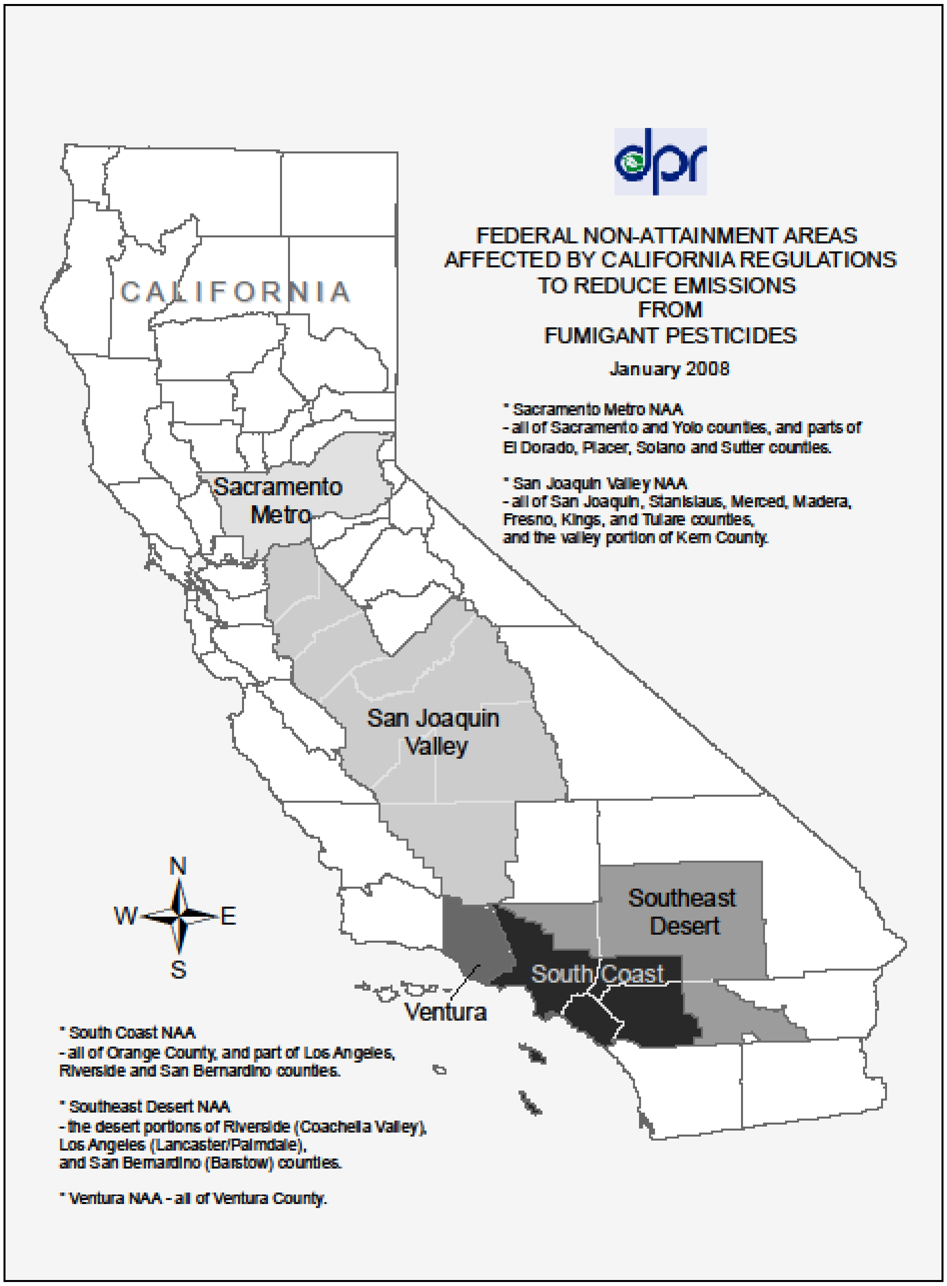


Figure 1. Federal nonattainment areas affected by California Regulations to reduce emissions from fumigant pesticides.

Table 2. A listing of counties wholly or partially within nonattainment areas in California.

NAA	Counties within the NAA
1 – Sacramento Metro	All of Sacramento, Yolo Parts of Sutter, Solano, Placer, El Dorado
2 – San Joaquin Valley	All of Fresno, Kings, Madera, Merced, San Joaquin, Stanislaus, Tulare Western Part of Kern
3 – Southeast Desert	Parts of Los Angeles, San Bernardino, Riverside
4 – Ventura	All of Ventura
5 – South Coast	All of Orange Western Parts of Los Angeles, San Bernardino, Riverside

Nonattainment Area Goals

The emissions in DPR's VOC inventory are compared to NAA goals listed in Table 3, which are described in California's original 1994 SIP (62 Fed. Reg. at 1170, 1997) and Appendix H to the 2007 SIP (73 Fed. Reg. 41277, 2008). These "SIP goals" are a 20 percent reduction from 1990 for the Sacramento Metro, Southeast Desert, Ventura and South Coast NAAs, and a 12 percent reduction from 1990 for the San Joaquin Valley NAA. In August 2012, U.S. EPA approved DPR's SIP amendment for the San Joaquin Valley. This amendment includes a SIP goal of 18.1 tons/day, equivalent to a 12 percent reduction relative to 1990. Prior to the amendment, the SIP described the reduction commitment only as 12 percent less than 1990. Because the 18.1 tons/day represents the 12 percent reduction from the 1990 baseline calculated using a specific methodology, that methodology must continue to be used to calculate future emissions to assure a legitimate comparison to measure SIP compliance. Therefore, emission estimates for application methods that were used in 1990 cannot be modified, absent a SIP revision. Similarly, nonfumigant pesticides emission potentials of formulations that were used in the base year cannot be changed, absent a SIP revision. "

Table 3. Nonattainment Area Goals.

	NAA SIP Goal (tons/day)
1 – Sacramento Metro	2.2
2 – San Joaquin Valley	18.1
3 – Southeast Desert	0.92
4 – Ventura	3.0
5 – South Coast	8.7

Procedure for Calculating Unadjusted and Adjusted VOC Emissions

Prior to 2008, DPR reported an unadjusted emission inventory that assumed the entire volatile portion of a fumigant product eventually volatilizes, contributing to atmospheric VOC loadings. However, several dozen field studies have shown that actual emissions from soil-applied fumigants such as methyl bromide vary by application method and are generally less than 100 percent. DPR has developed an adjustment procedure to account for the effect of application method on reducing fumigant VOC emissions.

The unadjusted inventory is based on the premise that the VOC emission from a single application of fumigant or nonfumigant product is equal to the amount used times the Emission Potential (EP) (Spurlock, 2002; 2006).

emission = lbs of product used x EP

In the adjusted inventory the emission from a single application of a *fumigant* active ingredient (AI) is reduced by an additional factor called the Application Method Adjustment Factor (AMAF), also referred to as the emission rating. AMAFs have been determined from field study data and are AI and application method specific (Barry et al., 2007). Since the AMAFs are based on field measured data for specific application methods and fumigants, they yield more refined estimates of fumigant VOC emissions than the previous unadjusted emission estimates

emission = lbs of product used x EP x AMAF

In the adjusted inventory, *nonfumigant* product emissions are not currently adjusted for application method or other field factors due to a lack of data to support such adjustments. Consequently their emissions are calculated using the same procedure as the unadjusted inventory.

Usually there are several different types of application methods used for a particular fumigant in any particular NAA. Each method of use (e.g. drip, sprinkler, shank, tarp, etc.) represents a fraction of the total number of methods used and is referred to as the Method Use Fraction (MUF). The sum of all *MUFs* for any particular (NAA/fumigant AI) combination is one. Use practices change over time so that different *MUF*s are used for the baseline year (1990) as opposed to more recent inventory years. For 2007 and earlier years, *MUF*s are determined in a number of different ways. For 1,3-dichloropropene the *MUF*s are determined from use data collected by the registrant in support of DPR’s township application caps; for metam sodium and metam potassium grower/applicator surveys were conducted to determine types of applications for different crops and areas. Methyl bromide and chloropicrin *MUF*s are based on expert opinion and regulatory history. Finally, *MUF*s for dazomet and sodium tetrathiocarbonate equal one because the *AMAF*s for each of these two fumigants are constant, independent of application method. A detailed discussion of how MUF and AMAFs were determined is given by Barry et al (2007).

The 2008 VOC regulations included a change to pesticide use reports that requires recording the specific application method for each fumigation within NAAs. The *MUFs* for 2008 and later years are calculated using the fumigation method documented in pesticide use reports rather than the surrogate data described above. The use of a fumigant code to identify the fumigant application method in the pesticide use report was implemented in 2009 (Ibewiro, 2008). For all NAAs combined, less than one percent of the pesticide use reports for 2011 are missing the identification of the application method (fumigant code). In these cases, DPR used a conservative approach by assuming that the application method with the highest AMAF allowed by the regulations for that fumigant was used. Field fumigation methods (FFM), FFM codes for pesticide use reporting, and corresponding emission ratings, and the AMAFs and method use fractions for 1990, 2005, 2006, 2007 and 2008 in each of the NAAs are included in the appendix of this document (Tables A1 – 1 to A1 – 27, Appendix 1B).

In addition to the VOC emissions derived from fumigant active ingredients, inert ingredients for products that contain chloropicrin, methyl bromide, 1,3-dichloropropene and methyl iodide are assumed to be volatile and are included in the inventory calculations. For the highest use products containing those fumigants, DPR analyzes their confidential statements of formula to determine the composition of inerts and decides whether those inerts are nonvolatile. Inert ingredients used in products containing metam sodium, metam potassium, sodium tetrathiocarbonate and dazomet are non-volatile and so do not contribute to the emission potential of these products.

VOC emissions were calculated for each NAA and summed according to primary active ingredient, application site, and emission category as defined by the Air Resources Board (ARB). The primary active ingredient is defined as the pesticide active ingredient present at the highest percentage in a product. If a pesticide product contains 20 percent of active ingredient “A” and 10 percent of active ingredient “B”, all estimated emissions from that product are assigned to the primary active ingredient “A”. This approach prevents “double-counting” of emissions from products containing two active ingredients.

Both unadjusted and adjusted emission inventory data for the top ten primary active ingredients contributing to May-October ozone in 2008, 2009 and 2010 are included in this report. Appendix 2 contains summaries of emissions attributable to specific application sites (or commodities). These summary data are provided only for *unadjusted* emissions because it is not possible to allocate adjusted emissions to specific application sites with the currently available data.

ARB defines four VOC emission categories: methyl bromide emissions from agricultural applications, non-methyl bromide emissions from agricultural applications, methyl bromide emissions from structural applications, and non-methyl bromide emissions from structural applications. Emissions were calculated for the May–October ozone season, and are reported as U.S. tons per day (tpd).

Data Revisions

DPR continually evaluates pesticide use report data, EP values, MUFs, and AMAFs to ensure the VOC inventory includes the most reliable data. Since the last annual report, a few methyl iodide fumigations occurred. DPR first registered and approved this fumigant for sale in California in December 2010. A handful of applications were made in the San Joaquin Valley NAA during May-October 2011, and these applications are included in the emission inventory. However, registration of methyl iodide was voluntarily withdrawn in March 2012, and all stocks previously sold were returned to the registrant. Therefore, no other methyl iodide applications are expected in the future. Based on uncertainties in the emission data, DPR assumed an AMAF of 100 percent for all methyl iodide fumigation methods when it registered this fumigant (Segawa and Barry, 2010). While the registrant subsequently submitted additional emission data, DPR had not yet reviewed the data when registration was withdrawn. Since only a handful of applications were made, DPR will continue to assume that the AMAF is 100 percent for all fumigation methods.

Table 4. New application method adjustment factors (emission ratings)

Method Description	Fumigation Method Code	AMAF (%)
Day Tarpaulin/Shallow/Broadcast	1701	100
Day Tarpaulin/Shallow/Bed	1702	100
Day Tarpaulin/Deep/Broadcast	1703	100
Day Chemigation (Drip)/Tarpaulin	1704	100
Day Auger-Probe	1705	100

VOLATILE ORGANIC COMPOUND INVENTORY RESULTS

The main text of this report summarizes the pesticide VOC emission inventory data for 2011 only. Adjusted and unadjusted emission data for 2008, 2009 and 2010, and unadjusted data for 2011 are summarized in Appendices 2 and 3. Previous inventory memos and the 2008, 2009 and 2010 reports included a summary of pesticide VOC emissions by commodity/site. At this time it is not possible to determine the breakdown of adjusted emissions by commodity, so only the *unadjusted* emissions are shown by commodity. Tables for emissions calculated for active ingredients (adjusted and unadjusted) and application sites (unadjusted) contain information for the top ten contributors only.

Figure 2 illustrates the changes in *unadjusted* VOC emissions from 1990 to 2011. These values are *unadjusted* and so do not take in to consideration MUFs and AMAFs that can only be applied to emissions in 2004 through 2011, and 1990. The figure is useful in that it compares emissions for the entire history of the inventory and shows trends in five NAAs.

Tables 5 and 6a and Figure 3 summarize the adjusted pesticide VOC emissions for 2004 through 2011, and compare them to the SIP goals that are based on a percentage reduction from the 1990. Table 6b compares the unadjusted and adjusted fumigant VOC emissions for 2004 through 2011. Table 6c shows the amount of emissions that resulted from nonfumigant products with emulsifiable concentrate formulations compared to all other formulations. The emissions in the base year are also included to reflect the long term decrease or increase. Generally, what the tables and figure show can be summarized as follows:

- Adjusted emissions in 2011 in the Sacramento Metro (1) continue to increase after the decline observed between 2006 and 2008. Emissions in 2011 increased from 0.980 tpd in 2010 to 1.004 tpd. Nonfumigants represented 94 percent of the total, the latter remaining well below the SIP goal. Fourty-two percent (0.400 tpd) of nonfumigant emissions were derived from products with emulsifiable concentrate formulations.
- Emissions in the South Coast NAA (5) decreased by 36 percent over 2010 values, falling to the lowest level seen since adjusted inventory calculations began (1.109 tpd), well below the SIP goal of 8.67 tpd. Eighty-three percent (83%) of the total adjusted VOC emissions came from non-fumigants (0.926 tpd), of which 37 percent are attributable to products with emulsifiable concentrate formulations.
- In 2011, fumigants accounted for only 35 percent of VOC emissions in the Southeast Desert (3), a significant departure from all previous years. Total VOC emissions in 2011 decreased by more than 50 percent from 2010, to fall to a level 90 percent below the SIP goal and one that has not been observed since adjusted inventory calculations began (0.210 tpd).
- 2010 VOC emissions in the Ventura NAA (4) increased by 0.290 tpd from the previous year but continue to meet the regulatory goals for 2011and 2012. Eighty-five percent (85%) of emissions came from fumigants, extending increases observed in the previous three years.
- In the San Joaquin Valley NAA (2), nonfumigants accounted for 74 percent of the total VOC emissions in 2011. In this NAA, VOC emissions increased from 2010 to 2011 by approximately seven percent, and continue to be below the SIP goal by 1.28 tpd.

> Emissions in 2011 (16.774 tpd) were below the average level of 2004-2010 (17.155 tpd), and are largely derived from nonfumigant sources. Nonfumigant emissions from products with emulsifiable concentrate formulations (6.853 tpd) accounted for 41 percent of the total VOC emissions for this NAA, up from 6.604 tpd in 2010 and 5.913 tpd in 2009.

Pesticide use varies from year to year depending on many factors, including weather, pest problems, economics and types of crops planted. Increases and decreases in pesticide use from one year to the next or in the span of a few years do not necessarily indicate a trend. Such variances are and will continue to be a normal occurrence. For example, extremely heavy rains result in excessive weeds, thus more pesticides may be used; drought conditions may result in fewer planted acres, thus less pesticide may be used. A more detailed explanation of pesticide use patterns is given in DPR's annual summary of pesticide use reports available at: http://www.cdpr.ca.gov/docs/pur/pur11rep/chmrpt11.pdf (pending).

While emissions in the Sacramento Metro, San Joaquin Valley and Ventura nonattainment areas increased in 2011, DPR, growers, registrants, and others have taken steps to reduce VOC emissions. In the last few years, DPR has registered several reformulated products with lower EPs, including products containing chlorpyrifos and abamectin that are major VOC contributors in the San Joaquin Valley. However, voluntary use of the reformulated products and fumigant regulatory restrictions may not be sufficient to meet the SIP goal for years with the highest pesticide use in the San Joaquin Valley. Based upon this possibility and consistent with the SIP amendment approved by U.S. EPA in August 2012, DPR has proposed regulations to reduce VOC emissions from nonfumigant pesticide products in the San Joaquin Valley, with the following major elements:

- The regulations specify pesticide products containing abamectin, chloropyrifos, gibberellins, or oxyfluorfen as "high-VOC" or "low-VOC" based on the product's emission potential.
- If the 17.2 tons/day trigger level is reached in the San Joaquin Valley, instead of triggering a fumigant limit in the Valley, the amended regulations trigger a prohibition on most uses of high-VOC nonfumigant products when applied to any of seven crops, with some exceptions.
- For high-VOC products to be sold or used in the San Joaquin Valley:
    - Pesticide dealers are required to provide information to purchasers on the possible restrictions for using high-VOC products.
    - Growers of certain crops can only use high-VOC pesticides if they have a recommendation from a pest control adviser.
    - If high-VOC prohibitions are in effect, pest control advisers must justify use of a high-VOC product as consistent with the any exceptions to the restrictions.

DPR anticipates that these regulations would be in effect for the May-October 2014 ozone season. Details of the proposed regulations are available at http://www.cdpr.ca.gov/docs/legbills/rulepkgs/12-001/12-001.htm

Figure 2. Annual ***unadjusted*** ozone season pesticide VOC emissions by NAA from 1990 to 2011, inclusive.

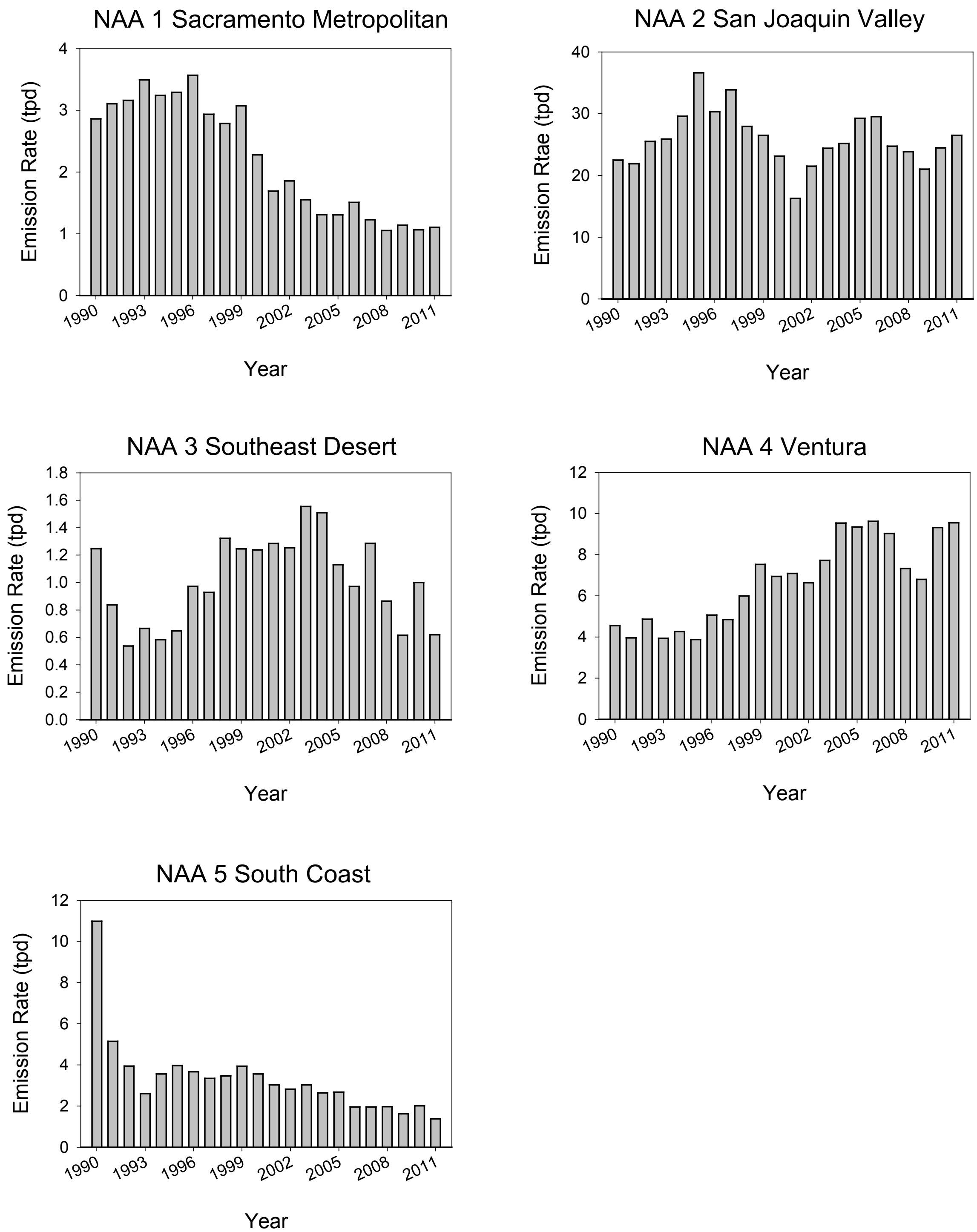


Table 5. May–October (ozone season) ***adjusted*** pesticide VOC emissions and goals.

NAA	1990 Emissions (tons/day)	SIP Goal (tons/day)	2004 Emissions (tons/day)	2005 Emissions (tons/day)	2006 Emissions (tons/day)	2007 Emissions (tons/day)	2008 Emissions (tons/day)	2009 Emissions (tons/day)	2010 Emissions (tons/day)	2011 Emissions (tons/day)
1 – Sacramento Metro	2.784	2.2	1.235	1.239	1.354	1.041	0.903	0.910	0.980	1.004
2 – San Joaquin Valley	20.517	18.1	17.322	20.740	21.305	17.093	14.525	13.474	15.625	16.774
3 – Southeast Desert	1.153	0.92	0.995	0.740	0.634	0.762	0.286	0.283	0.460	0.210
4 – Ventura	3.787	3.0 a	3.924	3.617	3.682	3.363	1.739	2.081	2.599	2.889
5 – South Coast	10.840	8.7	1.922	1.969	1.482	1.487	1.283	1.227	1.740	1.109

a These numbers reflect the SIP goal for 2012 in Ventura, and do not reflect the phase in of reductions between 2008 and 2012.

Table 6a. May–October (ozone season) ***adjusted*** fumigant and nonfumigant pesticide VOC emissions.

NAA	1990 Emissions (tons/day)	2004 Emissions (tons/day)	2005 Emissions (tons/day)	2006 Emissions (tons/day)	2007 Emissions (tons/day)	2008 Emissions (tons/day)	2009 Emissions (tons/day)	2010 Emissions (tons/day)	2011 Emissions (tons/day)
1 – Sacramento Metro									
Fumigants	0.384 (14%)	0.111 (9%)	0.085 (7%)	0.162 (12%)	0.189 (18%)	0.064 (7%)	0.134 (15%)	0.097 (10%)	0.061 (6%)
Nonfumigants	2.400 (86%)	1.124 (91%)	1.154 (93%)	1.192 (88%)	0.851 (82%)	0.838 (93%)	0.775 (85%)	0.833 (90%)	0.944 (94%)
2 - San Joaquin Valley									
Fumigants	5.536 (27%)	6.362 (37%)	6.910 (33%)	6.808 (32%)	6.123 (36%)	3.370 (23%)	3.857 (27%)	4.097 (26%)	4.399 (26%)
Nonfumigants	14.981 (73%)	10.960 (63%)	13.831 (67%)	14.498 (68%)	10.970 (64%)	11.154 (77%)	9.887 (73%)	11.528 (74%)	12.375 (74%)
3 - Southeast Desert									
Fumigants	0.840 (73%)	0.762 (77%)	0.474 (64%)	0.413 (65%)	0.575 (75%)	0.119 (42%)	0.137 (48%)	0.273 (59%)	0.073 (35%)
Nonfumigants	0.313 (27%)	0.233 (23%)	0.266 (36%)	0.221 (35%)	0.187 (25%)	0.167 (58%)	0.146 (52%)	0.186 (41%)	0.137 (65%)
4 - Ventura									
Fumigants	3.140 (83%)	3.302 (84%)	3.119 (86%)	3.175 (86%)	2.935 (87%)	1.252 (72%)	1.627 (78%)	2.122 (82%)	2.464 (85%)
Nonfumigants	0.647 (17%)	0.622 (16%)	0.497 (14%)	0.508 (14%)	0.428 (13%)	0.486 (28%)	0.454 (22%)	0.477 (18%)	0.425 (15%)
5 – South Coast									
Fumigants	9.372 (86%)	0.702 (37%)	0.594 (30%)	0.422 (28%)	0.411 (28%)	0.377 (29%)	0.299 (24%)	0.375 (22%)	0.183 (17%)
Nonfumigants	1.468 (14%)	1.220 (63%)	1.375 (70%)	1.060 (72%)	1.075 (72%)	0.906 (71%)	0.927 (76%)	1.365 (78%)	0.926 (83%)

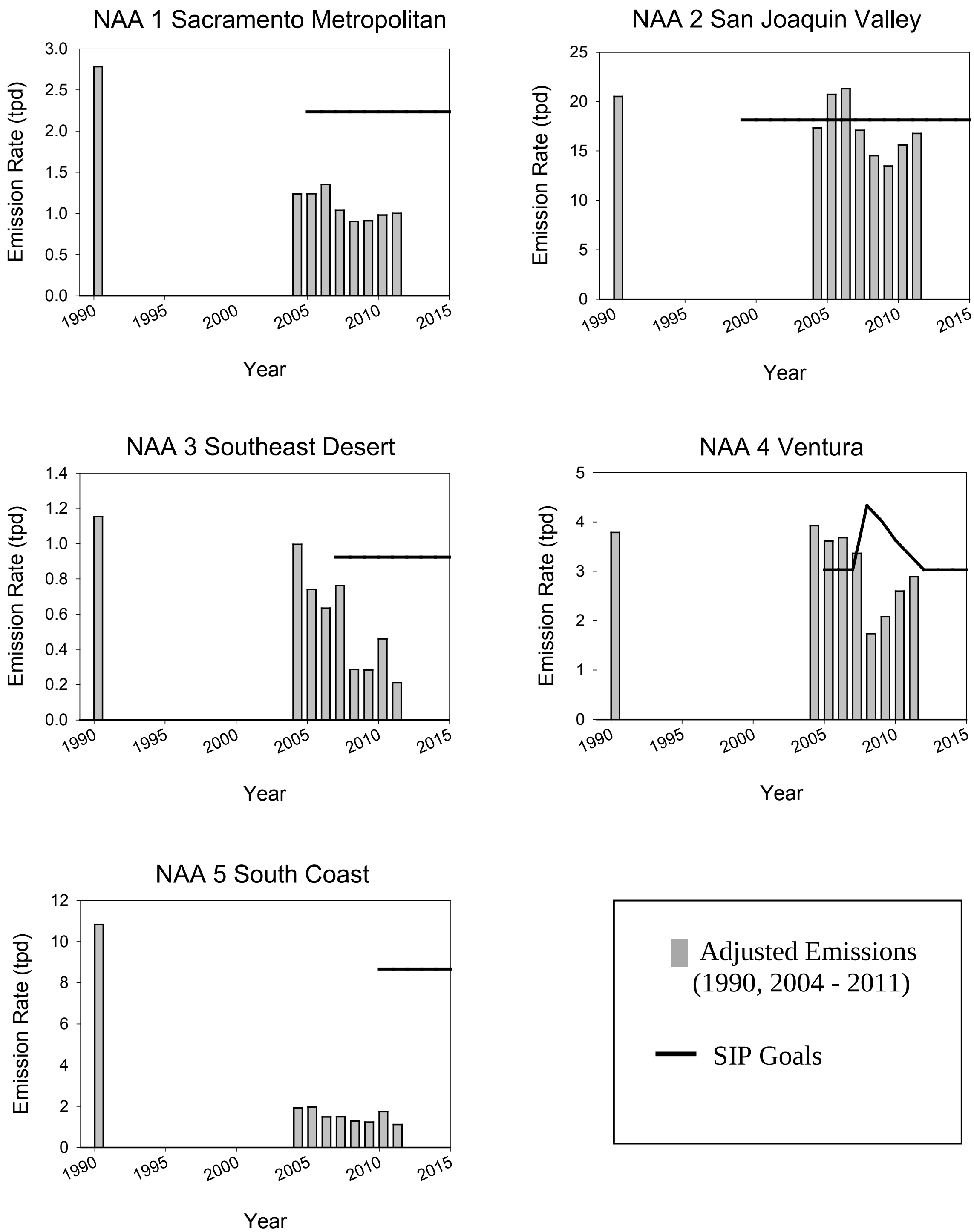
Table 6b. May–October (ozone season) ***unadjusted and adjusted*** fumigant pesticide VOC emissions. VOC/applied (tons or pounds of VOCs emitted for each ton or pound of fumigant applied) was calculated by dividing the adjusted fumigant emissions by the unadjusted fumigant emissions. The trends over time and between NAAs indicate if the fumigants and/or fumigation methods used are lower-emitting or higher-emitting.

NAA	1990 Emissions	2004 Emissions	2005 Emissions	2006 Emissions	2007 Emissions	2008 Emissions	2009 Emissions	2010 Emissions	2011 Emissions
1 – Sacramento Metro									
Unadjusted (tons/day)	0.461	0.186	0.151	0.315	0.383	0.241	0.363	0.181	0.162
Adjusted (tons/day)	0.384	0.111	0.085	0.162	0.189	0.064	0.134	0.097	0.061
VOC/applied (tons/ton)	0.833	0.597	0.563	0.514	0.493	0.266	0.369	0.536	0.377
2 - San Joaquin Valley									
Unadjusted (tons/day)	7.491	14.213	15.400	15.034	13.750	12.620	11.119	12.944	14.116
Adjusted (tons/day)	5.536	6.362	6.910	6.808	6.123	3.370	3.587	4.097	4.399
VOC/applied (tons/ton)	0.739	0.448	0.449	0.453	0.445	0.267	0.323	0.317	0.312
3 - Southeast Desert									
Unadjusted (tons/day)	0.933	1.275	0.863	0.750	1.086	0.684	0.469	0.814	0.482
Adjusted (tons/day)	0.840	0.762	0.474	0.413	0.575	0.119	0.137	0.273	0.073
VOC/applied (tons/ton)	0.900	0.598	0.549	0.551	0.529	0.174	0.292	0.335	0.151
4 - Ventura									
Unadjusted (tons/day)	3.909	8.916	8.841	9.113	8.658	6.543	6.345	8.844	9.126
Adjusted (tons/day)	3.140	3.302	3.119	3.175	2.935	1.252	1.627	2.122	2.464
VOC/applied (tons/ton)	0.803	0.370	0.353	0.348	0.339	0.191	0.256	0.240	0.270
5 – South Coast									
Unadjusted (tons/day)	9.514	1.418	1.301	0.898	0.883	1.043	0.694	0.647	0.449
Adjusted (tons/day)	9.372	0.702	0.594	0.422	0.411	0.377	0.299	0.375	0.183
VOC/applied (tons/ton)	0.985	0.495	0.457	0.470	0.465	0.361	0.431	0.580	0.408

Table 6c. May-October (ozone season) nonfumigant pesticide VOC emissions derived from Emulsifiable Concentrate formulations (ECs) and all Others. The adjusted and unadjusted VOC emissions for nonfumigants are the same.

NAA	1990 Emissions (tons/day)	2004 Emissions (tons/day)	2005 Emissions (tons/day)	2006 Emissions (tons/day)	2007 Emissions (tons/day)	2008 Emissions (tons/day)	2009 Emissions (tons/day)	2010 Emissions (tons/day)	2011 Emissions (tons/day)
1 – Sacramento Metro									
ECs	1.129 (47%)	0.534 (47%)	0.642 (56%)	0.640 (54%)	0.470 (55%)	0.487 (58%)	0.379 (49%)	0.411 (47%)	0.400 (42%)
Others	1.271 (53%)	0.590 (53%)	0.513 (44%)	0.552 (46%)	0.382 (45%)	0.351 (42%)	0.397 (51%)	0.472 (53%)	0.543 (58%)
2 - San Joaquin Valley									
ECs	12.162 (81%)	8.613 (79%)	10.199 (74%)	10.119 (70%)	7.547 (69%)	7.491 (67%)	5.913 (60%)	6.604 (57%)	6.853 (55%)
Others	2.819 (19%)	2.347 (21%)	3.632 (26%)	4.379 (30%)	3.423 (31%)	3.663 (33%)	3.974 (40%)	4.924 (43%)	5.522 (45%)
3 - Southeast Desert									
ECs	0.217 (69%)	0.150 (64%)	0.185 (69%)	0.131 (59%)	0.105 (56%)	0.089 (53%)	0.073 (50%)	0.092 (49%)	0.071 (52%)
Others	0.096 (31%)	0.083 (36%)	0.082 (31%)	0.091 (41%)	0.083 (44%)	0.078 (47%)	0.074 (50%)	0.095 (51%)	0.066 (48%)
4 - Ventura									
ECs	0.402 (62%)	0.263 (42%)	0.286 (58%)	0.272 (54%)	0.210 (49%)	0.237 (49%)	0.227 (50%)	0.224 (47%)	0.184 (43%)
Others	0.245 (38%)	0.360 (58%)	0.211 (42%)	0.236 (46%)	0.218 (51%)	0.250 (51%)	0.227 (40%)	0.253 (53%)	0.242 (57%)
5 – South Coast									
ECs	0.921 (63%)	0.647 (53%)	0.762 (55%)	0.514 (48%)	0.459 (43%)	0.339 (37%)	0.376 (41%)	0.418 (31%)	0.346 (37%)
Others	0.547 (37%)	0.573 (47%)	0.613 (45%)	0.546 (52%)	0.616 (57%)	0.567 (63%)	0.552 (59%)	0.947 (69%)	0.580 (63%)

Figure 3. Annual ozone season pesticide VOC emissions by NAA. These figures show adjusted emissions and SIP goals (reductions from 1990 emissions).



Sacramento Metro Area - NAA 1

The Sacramento Metro NAA (NAA 1) 2011 adjusted emissions increased to above the levels of the three previous years. Adjusted emissions in 2008 were 0.903 tpd which increased to 0.910 tpd in 2009, 0.980 tpd in 2010 and increased again to 1.004 in 2011. Fumigant emissions, accounting for seven percent of adjusted emissions in 2008 (0.064 tpd), increased in 2009 to 0.134 tpd, decreased to 0.097 tpd in 2010 and decreased further to 0.061 tpd in 2011. In 2011, 94 percent of emissions were attributable to nonfumigants, 42 percent (0.400 tpd) of which were from products with emulsifiable concentrate formulations. Total adjusted VOC emissions (1.004 tpd) continue to remain well below the SIP goal of 2.2 tpd. (Tables 6a, 6b, 6c, Figures 3, 4).

Emissions from chlorpyrifos use decreased from 0.076 tpd in 2010 and 0.058 tpd in 2011, the latter accounting for less than six percent of the total emissions in 2011 (Table 7). Emissions from the use of 1,3-dichloropropene, which doubled from 2008 to 2009, decreased to 0.035 tpd in 2010, and further to 0.019 tpd in 2011 accounting for two percent of emissions, and emissions from methyl bromide use also declined from 0.046 tpd in 2010 to 0.025 tpd in 2011. Emissions from bifenthrin, a pyrethroid insecticide used on a range of crops, have increased every year from 0.026 tpd in 2008 to 0.075 tpd in 2011, with more than double the amount of emissions between 2010 and 2011. Emissions from abamectin also continued to rise from 0.024 tpd in 2008 to 0.056 tpd in 2011. (Tables 7, A3-1a to A3-1d, Figure 5).

In 2011 combined emissions from tomatoes and walnuts accounted for 29 percent of the total emissions in the Sacramento Metro Area NAA (0.130 tpd and 0.187 tpd, respectively), with emissions from rice accounting for an additional 18 percent, a decrease from 0.206 tpd in 2010 to 0.201 tpd in 2011. Emissions from wine grapes rose from 0.055 tpd in 2010 to 0.078 tpd in 2011. More than half of bifenthrin use was on walnuts and tomatoes, and almost two thirds of abamectin use was on grapes, walnuts and tomatoes. It should be noted that in 2011 emissions from the category "soil application" as a site/commodity increased to 0.11tpd but did not return to the levels observed prior to 2009. The "soil application" category is often used when a field is treated before a commodity has been planted. As in 2010 it is most likely that this category has been replaced by more specific annual commodities such as tomatoes, sunflowers, strawberries, alfalfa, etc. (Tables 8, A2-1e to A2-1h, Figure 6).

Since this NAA has complied with the SIP goal for several years, most provisions of the 2008 fumigant regulations do not apply. Therefore, the fumigant regulations had little or no impact on emissions in this NAA.

Using the ARB emission inventory classification, emissions from structural applications of methyl bromide continue to be less than 0.001 tpd. Agricultural applications increased from 0.036 tpd in 2009 to 0.058 tpd in 2010, but decreased to 0.038 tpd in 2011. Non-methyl bromide emissions from structural applications increased from 0.048 tpd in 2010 to 0.094 tpd in 2011 (Tables 9, A2-1i - A2-1l), corresponding to the decrease in methyl bromide emissions shown in Figure 5 and the increase in emissions from structural pest control in Figure 6.

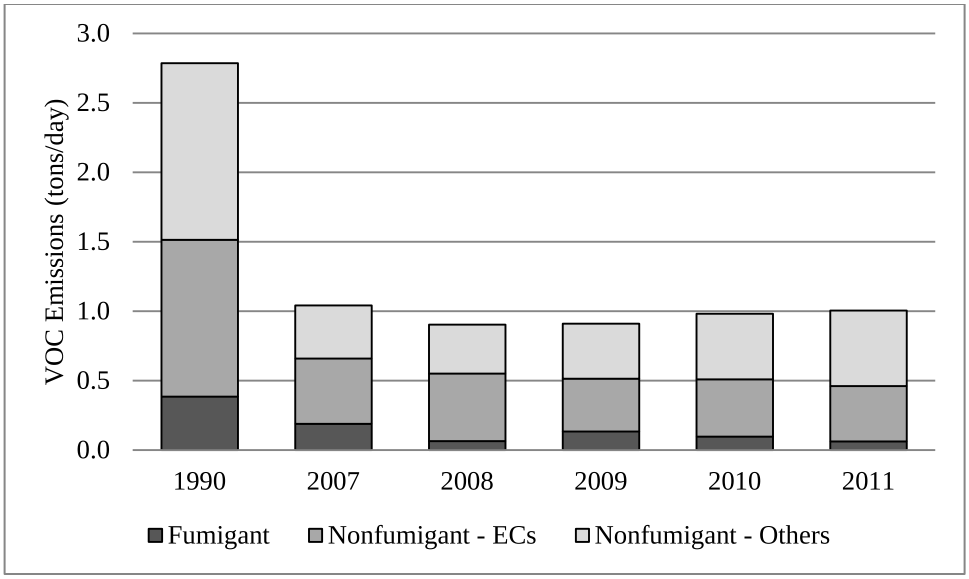


Figure 4. Pesticide VOC emissions for the Sacramento Metro NAA, May–October. Emissions for each year are divided into fumigants, nonfumigants with emulsifiable concentrate formulations (ECs) and other nonfumigants (Others). Fumigant emissions are *adjusted* to account for fumigation method.

Table 7. Top ten primary active ingredients contributing to **2011** May-October ozone season *adjusted* VOC emissions in NAA 1, the Sacramento Metro Area.

Primary AI	Total Product Adjusted Emissions (tons/day)	Percent of All NAA 1 May – Oct 2011 Adjusted Emissions
BIFENTHRIN	0.075	7.51
CHLORPYRIFOS	0.058	5.76
ABAMECTIN	0.056	5.56
PENOXSULAM	0.047	4.66
OXYFLUORFEN	0.043	4.25
THIOBENCARB	0.042	4.15
TRIFLURALIN	0.037	3.68
GLUFOSINATE-AMMONIUM	0.035	3.52
PROPANIL	0.034	3.39
CLOMAZONE	0.032	3.18

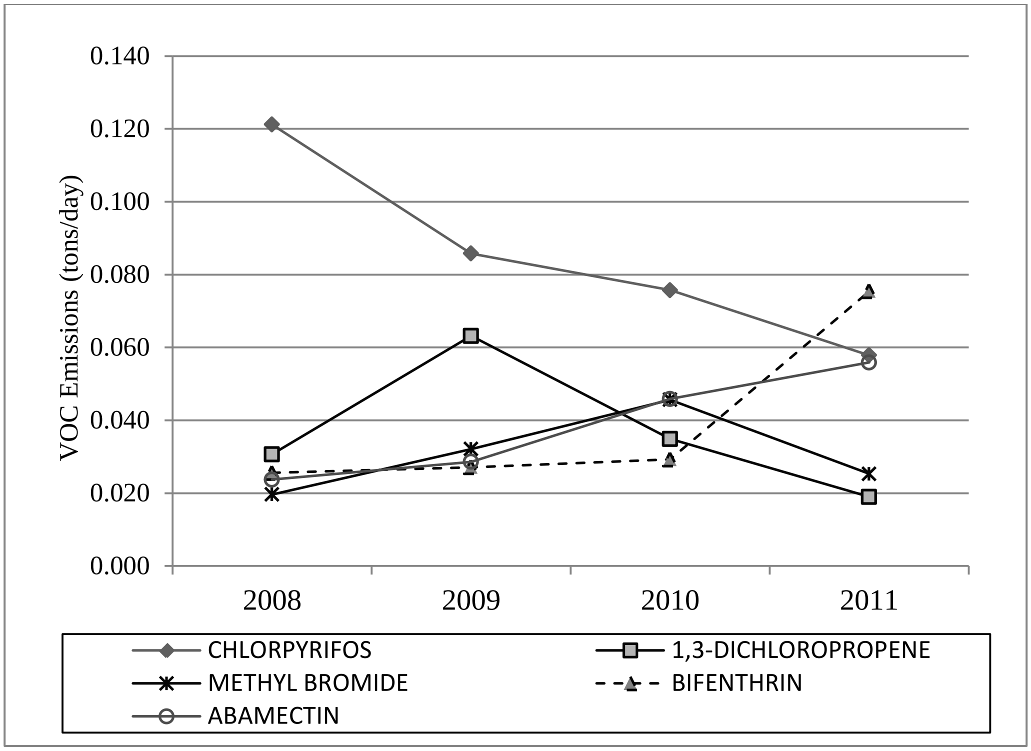


Figure 5. Changes in adjusted emissions of selected AIs in the Sacramento Metro NAA from 2008 to 2011.

Table 8. Top ten pesticide application sites contributing to **2011** May-October ozone season *unadjusted* VOC emissions in NAA 1.

Application Site	**Emissions (tons/day)**	**Percent of all NAA 1 May – Oct 2011 emissions**
RICE	0.201	18.16
WALNUT	0.187	16.89
TOMATOES, FOR PROCESSING/CANNING	0.130	11.78
STRUCTURAL PEST CONTROL	0.093	8.45
GRAPES, WINE	0.078	7.04
RIGHTS OF WAY	0.059	5.31
ALMOND	0.055	4.93
LANDSCAPE MAINTENANCE	0.044	3.95
N-OUTDR CONTAINER/FLD GRWN PLANTS	0.038	3.43
SUNFLOWER, GENERAL	0.032	2.91

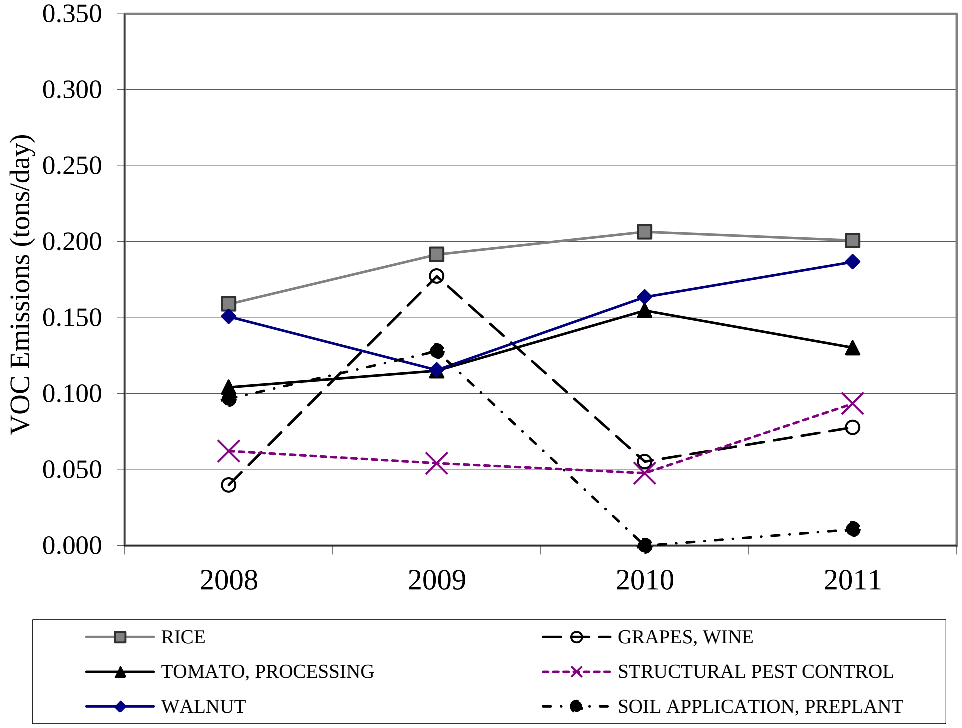


Figure 6. Changes in unadjusted emissions from selected commodities/sites in the Sacramento Metro NAA from 2008 to 2011.

Table 9. *Unadjusted* **2011** May–October VOC emissions in NAA1 by ARB emission inventory classification (tons per day, tpd).

NAA 1 - 2011	**Agricultural Applications**	**Structural Applications**
METHYL BROMIDE EMISSIONS	0.038	0.000
NON-METHYL BROMIDE EMISSIONS	0.967	0.094

San Joaquin Valley - NAA 2

Adjusted emissions in 2011 rose from 15.625 tpd in 2010 to 16.774 tpd in 2011, an increase of seven percent. As with the 2010 emissions, the 2011 emissions are below the SIP goal of 18.1 tpd (Tables 6a, 6b, Figure 3, 7).

Nonfumigants continue to account for the largest portion of adjusted emissions, with more than 74 percent of the total in 2011 (12.375 tpd). Overall, nonfumigant emissions increased by 0.847 tpd (11 percent) in 2011, exceeding annual nonfumigant emissions since 2007. In 2011, fifty-five percent (55%) of nonfumigant emissions were from products with emulsifiable concentrate formulations (6.853 tpd), an increase of 0.249 tpd from 2010 (Table 6c). The top emission contributor for 2008 through 2011 was the nonfumigant, chlorpyrifos, which accounted for 2.221 tpd in 2008, 1.397 tpd in 2009, 1.856 tpd in 2010 and 1.975 tpd in 2011. (Tables 10, A3-2a to A3-2d, Figure 7). In 2011, 22 percent of emissions from chlorpyrifos came from use on cotton, with another 52 percent of emissions from chlorpyrifos from the combined use on almonds, oranges and alfalfa. Fumigant use on carrots, in the form of metam-sodium, 1,3-dichloropropene and potassium N-methyldithiocarbamate, accounted for more than 99 percent of emissions from this commodity (Tables 11, A2- 2e to A2-2h, Figure 9). Total adjusted emissions of metam-sodium, primarily from use on carrots, potatoes and onions, increased slightly from 1.178 tpd in 2010 to 1.193 tpd in 2011. Emissions from products containing bifenthrin almost doubled from 0.249 tpd in 2010 to 0.495 tpd in 2011, due in large part to increased use on cotton and almonds (Figure 8). Emission from abamectin products also increased in 2011 to 1.569 tpd, up from 1.103 tpd in 2010, again due largely to increased use on cotton and almonds. Only three applications of methyl iodide were reported in nonattainment areas in 2011, and all took place in the San Joaquin Valley. The combined contribution of these applications to the VOC inventory for this NAA was 0.0004 tpd.

Adjusted fumigant emissions increased by 0.302 tpd (7 percent) between 2010 and 2011, which is about half the increase observed between 2009 and 2010. Use (unadjusted emissions) of fumigants increased by 9 percent from 12.944 tpd to 14.116 tpd (Table 6b), indicating the use of low-emission fumigation methods required by the 2008 regulations is now well established.

Using the ARB emission inventory classification, emissions from structural applications of methyl bromide increased slightly in 2011 going from less than 0.001 tpd in 2010 to 0.001 tpd in 2011. Agricultural applications decreased by approximately 32 percent from 1.044 tpd in 2010 to 0.709 tpd in 2011. Non-methyl bromide emissions from agricultural applications increased from 22.583 tpd in 2010 to 25.380 tpd in 2011, and structural applications increased from 0.236 tpd in 2010 to 0.271 tpd in 2011. (Tables 12, A2-2i to A2-2l).

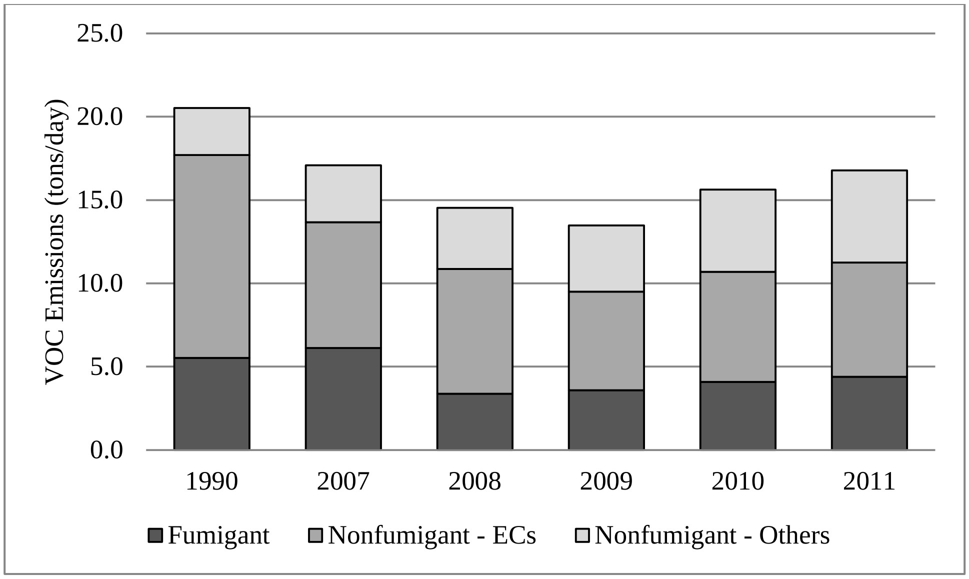


Figure 7. Pesticide VOC emissions for the San Joaquin Valley NAA, May–October. Emissions for each year are divided into fumigants, nonfumigants with emulsifiable concentrate formulations (ECs) and other nonfumigants (Others). Fumigant emissions are *adjusted* to account for fumigation method.

Table 10. Top ten primary active ingredients contributing to **2011** May-October ozone season *adjusted* VOC emissions in NAA 2, the San Joaquin Valley.

Primary AI	**Total Product Adjusted Emissions (tons/day)**	**Percent of All NAA 2 May – Oct 2011 Adjusted Emissions**
CHLORPYRIFOS	1.975	11.77
1,3-DICHLOROPROPENE	1.958	11.67
ABAMECTIN	1.569	9.35
METAM-SODIUM	1.193	7.11
OXYFLUORFEN	0.633	3.78
GIBBERELLINS	0.622	3.71
BIFENTHRIN	0.495	2.95
POTASSIUM N-METHYLDITHIOCARBAMATE	0.442	2.63
GLYPHOSATE, ISOPROPYLAMINE SALT	0.423	2.52
METHYL BROMIDE	0.413	2.46

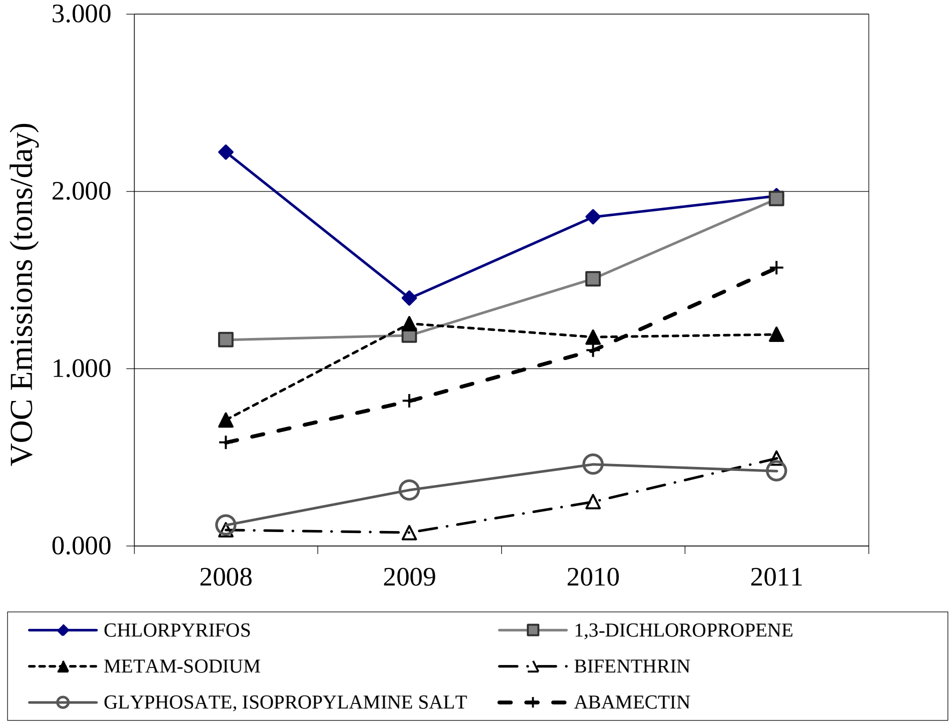


Figure 8. Changes in adjusted emissions of selected AIs in the San Joaquin Valley NAA from 2008 to 2011.

Table 11. Top ten pesticide application sites contributing to **2011** May-October ozone season *unadjusted* VOC emissions in NAA 2.

Application Site	Emissions (tons/day)	Percent of all NAA 2 May – Oct 2011 emissions
ALMOND	3.926	14.82
CARROTS, GENERAL	3.670	13.85
COTTON	2.488	9.39
GRAPES	1.597	6.03
ORANGE	1.210	4.57
N-OUTDR CONTAINER/FLD GRWN PLANTS	0.944	3.57
ONION	0.933	3.52
SOIL APPLICATION, PREPLANT-OUTDOOR	0.891	3.36
POTATO	0.890	3.36
WALNUT	0.872	3.29

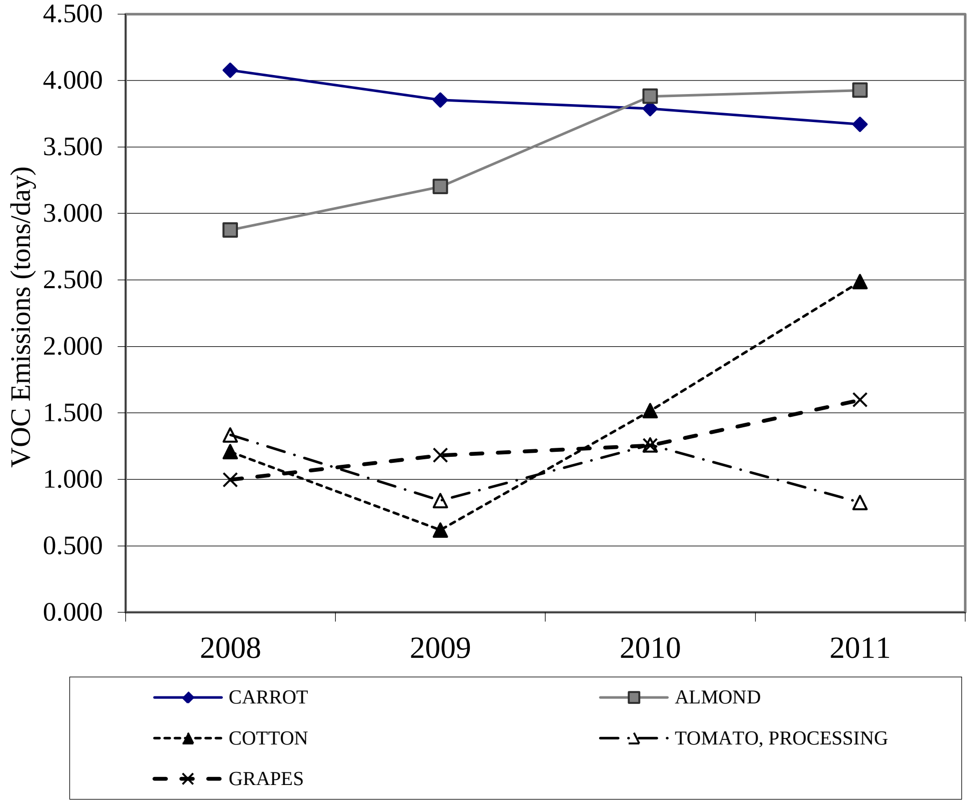


Figure 9. Changes in unadjusted emissions from selected commodities/sites in the San Joaquin Valley NAA from 2008 to 2011.

Table 12. *Unadjusted* **2011** May–October VOC emissions in NAA 2 by ARB emission inventory classification (tons per day, tpd).

NAA 2 - 2011	Agricultural Applications	Structural Applications
METHYL BROMIDE EMISSIONS	0.709	0.001
NON-METHYL BROMIDE EMISSIONS	25.380	0.271

Southeast Desert - NAA 3

Total adjusted emissions for the Southeast Desert decreased from 0.460 tpd in 2010 to 0.210 tpd in 2011. The 2011 rate is well below the SIP goal of 0.92 tpd, (Tables 6a, 6b, Figure 3, 10).

Fumigants accounted for 35 percent of the emissions in this NAA in 2011, decreasing to 0.073 tpd, one quarter of, and significantly lower than at any time since adjusted inventory calculations began. The reduction of emissions from metam-sodium accounted for most of the overall reduction of emissions, dropping from 0.159 tpd in 2010 to 0.038 tpd in 2011. Emissions from other fumigants, notably 1,3-dichloropropene, dazomet and methyl bromide also declined between 2010 and 2011 (Tables 13, A3-3a to A3-3d, Figure 11). Approximately half of emissions from nonfumigants came from products with emulsifiable concentrate formulations (Table 6c). With the exception of peppers, which accounted for 45 percent of all emissions, unadjusted emissions from most of the major commodities during the ozone season in 2011 decreased. Emissions from uncultivated agricultural sites, which are applications that are made before the grower has made a decision about which commodity to plant, increased, and may account for the decrease in emissions from other commodities. The decline in emissions from the use of metam-sodium correlates to the reduction in emissions from potatoes and watermelons (Tables 14, A2- 3d to A2-3h, Figure 12).

Unadjusted fumigant emissions, which indicate actual use, were reduced by 40 percent in 2011, from 0.814 tpd in 2010 to 0.482 tpd, however adjusted fumigant emissions declined by 73 percent (Table 6b). The greater decline in adjusted emissions compared to unadjusted emissions (0.335 to 0.151 tons VOCs emitted per ton of fumigant applied) indicates the use of lower emission application methods and the success of the 2008 fumigant regulations. Fumigants accounted for almost two-thirds of the pesticide emissions in 2010 for this NAA, but only accounted for slightly more than a third of the emissions in 2011 (Figure 10).

Using the ARB emission inventory classification, emissions from structural applications of methyl bromide have been less than 0.001 tpd since 2005. Agricultural applications of methyl bromide continue to decline from 0.077 tpd in 2008 to 0.005 tpd in 2011. These findings are consistent with the trend found for the decline in use of methyl bromide on turf/sod. Non-methyl bromide emissions from agricultural applications decreased by 38 percent from 0.928 tpd in 2010 to 0.573 tpd in 2011. Structural non-methyl bromide emissions also declined from 0.058 tpd in 2010 to 0.041 tpd in 2011 (Tables 15, A2-3i to A2-3l).

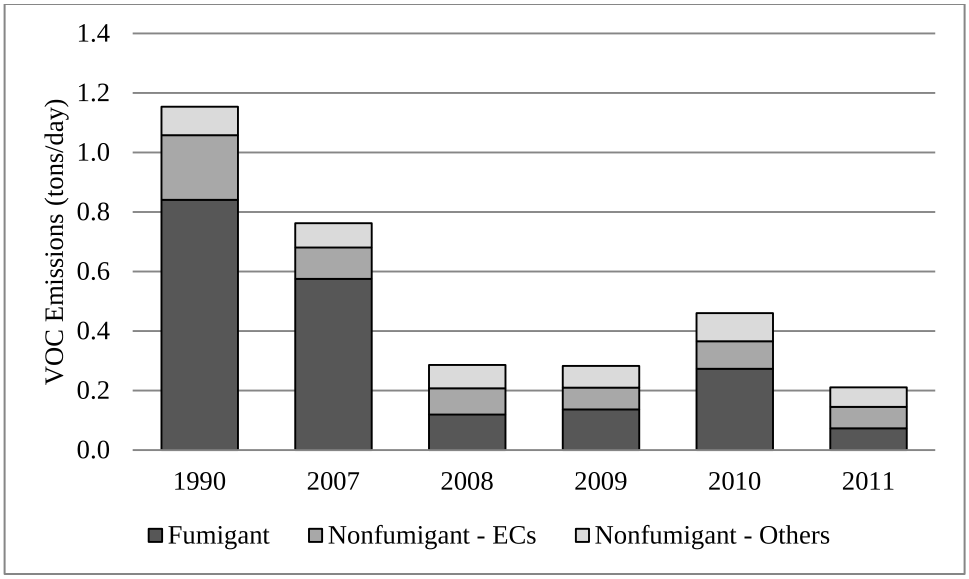


Figure 10. Pesticide VOC emissions for the Southeast Desert NAA, May–October. Emissions for each year are divided into fumigants, nonfumigants with emulsifiable concentrate formulations (ECs) and other nonfumigants (Others). Fumigant emissions are *adjusted* to account for fumigation method.

Table 13. Top ten primary active ingredients contributing to **2011** May-October ozone season *adjusted* VOC emissions in NAA 3, the Southeast Desert

Primary AI	**Total Product Adjusted Emissions (tons/day)**	**Percent of All NAA 3 May – Oct 2011 Adjusted Emissions**
METAM-SODIUM	0.038	17.84
BENSULIDE	0.023	10.86
1,3-DICHLOROPROPENE	0.017	8.10
EPTC	0.011	5.42
PERMETHRIN	0.009	4.04
DAZOMET	0.008	3.81
GLYPHOSATE, ISOPROPYLAMINE SALT	0.007	3.38
BIFENTHRIN	0.006	2.97
N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	0.006	2.72
TRIFLURALIN	0.005	2.49

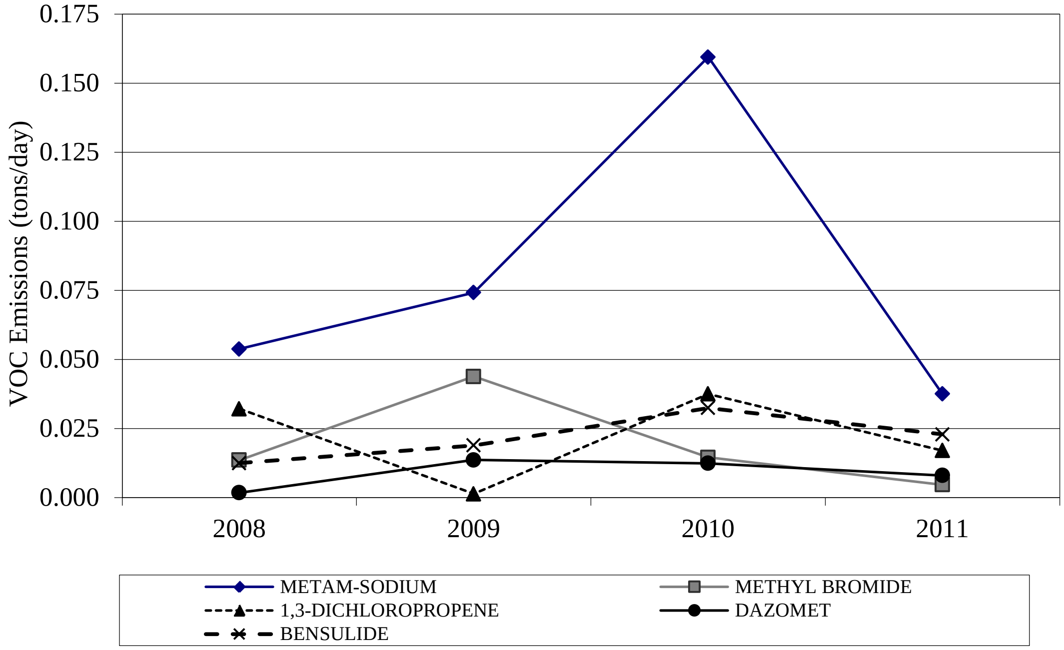


Figure 11. Changes in adjusted emissions of selected AIs in the Southeast Desert NAA from 2008 to 2011.

Table 14. Top ten pesticide application sites contributing to **2011** May-October ozone season *unadjusted* VOC emissions in NAA 3.

Application Site	Emissions (tons/day)	Percent of all NAA 3 May – Oct 2011 emissions
PEPPERS	0.280	45.20
UNCULTIVATED AGRICULTURAL AREAS*	0.112	18.07
STRUCTURAL PEST CONTROL	0.041	6.60
STRAWBERRY	0.027	4.33
CORN, HUMAN CONSUMPTION	0.021	3.40
BEANS	0.017	2.82
LETTUCE, LEAF	0.017	2.72
LANDSCAPE MAINTENANCE	0.017	2.69
RIGHTS OF WAY	0.017	2.69
CHINESE GREENS, CHINESE LEAFY VEGETABLES	0.014	2.21

* Treatment of an area prior to determining which crop will be planted.

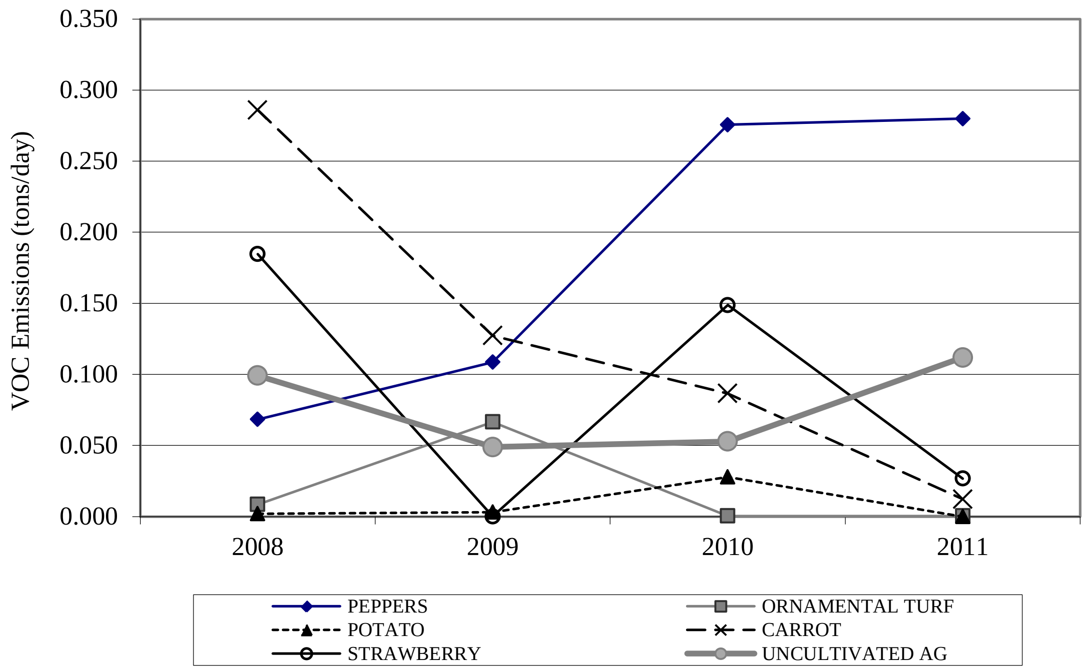


Figure 12. Changes in unadjusted emissions from selected commodities/sites in the Southeast Desert NAA from 2008 to 2011.

Table 15. *Unadjusted* **2011** May–October VOC emissions in NAA 3 by ARB emission inventory classification (tons per day, tpd).

NAA 3 - 2011	**Agricultural Applications**	**Structural Applications**
METHYL BROMIDE EMISSIONS	0.005	0.000
NON-METHYL BROMIDE EMISSIONS	0.573	0.041

Ventura - NAA 4

Ozone season adjusted emissions in the Ventura NAA (NAA 4) increased by 0.290 tpd from 2.599 tpd in 2010 to 2.889 tpd in 2011 (11 percent). Emissions continued to meet the SIP goal for 2012 (3.0 tpd). (Tables 6a, 6b, Figure 3, 13).

As in previous years, fumigants dominate the pesticide inventory for this NAA. In 2011 fumigants accounted for 85 percent of the emissions, up from 82 percent in 2010 and 78 percent in 2009. The most heavily used fumigants in NAA 4 in 2011 were chloropicrin, methyl bromide, and 1,3-dichloropropene, which together accounted for over 72 percent of emissions (Tables 16, A3-4a to A3-4d, Figure 14). Emissions from methyl bromide and chloropicrin increased in 2011, while emissions from 1,3-dichloropropene declined from 0.380 tpd in 2010 to 0.222 tpd in 2011, but were above emission levels in 2009 (0.183 tpd). In 2011 over 96 percent of chloropicrin emissions and over 82 percent of methyl bromide emissions came from applications to strawberries, and 14 percent of methyl bromide emissions were derived from applications to raspberries. Emissions from the site “soil fumigation/preplant” continued to decline (0.010 tpd) indicating that in 2011 growers identified which crops were to be planted prior to fumigation. Other notable commodities/sites in 2011 include lemons, tomatoes, carrot and peppers. (Tables 17, A2-4e to A2-4h, Figure 15). In 2011 forty-three percent (43%) of nonfumigant emissions, which account for 15 percent of this NAA’s total adjusted emissions, were from products with emulsifiable concentrate formulations (0.184 tpd) (Table 6c).

Using the ARB emission inventory classification, emissions from structural methyl bromide applications were below 0.001 tpd in 2011. Emissions from agricultural applications of methyl bromide increased from 1.073 tpd in 2010 to 1.501 tpd in 2011. These findings are consistent with the trend found for the use of methyl bromide to strawberries and raspberries. Non-methyl bromide emissions from agricultural applications decreased from 7.635 tpd in 2010 to 6.557 tpd in 2011. Structural non-methyl bromide emissions were less than 0.030 tpd (Tables 18, A2-4i to A2-4l).

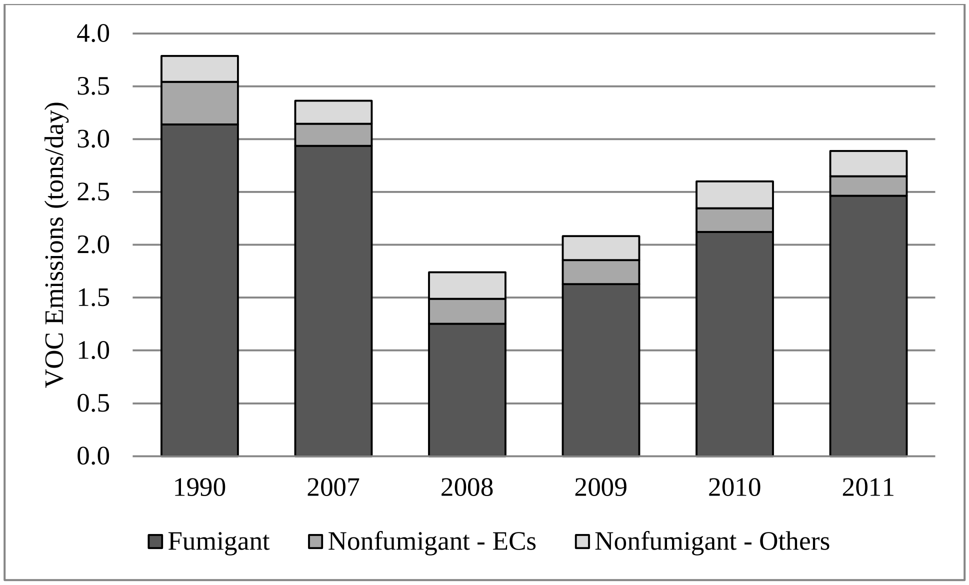


Figure 13. Pesticide VOC emissions for the Ventura NAA, May–October. Emissions for each year are divided into fumigants, nonfumigants with emulsifiable concentrate formulations (ECs) and other nonfumigants (Others). Fumigant emissions are *adjusted* to account for fumigation method.

Table 16. Top ten primary active ingredients contributing to **2011** May-October ozone season *adjusted* VOC emissions in NAA 4, Ventura.

Primary AI	Total Product Adjusted Emissions (tons/day)	Percent of All NAA 4 May – Oct 2011 Adjusted Emissions
CHLOROPICRIN	1.137	39.37
METHYL BROMIDE	0.721	24.95
1,3-DICHLOROPROPENE	0.222	7.69
METAM-SODIUM	0.058	1.99
ABAMECTIN	0.034	1.17
MINERAL OIL	0.027	0.94
PETROLEUM OIL, UNCLASSIFIED	0.027	0.94
CHLORPYRIFOS	0.022	0.77
OXAMYL	0.022	0.76
METALDEHYDE	0.019	0.64

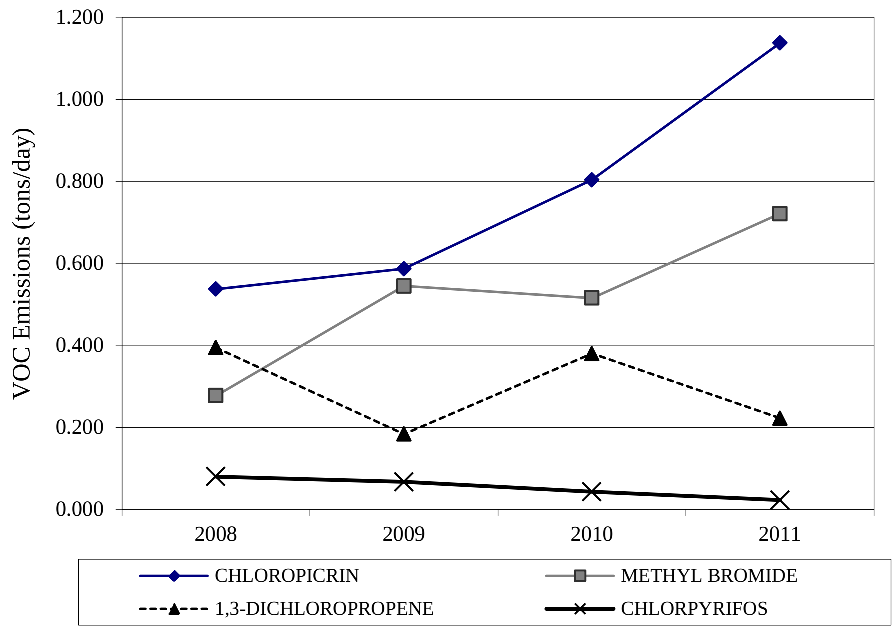


Figure 14. Changes in adjusted emissions of selected AIs in the Ventura NAA from 2009 to 2011.

Table 17. Top ten pesticide application sites contributing to **2011** May-October ozone season *unadjusted* VOC emissions in NAA 4.

Application Site	Emissions (tons/day)	Percent of all NAA 4 May – Oct 2011 emissions
STRAWBERRY	8.384	87.78
RASPBERRY	0.466	4.88
TOMATO	0.143	1.50
LEMON	0.124	1.30
CARROTS	0.073	0.76
PEPPERS	0.070	0.74
N-OUTDR GRWN CUT FLWRS OR GREENS	0.055	0.58
AVOCADO	0.030	0.32
STRUCTURAL PEST CONTROL	0.030	0.31
CELERY, GENERAL	0.018	0.19

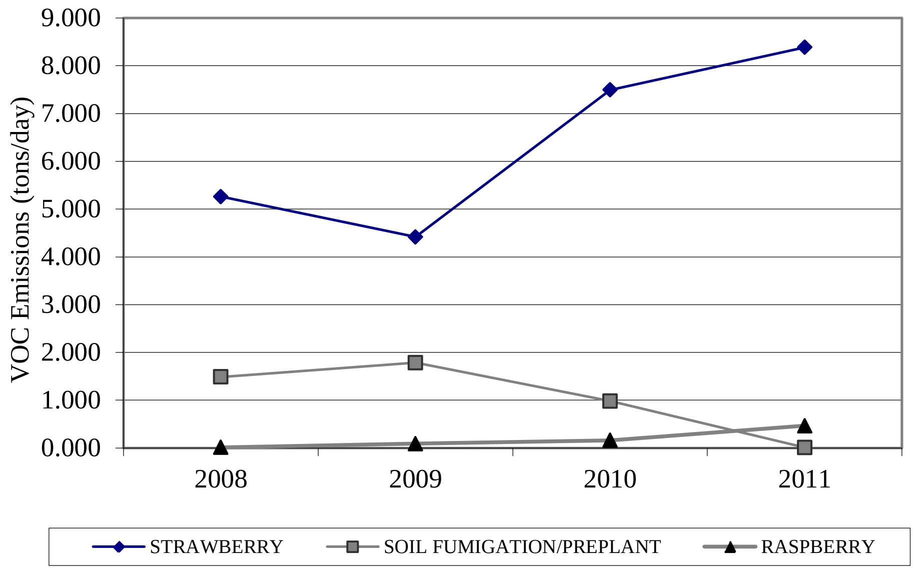


Figure 15. Changes in unadjusted emissions from selected commodities/sites in the Ventura NAA from 2008 to 2011.

Table 18. *Unadjusted* **2011** May–October VOC emissions in NAA 4 by ARB emission inventory classification (tons per day, tpd).

NAA 4 - 2011	**Agricultural Applications**	**Structural Applications**
METHYL BROMIDE EMISSIONS	1.501	0.000
NON-METHYL BROMIDE EMISSIONS	6.557	0.030

South Coast - NAA 5

In the South Coast NAA, adjusted emissions decreased from 1.740 tpd in 2010 to 1.109 tpd in 2011, well below the SIP goal of 8.7 tpd, and to the lowest levels since calculation of the adjusted inventory began. In 2011, emissions from nonfumigants accounted for more than 83 percent of the total for the South Coast NAA. Emissions from nonfumigants with emulsifiable concentrate formulations accounted for 0.346 tpd, which is 31 percent of the nonattainment area's total adjusted emissions (Tables 6a, 6b, 6c, Figure 3, 16).

The fumigants methyl bromide, chloropicrin, and 1,3-dichloropropene, contributed 13 percent of 2011 total adjusted emissions, down from 2010. Emissions from methyl bromide decreased from 2010 by 0.064 tpd, and chloropicrin and 1,3-dichloropropene emissions decreased from 0.106 tpd and 0.071 in 2010 to 0.033 and 0.033 tpd in 2011, respectively. Permethrin, a pyrethroid insecticide used in structural pest control, landscape maintenance and on a wide range of nursery commodities, was the largest nonfumigant contributor to the adjusted inventory accounting for almost 20 percent (0.219 tpd) of emissions. Cyfluthrin emissions, also an insecticide used to control pests, dropped from a high of 0.262 tpd in 2010 to 0.033 tpd in 2011, the latter being more consistent with rates for the years prior to 2010. (Tables 19, A3-5a to A3-5d, Figure 17). Fipronil, a broad use insecticide that is used to control ants, termites and a wide range of other insects, doubled emissions from 0.018 tpd in 2010 to 0.040 tpd in 2011. Almost half of emissions in NAA 5 in 2011 came from fumigant and nonfumigant use in structural pest control (0.685 tpd), a further 25 percent from strawberries (0.354 tpd), with landscape maintenance accounting for another 10 percent (0.132 tpd), all of which contributed fewer emissions than in 2010. Emissions from dazomet, primarily used on rights-of-way, also decreased, from 0.024 tpd in 2010 to 0.016 tpd in 2011 to (Tables 20, A2-5e to A2-5h, Figure 18).

Since this NAA has complied with the SIP goal for several years, most provisions of the 2008 fumigant regulations do not apply. Therefore, the fumigant regulations had little or no impact on emissions in this NAA.

Using the ARB emission inventory classification, emissions from structural applications of methyl bromide remained at 0.002 tpd in 2011. Agricultural applications decreased from 0.185 tpd in 2010 to 0.083 tpd in 2011. Non-methyl bromide emissions from agricultural applications decreased from 0.771 tpd in 2010 to 0.603 tpd in 2011. Structural non-methyl bromide emissions decreased from 1.013 tpd in 2010 to 0.684 tpd in 2011 (Tables 21, A2-5i to A2-5l).

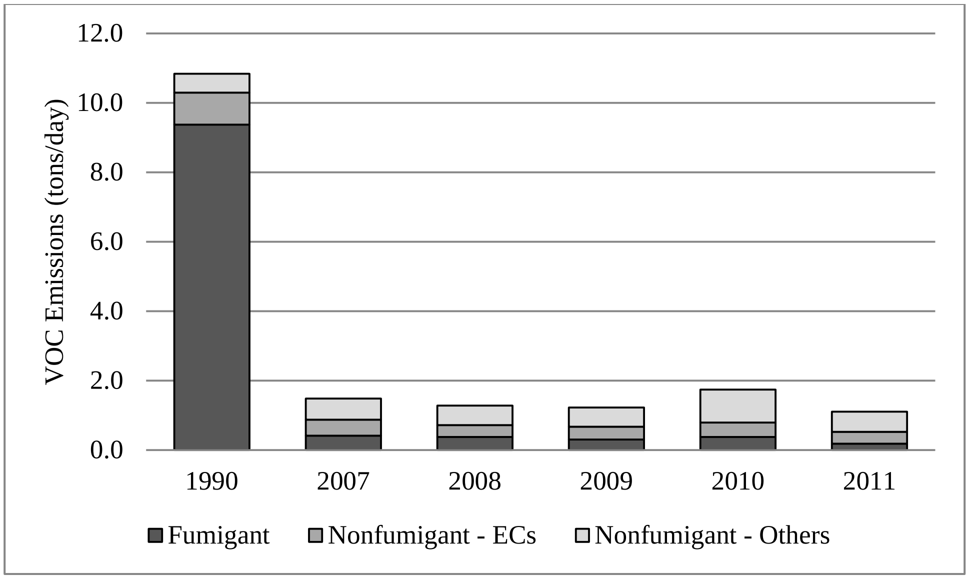


Figure 16. Pesticide VOC emissions for the South Coast NAA, May–October. Emissions for each year are divided into fumigants, nonfumigants with emulsifiable concentrate formulations (ECs) and other nonfumigants (Others). Fumigant emissions are *adjusted* to account for fumigation method.

Table 19. Top ten primary active ingredients contributing to **2011** May-October ozone season *adjusted* VOC emissions in NAA 5, South Coast.

Primary AI	**Total Product Adjusted Emissions (tons/day)**	**Percent of All NAA 5 May – Oct 2011 Adjusted Emissions**
PERMETHRIN	0.219	19.78
N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	0.090	8.12
METHYL BROMIDE	0.082	7.43
BIFENTHRIN	0.062	5.59
FIPRONIL	0.040	3.60
DISODIUM OCTABORATE TETRAHYDRATE	0.039	3.50
CYFLUTHRIN	0.034	3.08
1,3-DICHLOROPROPENE	0.033	2.99
CHLOROPICRIN	0.033	2.98
LIMONENE	0.033	2.94

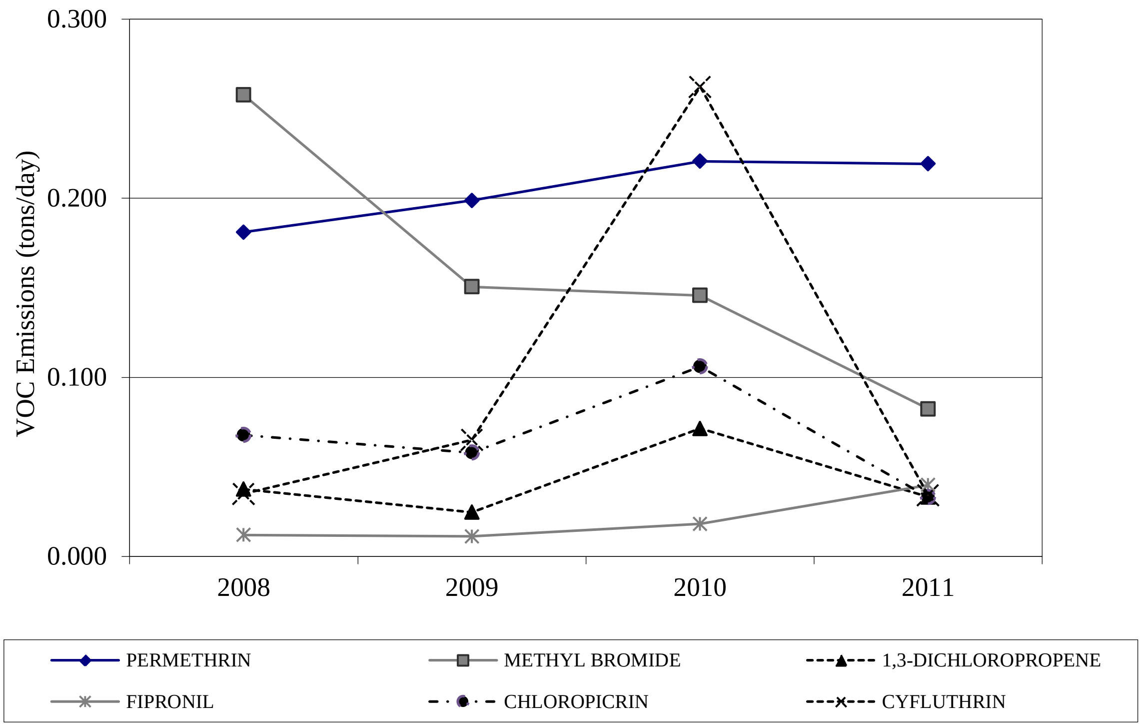


Figure 17. Changes in adjusted emissions of selected AIs in the South Coast NAA from 2008 to 2011.

Table 20. Top ten pesticide application sites contributing to **2011** May-October ozone season *unadjusted* VOC emissions in NAA 5.

Application Site	Emissions (tons/day)	Percent of all NAA 5 May – Oct 2011 emissions
STRUCTURAL PEST CONTROL	0.685	49.82
STRAWBERRY	0.354	25.72
LANDSCAPE MAINTENANCE	0.132	9.60
FUMIGATION, OTHER	0.059	4.29
RIGHTS OF WAY	0.042	3.08
COMMODITY FUMIGATION	0.020	1.45
N-GRNHS GRWN PLANTS IN CONTAINERS	0.017	1.26
N-OUTDR CONTAINER/FLD GRWN PLANTS	0.013	0.92
SOIL APPLICATION, PREPLANT-OUTDOOR	0.009	0.62
AVOCADO	0.008	0.61

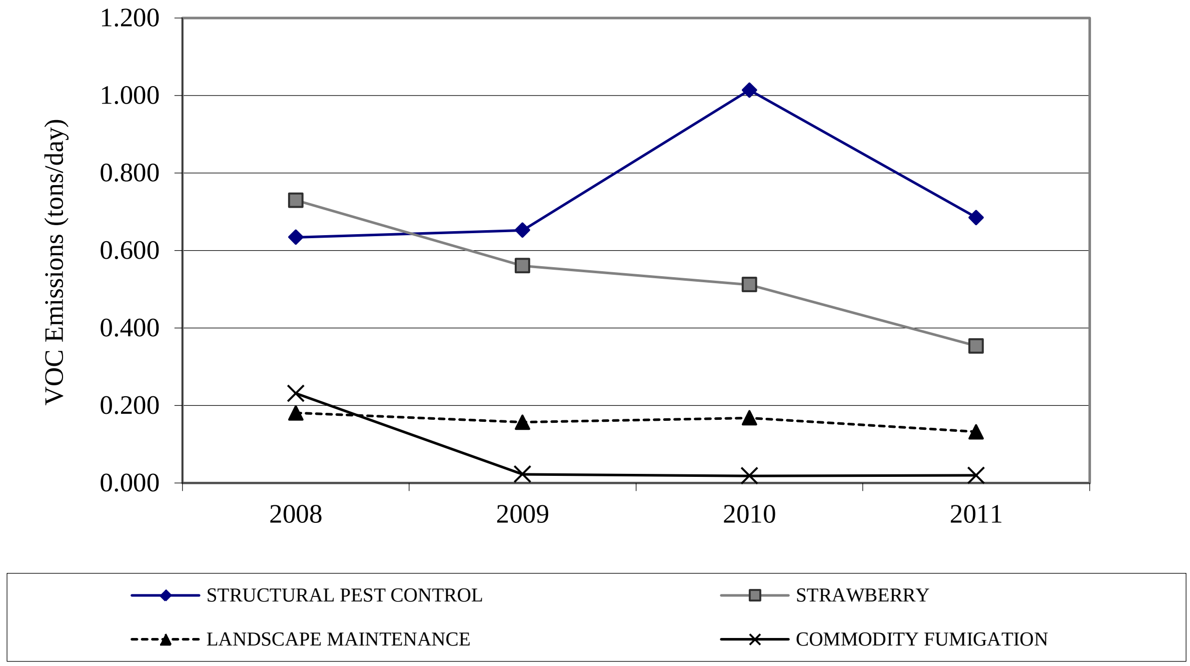


Figure 18. Changes in unadjusted emissions from selected commodities/sites in the South Coast NAA from 2008 to 2011.

Table 21. *Unadjusted* **2011** May–October VOC emissions in NAA 5 by ARB emission inventory classification (tons per day, tpd).

NAA 5 - 2011	**Agricultural Applications**	**Structural Applications**
METHYL BROMIDE EMISSIONS	0.083	0.002
NON-METHYL BROMIDE EMISSIONS	0.603	0.684

PROJECTION OF 2012 VOC EMISSIONS AND FUMIGANT LIMITS

DPR is required to limit VOC emissions of volatile organic compounds from pesticides if pesticide VOC emissions exceed 95 percent of the benchmarks specified in 3 CCR section 6452.2. As shown in Table 22, pesticide VOC emissions are less than 95 percent of the benchmarks that trigger fumigant limits in the Sacramento Metro, San Joaquin Valley, Southeast Desert and South Coast NAAs. Ventura exceeded its trigger level.

Table 22. Fumigant limit triggers and 2011 pesticide VOC emissions.

NAA	Benchmark and SIP Goal (tons/day)	Fumigant Limit Trigger (95% of Benchmark) (tons/day)	2011 Emissions (tons/day)
1 – Sacramento Metro	2.2	2.1	1.004
2 – San Joaquin Valley	18.1	17.2	16.774
3 – Southeast Desert	0.92	0.87	0.210
4 – Ventura	3.0	2.85	2.889
5 – South Coast	8.7	8.3	1.109

The maximum allowable annual ozone season pesticide VOC emissions (VOC_{MAX}) are defined in regulation 3 CCR, section 6452.2. DPR limits emissions by restricting use of the highest VOC contributing pesticides. These are the fumigants methyl bromide, 1,3-dichloropropene, chloropicrin, metam-sodium, metam-potassium, dazomet and sodium tetrathiocarbonate. DPR calculates the maximum allowable fumigant emissions (VOC_{FUM}) as the difference between VOC_{MAX} and projected nonfumigant pesticide emissions (VOC_{NF}) during the ozone season.

[1] $$VOC_{FUM} = VOC_{MAX} - VOC_{NF}$$

The allowable fumigant use is then calculated from VOC_{FUM} using the most recent method use fractions and application method adjustment factors as originally described in Barry et al. (2007). This procedure is defined in regulation (3 CCR section 6452.2) and requires DPR to develop an estimate of nonfumigant emissions in advance of an upcoming ozone season. For 2013, the 2011 method use fraction data and the application method adjustment factors used to determine allowable fumigant use from VOC_{FUM} are given in Appendix 1.

DPR developed a forecasting method to estimate Ventura NAA NOC_{NF} based on a statistical time series analysis (Spurlock, 2009). The time series model is updated each year to include the most recent available pesticide use report data. After updating, the revised time series model is used to forecast nonfumigant emissions which, in turn, are used to calculate allowable fumigant emissions and fumigant use as described above. Table 23 compares 2004–2011 NAA 4 nonfumigant ozone seasons emissions, while Table 24 provides the forecast 2013 nonfumigant emissions and resultant allowable fumigant emissions based on the regulatory benchmark and the SIP goal.

Table 23. May–October (ozone season) nonfumigant pesticide VOC emissions and percent of total adjusted emissions.

NAA	2004 Emissions (tons/day)	2005 Emissions (tons/day)	2006 Emissions (tons/day)	2007 Emissions (tons/day)	2008 Emissions (tons/day)	2009 Emissions (tons/day)	2010 Emissions (tons/day)	2011 Emissions (tons/day)	Mean Percent of Total Emissions
4 – Ventura									
Nonfumigants	0.622 (16%)	0.497 (14%)	0.508 (14%)	0.428 (13%)	0.486 (28%)	0.454 (22%)	0.477 (18%)	0.425 (15%)	17%

Table 24. Projection for 2013 NAA 4 VOC emissions. The 2013 fumigant emission limit was determined by subtracting the forecast 2013 nonfumigant emissions from the SIP goal and VOC regulation benchmark (Tao, 2012).

Non-Attainment Area	SIP Goal and VOC Regulation Benchmark (tons/day)	Forecast 2013 Nonfumigant Emissions (tons/day)	2013 Fumigant Limit (tons/day)	2013 Fumigant Limit (pounds)	2011 Adjusted Fumigant Emissions (tons/day)
4 - Ventura	3.0	0.432	2.57	940,000	2.464

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